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Four Trends Impacting Enterprise Networks, And How to Support Them

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Introduction

In today's data-driven world, businesses prioritize digital transformation to unlock new opportunities and gain a competitive edge. However, IT leaders face a complex challenge: effectively implementing these innovative technologies into their enterprise networks.

As an IT leader responsible for supporting these advancements, you understand the critical role a robust network plays. This white paper, by Chatsworth Products (CPI), explores the top four trends shaping the enterprise network and the advanced infrastructure solutions specifically designed to empower your digital transformation journey. By optimizing your enterprise network's performance and reliability, you'll lay the groundwork for a successful transformation that propels your business forward.

Hybrid Cloud

Edge Computing

Advanced Wireless

Digitalization

The Migration to Hybrid Cloud

Enterprise organizations originally embraced the public cloud to transform their IT spending model. The public cloud's subscription-based services and on-demand scaling capabilities facilitate a shift from upfront capital expenditures (Capex) to ongoing operational expenditures (Opex), eliminating the need for costly infrastructure upgrades. While the public cloud remains the go-to solution for data storage, popular business applications like Microsoft 365 and Salesforce, and remote working tools like Zoom and Google Drive, a new trend is emerging. Many organizations are now migrating mission-critical and industry-specific applications to private clouds. These private clouds are hosted on premises or within dedicated leased spaces in multi-tenant data centers (MTDCs). Flexera's 2024 State of the Cloud report underscores this trend, revealing that 73% of enterprise organizations are adopting a hybrid cloud approach, leveraging both public and private cloud environments.[ii]

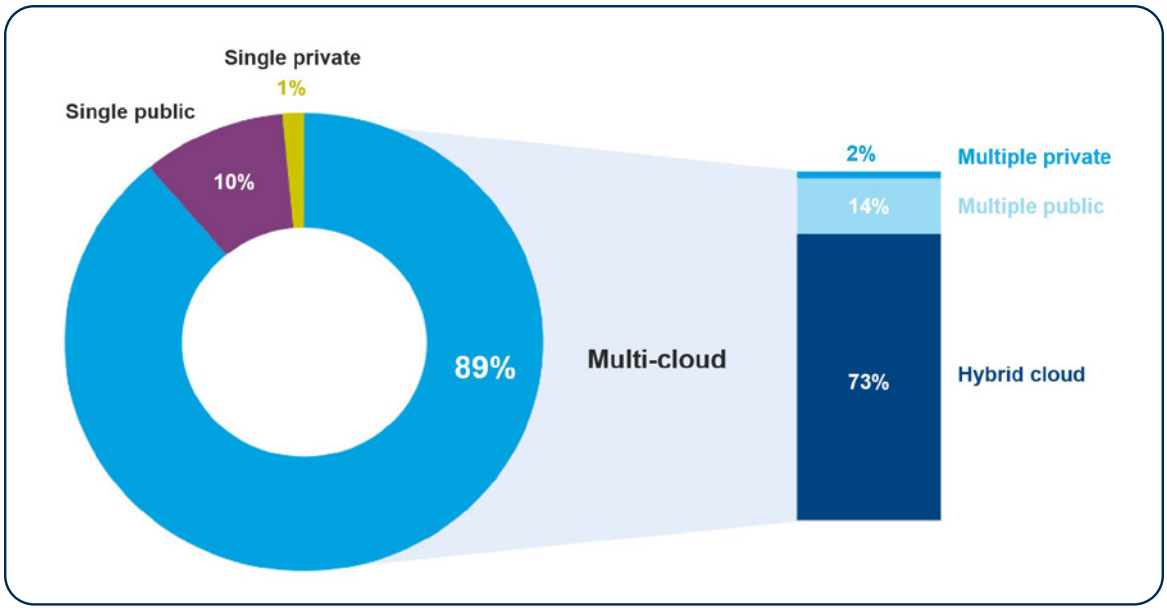

Figure 1: 89% of enterprise organizations are adopting a multi-cloud approach, with 73% opting for hybrid cloud.[ii]

The high cost of the public cloud is a primary driver for enterprise organizations to adopt a hybrid cloud approach. While initial public cloud adoption aimed to reduce operational expenses (Opex), many businesses have found that their spending significantly exceeds expectations. A Flexera report highlights this challenge, ranking cloud cost management as the top concern, with nearly half of respondents reporting cloud spending exceeded plans by some or a significant degree.[ii] Economic uncertainty plays a role, but factors like storage and data egress fees (charges for transferring data out of cloud storage) can quickly spiral out of control if left unchecked. Lack of visibility, hidden fees, and unplanned growth all contribute to this "cost creep." Public cloud providers have also raised hosting and storage fees in recent years to counter rising energy costs, inflation, and material shortages.[iii]

Security concerns are another primary reason for moving certain applications and data to private clouds. Public clouds offer cost-effective storage for non-sensitive data, but many enterprise organizations hesitate to store confidential information there, especially when shared resources with other organizations are involved. This includes human resource records, intellectual property, financial data, and customer information. A 2023 Flexera report found that 79% of respondents ranked security as their second-biggest public cloud challenge.[ii] Public cloud storage can also make compliance difficult for heavily regulated industries like finance and healthcare, which have strict privacy and security requirements for classified financial and medical records. While some public cloud providers may have secure infrastructure that meets compliance standards, they may not guarantee compliance at the rack level in their service level agreements (SLAs). Ultimately, the responsibility falls on the enterprise organization to ensure compliance, which is significantly easier to manage in a private cloud environment.

While the public cloud offers cost benefits and scalability, it can limit control and customization for organizations with unique or complex application needs.

Additionally, shared resources and geographic distribution inherent to the public cloud can introduce latency issues for real-time applications like AI, virtual reality, and e-commerce that require closer proximity to users and devices. For enterprise organizations requiring ultra-low latency, strategically deploying cloud resources in regional MTDCs or on-prem edge data centers can significantly reduce data travel distances and minimize latency.

Enterprise organizations have long struggled to run cloud-scale applications within their on-prem data centers due to limited capacity and lack of access to high-performance computing (HPC) systems. Fortunately, the landscape is changing. Broader access to open-source solutions, cloud-scale virtualized servers, powerful GPUs, software-defined networking, efficient liquid cooling, and high-speed fiber connectivity (up to 400 Gigabits) now empower enterprise organizations to achieve high performance and scalability within their own data centers.

For organizations unable to implement private clouds on premises, regional MTDC facilities offer a compelling alternative. Retail and wholesale colocation data center deployments are booming, driven by the surge in demand for cloud-based services and digital transformation initiatives. As MTDC providers invest in new facilities across diverse locations and offer more flexible leasing options, enterprise organizations of all types and sizes can access the resources they need for private cloud deployments while also benefiting from closer proximity to users and devices for low-latency applications.

Migrating from a public cloud to a private cloud presents additional hurdles. Security, compliance, and maintaining efficiency remain concerns. Additionally, the return of capital expenditure (Capex) budgeting, a driver for the initial public cloud move, once again becomes a factor. Enterprise organizations may also face limitations due to a lack of skilled personnel, ever-changing market and customer demands, and a resistant internal culture. To navigate these challenges, IT leaders need executive buy-in, optimized workflows, and access to training and design expertise. Partnering with trusted infrastructure providers who can guide them through complex designs, recommend suitable solutions, and ensure smooth installation can significantly bolster successful private cloud deployments.

The Rise of Low-Latency Edge Computing

Enterprise organizations are increasingly embracing real-time technologies that necessitate low latency. This trend fuels the adoption of edge computing, which processes data near users and devices. Spending on enterprise edge infrastructure is outpacing traditional network equipment and overall IT expenditures, reflecting this shift.[iv]

Next generation 5G cellular that delivers high-speed mobile wireless connectivity is a key edge computing technology. 5G may utilize higher frequencies with shorter ranges, requiring the deployment of denser small cells strategically placed closer to users often with local edge compute capabilities for real-time applications and high-bandwidth uplink and downlink networking for backhaul.

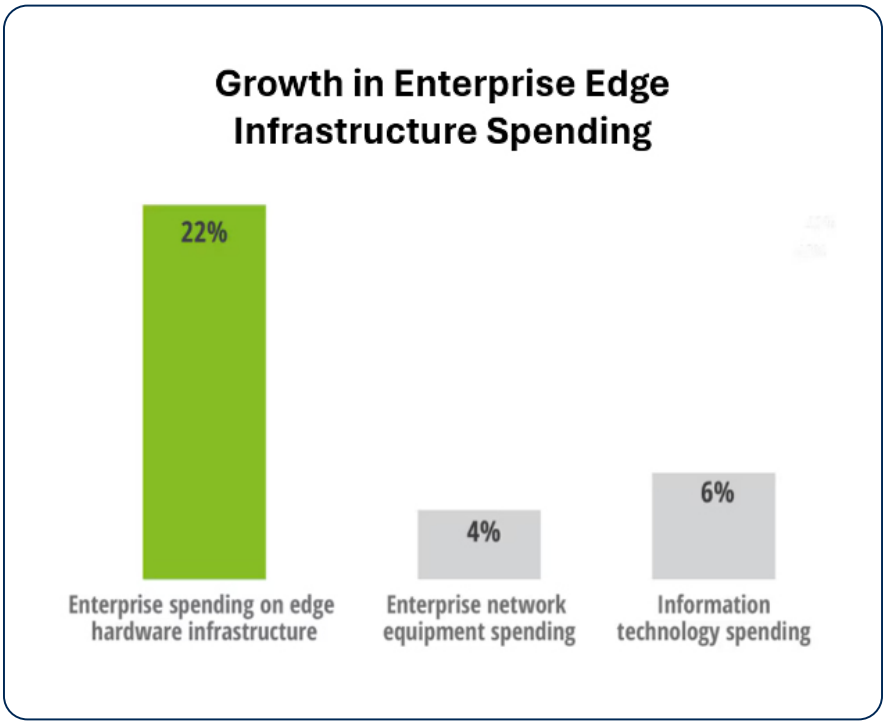

Figure 3: Growth in enterprise edge infrastructure spending is far outpacing growth in network equipment and overall IT spending.[iv]

AI also thrives on low-latency networks. It's rapidly becoming a mainstay in enterprise organizations, tackling complex challenges and providing advanced analytics across various domains. AI offers many benefits, from improved business forecasting and threat detection to industrial automation, drug discovery, medical diagnosis, and customer service chatbots.

Low-latency edge computing is crucial for various applications beyond AI and 5G. This includes the Internet of Things (IoT) and Industrial IoT (IIoT), e-commerce platforms, and predictive maintenance solutions. By processing data closer to its source, edge computing empowers these applications to deliver optimal performance.

Large public cloud data centers, often situated hundreds of miles away, are unsuitable for these real-time applications. Consequently, enterprise organizations are strategically deploying edge compute in smaller edge data centers, including remote micro data centers. These edge data centers can vary in size and location. For instance, edge compute could reside in a single server rack in a hospital telecom room to process real-time patient data. At the same time, a stand-alone ruggedized enclosure on a factory floor could support machine learning and automation tasks and remote, free-standing outdoor enclosures can provide edge compute capabilities for real-time 5G applications on industrial sites and college campuses.

Advanced High-Throughput Wireless Technologies

The past two decades have witnessed the rise of advanced wireless technology as an essential tool. It seamlessly transmits voice, data, and video, connecting people and devices to the internet.

When it comes to indoor and short-range wireless connections, Wi-Fi reigns supreme. From corporate offices and hospitals to schools, factories, and even stadiums, nearly every enterprise building boasts Wi-Fi coverage. This technology is based on the IEEE 802.11 family of standards, which has seen significant advancements in speed, capacity, and coverage over the past two decades.

Wi-Fi 6 and 6E (approved in 2019 and 2020) boast impressive typical speeds of 5 Gigabits per second (Gb/s) – a fourfold increase compared to the previous Wi-Fi 5 generation. Building upon this foundation, Wi-Fi 7 (approved in 2024) further pushes the boundaries with typical speeds reaching a staggering 18 Gb/s, achieved through more spatial streams and wider channels.

Wi-Fi 6 utilizes the traditional 2.4 GHz and 5 GHz bands, while Wi-Fi 6E and Wi-Fi 7 add the 6 GHz band to increase capacity significantly. These high-performance Wi-Fi technologies cater to a broader range of devices and applications. The 2.4 GHz band offers superior range and better penetration through walls, making it ideal for low-bandwidth IoT devices. The 5 GHz and 6 GHz bands, while having a shorter range, provide more bandwidth due to the wider spectrum and channel bonding capabilities. This makes them perfect for high-speed devices like laptops and smartphones used for streaming or large file transfers.

Comparison of IEEE 802.11 Amendments

Wi-Fi Generation	Wi-Fi 5	Wi-Fi 6	Wi-Fi 6E	Wi-Fi 7
IEEE Standard	IEEE 802.11ac	IEEE 802.11ax	IEEE 802.11ax	IEEE 802.be
Frequency Band(s)	5 GHz	2.4, 5 GHz	2.4, 5, 6 GHz	2.4, 5, 6 GHz
Max Number of Spatial Streams	8	8	8	16
Max Data Rate per Stream	866 Mb/s	1.2 Gb/s	1.2 Gb/s	2.9 Gb/s
Max Aggregate Data Rate	6.93 Gb/s	9.61 Gb/s	9.61 Gb/s	46.1 Gb/s
Typical Throughput	1.3 Gb/s	5 Gb/s	5 Gb/s	18 Gb/s

For today's enterprise organizations, Wi-Fi 6 and 6E are the go-to wireless solutions. However, maximizing their potential requires a robust network LAN infrastructure with the right cabling to support the increased throughput. While older cabling (Category 5e/6) sufficed for Wi-Fi 5, Wi-Fi 6 and above demand higher-performance options. Industry standards recommend a minimum of two Category 6A connections per Wi-Fi access point (AP) and a minimum backbone uplink capacity of 25 Gbps. Many experts recommend that four Category 6A cables or fiber optic cabling should be deployed to each AP to future-proof the network. It's important to consider that while APs typically get refreshed every 3-5 years, the underlying cabling infrastructure should last 10-15 years.

The increased labor, space, and material requirements of deploying four Category 6A cables per AP often make fiber optic cabling more attractive. However, most APs utilize Power over Ethernet (PoE), so using fiber requires an alternative power source, such as local AC power or a hybrid fiber-copper cable that combines fiber strands for data and copper strands for power delivery

Additional Wireless Technologies

Wi-Fi 6/6E and Wi-Fi 7 excel in supporting daily business needs, Wi-Fi is not the only wireless game in town. The electromagnetic spectrum offers a vast range of licensed and unlicensed wireless technologies, from cellular networks and satellites to short-range, low-power applications.

5G cellular promises up to 10 Gbps speeds and lower latency than 4G. Operating within licensed high-frequency spectrums up to about 47 GHz, 5G uses lower-band frequencies for lower-speed blanket coverage across large areas and higher-band frequencies to deliver enhanced throughput and ultra-low latency. However, higher-band frequencies have poor propagation, which limits the range. With a growing number of connections relying on high-speed, low-latency connectivity, 5G requires a network of more closely spaced small cell stations (like mini base stations) on poles and buildings. While small cells deployed on utility poles, streetlights, and the corners of buildings deliver broadband access and support emerging outdoor IoT/IIoT applications like connected cars, smart traffic systems, and other smart city applications, most enterprise cellular use happens indoors. Here, indoor small cell and distributed antenna systems (DAS) amplify and distribute a single base station's signal throughout a building, similar to Wi-Fi access points.

Many enterprise organizations must also support various low-speed wireless technologies for battery-powered IoT/IIoT devices. For example, long-range technologies like NB-IoT, Sigfox, LoRaWAN, and Wi-Fi HaLow operate at low frequencies for better building penetration and extended range (up to 40km). Short-range technologies like Bluetooth, Zigbee, Z-Wave, and RFID offer shorter range (up to 100 meters) for device-to-device communication and tracking within buildings (inventory, payments, access control, asset tracking). Some Wi-Fi APs integrate multiple wireless technologies to support both high-speed 802.11 Wi-Fi (laptops, tablets, smartphones) and low-speed IoT/IIoT sensors.

Increasing Enterprise Digitalization

Enterprise network growth is driven by the emergence of powerful technologies like the IoT/IIoT, advanced wireless solutions, and edge computing. These advancements also expand and extend enterprise Local Area Networks (LANs) to deliver services and connect a growing number of devices across diverse locations.

Today, many connected devices, from access control panels and surveillance cameras to wireless APs and LED lighting fixtures can be powered remotely over the network using Power over Ethernet (PoE) technology. This trend, combined with the sheer number of devices, is increasing the complexity of telecommunications rooms (TRs) and horizontal cabling infrastructure with more equipment, pathways, and cable runs. Additionally, the growing number of devices in more locations often means connecting devices like surveillance cameras, access control panels, and wireless access points in remote locations like warehouses and parking garages. These spaces are frequently located beyond the traditional 100m reach limit of twisted-pair copper Ethernet cables as specified by ANSI/TIA-568 cabling standards for commercial buildings.

While fiber optic cables offer excellent reach to support devices located beyond 100m, the higher cost of fiber transmission often proves impractical for just a few outlying devices. Additionally, fiber doesn't support PoE, necessitating separate power solutions. Even with existing local power, finding fiber-compatible LAN devices can be difficult. Media converters that require their own power source might then be needed to connect devices, adding cost and complexity. Deploying new TRs to reach remote devices is an option, but it's an expensive one. TRs require dedicated floor space, power, and cooling infrastructure.

Supporting New Trends and Technologies in Your Enterprise Network

Moving compute resources to a private cloud, on premises or in an MTDC requires infrastructure capable of handling demanding cloud applications. New applications often necessitate significant processing power, leading to higher rack power densities and increased heat generation. This can require more efficient cooling methods like aisle containment or liquid cooling. Enterprise data centers needing to support HPC environments must also be able to support high-density fiber cabling required for high-speed applications. Maintaining efficiency and reliability when migrating from public to private clouds is also necessary.

Integrated cabinet solutions, like the CPI ZetaFrame®, are ideal for meeting the next-generation computing demands of enterprise data centers. ZetaFrame seamlessly integrates with CPI's aisle containment systems, effectively managing power densities up to 25kW per rack. For even higher densities, ZetaFrame integrates with advanced direct-to-chip liquid cooling, enabling data centers to support high-compute, cloud-scale technologies like AI. ZetaFrame also incorporates CPI intelligent Switched Pro eConnect® PDUs, facilitating remote power monitoring and control. This allows enterprise data centers to remotely measure and cycle power for each piece of equipment connected to the PDU. With real-time monitoring of power parameters and usage, eConnect PDUs also empower enterprise data centers to optimize efficiency and make informed decisions regarding capacity planning and resource allocation.

CPI intelligent eConnect PDUs enable real-time monitoring of environmental conditions like cabinet-level temperature and humidity, sending alerts when critical thresholds are reached. This enables enterprise data centers to swiftly identify and address issues before they cause downtime. Furthermore, eConnect PDUs manage and power electronic access control, a feature crucial for preventing downtime caused by human error or malicious activity. Additionally, they log all access attempts (successful and failed), which is essential for healthcare and financial institutions complying with security regulations like HIPAA and PCI-DSS.

Enterprise organizations deploying emerging edge computing technologies must also ensure adequate infrastructure and capacity (power, cooling, and connectivity), albeit on a smaller scale. CPI CUBE-iT® and ThinLine® II wall-mount cabinets are perfect for saving space and safeguarding edge equipment in various indoor environments. Reliability is also paramount for edge data centers, especially those in harsh environments. Mission-critical equipment needs protection from extreme temperatures, dust, moisture, and vibrations. CPI's RMR® wall mounted, free-standing, or floor-mount environmental enclosures are ideal for safeguarding edge computing equipment in these demanding conditions. RMR® NEMA rated enclosures can be customized with thermal management, cable management, power, and electronic access control. Additionally, remote and unmanned edge data centers require robust remote monitoring and access control. CPI's intelligent eConnect PDUs provide these capabilities, ensuring enterprise data center managers can manage edge infrastructure effectively, even from afar.

High-throughput wireless technologies like Wi-Fi 6/6E/7 and 5G require careful planning to ensure optimal coverage. A critical factor is choosing the right mounting solution for wireless Access Points (APs) for your environment. This ensures proper AP height and orientation while avoiding obstructions like soffits, ceiling tiles, and building systems. For instance, when suspended ceiling mounting isn't an option, CPI offers Oberon™ M-Frame™ Open-Ceiling mounts with various hanging options for open ceiling environments like warehouses, factories, and gymnasiums. Oberon H-Plane™ Right-Angle Surface Mounts allow APs to be mounted on the wall in a horizontal orientation for optimum coverage.

Harsh environments like industrial spaces, labs, gyms, warehouses, and outdoor areas also require additional protection for APs. NEMA-rated enclosures, such as CPI Oberon Skybar™ environmental enclosures, safeguard APs from dust, water, and extreme temperatures. In outdoor spaces where wall or pole mounting isn't feasible, Oberon NetPoint™ free-standing weatherproof bollards provide an ideal solution for securing and protecting outdoor rated APs, antennas, and associated cabling. Security is also crucial, especially in schools, hospitality, and healthcare settings. Wireless enclosures should prevent theft, vandalism, and unauthorized access. For healthcare facilities with suspended ceilings, infection control risk assessment (ICRA) procedure compliance is essential to avoid contaminant spread. CPI's Oberon Wi-Tile™ Ceiling Enclosure with a solid back box and cable entry plugs meets these requirements. In addition to protection, many enterprise spaces require a clean aesthetic. CPI Oberon wireless enclosures include recessed panels, matching flanges, and paintable covers, allowing them to blend seamlessly into ceilings or walls.

The increasing integration of digital technology across businesses demands more equipment and cabling within enterprise LANs. This can strain existing TRs designed initially for basic voice and data applications. These spaces must now prioritize organized connections, equipment protection, and future growth to ensure high performance for expanding systems and devices. In addition, twisted-pair copper cabling and Power over Ethernet (PoE) have significantly improved over the past three decades to handle rising bandwidth and power demands. Category 6A cabling, supporting speeds up to 10 Gbps, is the recommended industry standard for enterprise LAN deployments. However, this cable boasts enhanced features that make it thicker with a larger diameter. Additionally, higher PoE levels transmitted through these cables can generate heat buildup within bundles, impacting performance.

Enterprise TRs and horizontal infrastructure need ample capacity within racks, robust cable management systems, and designated pathways. Maintaining proper cable bend radius and spacing between bundles is crucial. Solutions like CPI Universal Rack and Adjustable QuadraRack® offer the strength needed for heavier loads. Likewise, CPI Evolution® vertical and horizontal cable managers provide increased load ratings, support larger bend radii, and feature adjustable accessories. These features accommodate larger quantities of Category 6A cables while enabling seamless scalability for growing LANs.

Zone cabling offers a strategic approach for managing many connected devices within enterprise LANs. This method utilizes intermediate connection points via patch panels housed in strategically placed CPI drop ceiling or wall-mount telecommunications and consolidation point enclosures. These enclosures, positioned closer to end devices, allow for shorter, more manageable cables. This setup facilitates faster moves, additions, and changes within the horizontal LAN infrastructure.

For businesses requiring reliable LAN connectivity beyond the traditional 100-meter Ethernet limit, housing telecommunications equipment in compact wall-mount or free-standing enclosures presents a cost-effective alternative to constructing an entirely new TR. CPI CUBE-iT and ThinLIne II wall-mount cabinets serve as ideal mini-TRs for limited floor space while RMR NEMA-rated free-standing and wall-mount enclosures empower businesses to create mini-TRs that offer protection from dust and moisture in challenging environments like warehouses or parking garages.

Summary of Enterprise Network Challenges

Trend	Network Impact	Other Consideration	Product Solution
Hybrid Cloud	Supporting HPC systems and higher rack power densities via advanced cooling. Managing high-density fiber optic cabling required for high-speed applications.	Optimizing reliability and efficiency with power monitoring and control, environmental monitoring, security, and compliance	ZetaFrame Cabinet System with aisle containment or liquid cooling to manage higher rack power densities. Intelligent Switched Pro eConnect PDUs for advanced power monitoring and control with USB temperature and humidity sensors and RFID Electronic Lock Kit for reliability
Edge Computing	Small, remote edge data centers located close to users and devices. Supporting high-density fiber optic cabling required for high-speed applications.	Ensuring reliability in harsh environments and remote monitoring and control. Limited access control	Space-saving CUBE-it and ThinLine II wall-mount cabinets to house edge compute equipment. RMR free-standing and floor-mount environmental enclosures for harsh environments. eConnect PDUs with remote monitoring and electronic access control.
Advanced Wireless	Requires high-speed 10 Gigabit switches to support high-throughput Wi-Fi and 5G small cell or DAS. Recommend four Category 6A connections or fiber optic connections to wireless APs. Fiber-connected APs will need an alternative to PoE for power.	Maintaining proper AP height and orientation for optimal coverage. Protecting APs in harsh facilities and outdoor environments. Ensuring security, compliance, and aesthetics.	Oberon M-Frame Open-Ceiling mounts for open ceiling environments. Oberon H-Plane right-angle surface mounts to maintain horizontal orientation where ceiling mount isn't feasible. NEMA-rated Oberon Skybar environmental enclosures for harsh and outdoor environments. Oberon NetPoint free-standing bollards for outside deployments. Oberon Wi-Tile ceiling enclosures ensure ICRA compliance in healthcare settings and enhanced aesthetics.
Digitalization	Supporting more equipment and connections in TRs. Providing ample capacity in racks, cable managers, and pathways to support Category 6A and advanced PoE.	Zone cabling to ease moves, adds, and changes in horizontal spaces. Deploying mini-TRs to provide LAN connectivity to remote locations beyond 100m from TRs, including harsh environments like warehouses and parking garages	CPI Universal Rack and Adjustable QuadraRack support heavier loads. Evolution cable managers accommodate large quantities of Category 6A cables with scalability. Telecommunications and consolidation point enclosures for zone cabling. Cube-IT, ThinLIne, and RMR create mini-TRs in a variety of remote spaces.

Recommended Product Solutions

ZetaFrame® Cabinet System – Integrates with aisle containment and liquid cooling to handle higher rack power densities and eConnect PDUs for advanced power management, environmental monitoring, and access control.

eConnect® PDUs – Delivers advanced power monitoring and control, environmental monitoring, and RFID electronic access control, including intelligent Switched Pro eConnect PDU for controlling individual outlets and remotely measuring and cycling power for each piece of powered equipment.

CUBE-iT® Wall-Mount Cabinet – Dual hinge wall-mount enclosure for housing and protecting network equipment in edge computing applications or to serve as a mini-TR for extending enterprise LANs while providing easy front and rear access for cabling.

ThinLine® II Wall-Mount Cabinet – Vertical mount enclosure use minimal space to support edge compute network equipment and infrastructure or to serve as a mini-TR in space-constrained environments.

RMR® Wall-Mount and Free-Standing Environmental Enclosures – The ideal enclosure for protecting edge compute or LAN equipment from dust and moisture in harsh environments.

Oberon™ M-Frame™ Open-Ceiling Mounts – A modular wireless mounting platform with beam clamp, threaded rod, or cable hanging kits for fast wireless deployments in open-ceiling environments like warehouses, factories, and gymnasiums.

Oberon Wireless Enclosures and Mounts – A wide range of mounting solutions from open-ceiling to right-angle surface mounts to maintain proper AP height and orientation for optimal coverage. Wi-Tile Ceiling Enclosures for deploying wireless APs across a range of enterprise spaces and NEMA-rated Skybar Environmental Enclosures and NetPoint Bollards for harsh and outdoor wireless deployments.

Universal Rack – High-strength, two-post rack with heavier loading supports network equipment and patch panels while maximizing floor space in telecommunications rooms.

Adjustable QuadraRack – Provides a sturdy, feature-rich solution for supporting various rack-mount equipment and connectivity in telecommunications rooms.

Evolution Cable Managers – Vertical and horizontal cable managers with the capacity to handle high-density Category 6A and PoE deployments while ensuring bend radius protection, optimal spacing, and scalability.

Zone Enclosures – Variety of enclosures to create secure spaces above drop ceilings for network connections and enable easier moves, adds, and changes for high numbers of digital devices.

Conclusion

By embracing trends like AI, IoT/IIoT, and advanced wireless, businesses can unlock a digital future with greater efficiency, productivity, and customer satisfaction. However, ensuring that enterprise networks can effectively support these trends can mean the difference between a digital transformation strategy that delivers a competitive edge and one that fails.

As enterprise organizations migrate to hybrid cloud, edge computing, advanced wireless, and highly digitalized facilities, it's important to assess network infrastructure requirements—from the data center and network edge to the LAN, the device, and the user. Upgrading to cutting-edge solutions from CPI—all designed with the latest trends in mind— can help ensure that your network meets today's needs and positions you for future success. But navigating the ever-changing landscape and evolving enterprise use cases isn't easy. That's why CPI also provides expert support, working closely with your IT team to understand your unique needs and deliver solutions that empower your digital strategy.

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