WHITE PAPER

Four Technologies That Will Affect Your Enterprise Network, And How To Support Them In Your Premise Networks

By David Knapp
Product Marketing Manager
Chatsworth Products
and
Duke Robertson
Product Manager, Open Systems
Chatsworth Products

Published: March 2018

US & Canada
+1-800-834-4969
Toronto, Ontario, Canada
+905-850-7770
chatsworth.com

techsupport@chatsworth.com

Latin America
+52-55-5203-7525
Toll Free within Mexico
01-800-01-7592
chatsworth.com.co

Europe
+44-1628-524-834
chatsworth.com

Middle East & Africa
Dubai, UAE
+971-4-2602125
chatsworth.ae

Asia Pacific
+86 21 6880-0266
chatsworth.com.cn

CHATSWORTH PRODUCTS

Introduction

Business IP traffic is projected to have a combined annual growth rate of 21 percent between 2016 and 2021 to 45,452 Petabytes of data per month–about 4 Gigabytes per month for the average business user, according to the *Cisco Visual Networking Index: Forecast and Methodology, 2016-2021*[1]. That involves a 20 percent growth in public Internet traffic, a 10 percent growth in managed (LAN/WAN) traffic, and a 41 percent growth in mobile data traffic.

As a Network Engineer, responsible for ensuring availability and speed of the network to business users, there are a number of technologies you should consider when planning any upgrades to your enterprise network.

This white paper, by Chatsworth Products (CPI), summarizes these technologies and their impact on the physical premise network, and highlights some advancements in cable management and equipment storage that will help you with network upgrades.

SD-WAN

POE++

5G Cellular Wireless

Advanced Wi-Fi

SD-WAN: Software-defined networking

Software-defined networking (SDN) is the concept of decoupling networking hardware from its control mechanism. Software Defined Wide Area Network (SD-WAN) is a software overlay that allows dynamic path selection for load sharing across various WAN connections. It supports multiple connection types, including Multiprotocol Label Switching (MPLS), Internet and Long-Term Evolution (LTE). It provides a simple interface to manage your WAN, including zero-touch provisioning at branch locations. It supports Virtual Private Networks (VPN) and Network Functions Virtualization (NFV) such as software optimization controllers, load balancers, firewalls, intrusion detection and web gateways[2].

The advantage of SD-WAN is particularly clear with a large network supporting many branch locations. SD-WAN eliminates the need for separate hardware appliances for each network function at each branch. A single appliance that runs NFV, similar to the customer premise equipment in a home broadband connection, replaces multiple pieces of equipment (router, firewalls, load balancers, etc.) at each branch. Additionally, branches connect with lower cost broadband services and share site bandwidth dynamically.

Other reasons to consider SD-WAN are when refreshing WAN edge equipment, renegotiating a carrier contract or moving apps to the cloud. SD-WAN lets you reduce circuit cost by switching to broadband circuits, increase available bandwidth for the WAN spend, reduce the amount of onsite and programming time, and deploy new services quickly from a central location[3].

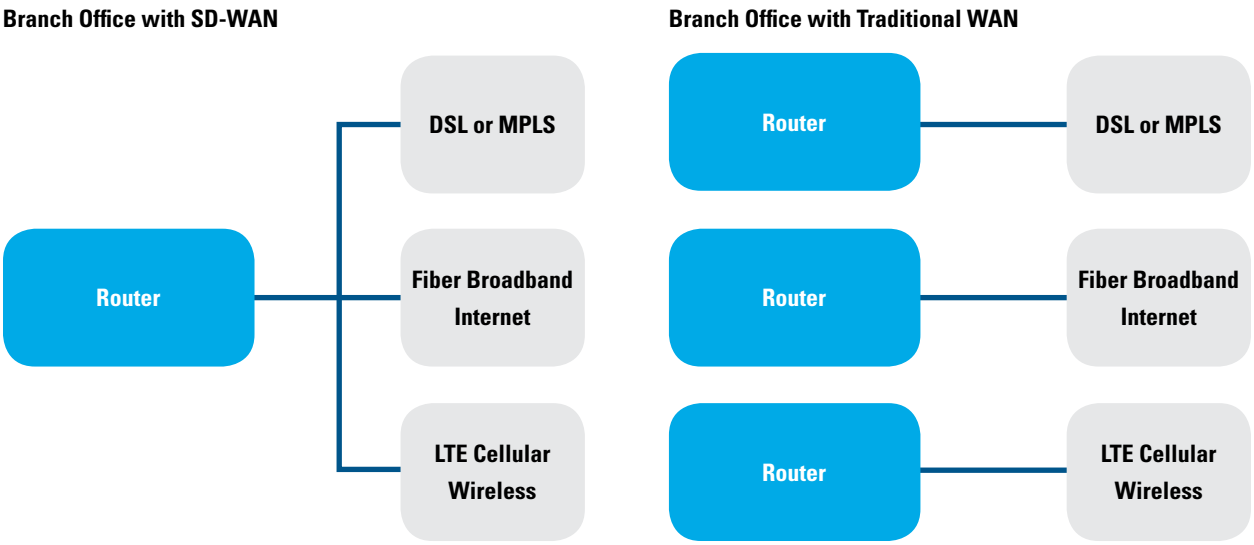

Figure 1: SD-WAN reduces costs of traditional WAN by virtualizing network services and consolidating customer premise equipment into a single hardware appliance that can manage multiple connections.

The impact to the physical network is a reduction of the amount of physical hardware used to create and connect the WAN, as shown in Figure 1 above. The structured cabling for the site does not change. The switch should support SDN to optimize WAN-LAN conditions and to prepare for intent-based networking. If upgrading switches, consider a cloud-managed switch and an integrated wireless LAN controller function. In some instances, a single appliance provides switching, wireless LAN and broadband connection.

802.3bt: Enhanced Power over Ethernet (PoE++)

Power over Ethernet (PoE) was introduced in 2003. The basic concept is to deliver power over the network connection to end devices, eliminating the need for a separate power connection. Currently deployed PoE delivers up to 25.5 Watts of power to equipment. PoE powers Voice over Internet Protocol (VoIP) desk phones, wireless access points (WAPs) and basic security cameras.

The enhanced PoE draft amendment, IEEE 802.3bt-2018[4], proposes two additional types, or power ranges, for 60 Watts and up to 100 Watts per connection, thus extending the possibilities to power other end devices such as high bandwidth WAPs, pan-tilt-zoom security cameras, access control systems and IoT sensors.

Table 1 (below) lists some of the technical differences for the various network power standard amendments. Note that each progressive amendment introduces more power to the end device.

Comparison of IEEE 802.3 PoE Amendments				
IEEE Standard	**802.3af – 2003[1]**	**802.3at – 2009[1] "POE+"**	**802.3bt – 2018 "POE++" (draft)[2]**	**802.3bt – 2018 "POE++" (draft)[2]**
Type	Type 1	Type 2	Type 3	Type 4
Power/Port	15.4 W	30 W	60 W	90-100 W
Volts Source (Min.-Max.)	44 - 57 VDC	50 - 57 VDC	50 - 57 VDC	52 - 57 VDC
Volts Device (Min.-Max.)	37 - 57 VDC	42.5 - 57 VDC	42.5 - 57 VDC	41.1 - 57 VDC
Current (Max.)	350 mA	600 mA	600 mA /pair	960 mA /pair
Assured Power	12.95 W	25.50 W	51 W	71 W
Supported Cabling (min.)	Category 3	Category 5	Category 5	Category 5

Table 1: Comparison of IEEE 802.3 Amendments related to delivering Power over Ethernet.

Notes:
1. IEEE 802.3af-2003 and IEEE 802.3at – 2009 are incorporated into IEEE 802.3 – 2012 and IEEE 802.3 - 2015, which are not listed in the table above.
2. IEEE 802.3bt is a draft standard anticipated to be approved in 2018. Several vendors are currently manufacturing switches that offer a power level similar to the 802.3bt Type 3 specification.
3. Table abbreviations: Watts (W); Volts Direct Current (VDC), milliamps (mA).

Deploying PoE requires a network switch or a separate in-line power injector to introduce power into the network connection. Network switches that support Type 1 and Type 2 PoE, may need to be upgraded to support higher power Type 3 and Type 4 PoE. The power supply in PoE switches is much higher wattage than power supplies for switches that do not support PoE, and consequently, the power connection to the switch is higher power.

Additionally, when PoE powers VoIP phones, a uninterruptable power supply (UPS) and battery backup are typically installed in line with the switch to maintain phone circuits during power outages. Higher power PoE will require a higher capacity UPS and batteries to maintain the same runtime. The switch, UPS and battery backup will also weigh more as compared to a non-PoE switch, which means the rack selected to support the IT equipment needs to be able to handle the additional weight.

PoE will transmit on existing Category 5e Unshielded Twisted Pair (UTP) cabling, but when using Type 4, you may need to adjust bundling size because of the additional heat from the higher power connection. PoE applications are covered in Article 725 of the 2017 National Electric Code[5] (NEC). Table 725.144 of the NEC provides guidance for bundle size based on the size of the conductor and temperature rating of the cable. For example, for an ambient air temperature of 86° Fahrenheit (30° Celsius), Category 5e UTP cable constructed of 24 American Wire Gauge (AWG) conductors and rated for 60°C would be limited to bundle sizes of 38 to 61 cables.

So, a bundle of 48 cables from a typical 2U patch panel would not need to be modified, but a larger bundle of 72 cables or 96 cables would need to be broken into smaller bundles. This means you may also need to space bundles in cable managers and pathways to maintain better airflow around bundles to remove heat.

5G Cellular Wireless: Neutral host small cells or distributed antenna system

The next generation of cellular wireless, 5G, will deliver mobile broadband access download speeds between 500 Megabits per second (Mbps) to 1 Gigabit per second (Gbps) with 10 milliseconds (ms) latency. Network speeds in many use cases are considerably higher from 300 Mbps up to 10 Gibabits per second (Gbps)[6]. The 3GPP - Release 15 standard[7], expected to publish in mid-2018, defines 5G. There are also a number of regional initiatives conducting trials and developing recommendations for 5G deployment, like 5G Americas based in the United States, 5GPPP in the European Union, the South Korean Ministry of Science, Fifth Generation Mobile Communication Promotion Forum (5GMF) in Japan, and the IMT-2020 (5G) Promotion Group in China[8]. Network deployment will begin in earnest in late 2018 with handsets anticipated in early 2020.

5G delivers considerably faster network speeds, but it uses very high bandwidth signals to do so. 5G signals propagate through glass, but quickly deteriorate against foliage and other building materials. Consequently, 5G requires a denser network of small cells to support the promised high speeds and low latency. Since most cellular wireless use originates indoors, neutral host indoor small cells or an upgraded distributed antenna system (DAS) will be a critical component of high quality of service for users[9]. Traditionally, one of the challenges to deploying small cells or DAS is the high expense of multiple systems to connect multiple carriers. Neutral host small cell or DAS provide the solution, allowing multiple carriers to share expense of network densification and deliver a stronger cellular wireless signal into the interior of buildings[10]. Building owners may also benefit by providing points to deploy outdoor small cells, especially in dense urban areas where access to utility poles or street furniture may be limited.

Small cell and DAS deployments are similar. The main difference is that small cells are individual mini-base stations, but DAS shares a single base station signal across a network of antennas. Small cells can attach to the existing network and use the building's broadband connection for backhaul. DAS is a separate network overlay with independent backhaul connections, as shown in Figure 2 below. Small cell are better suited for small- and medium-size environments or user groups. DAS supports very large venues and user groups[11]

Basic Indoor Small Cell Diagram
Note: Each small cell connects to the carriers through the site LAN/WAN

Basic DAS Diagram
Note: There is a single base station that connects the carriers

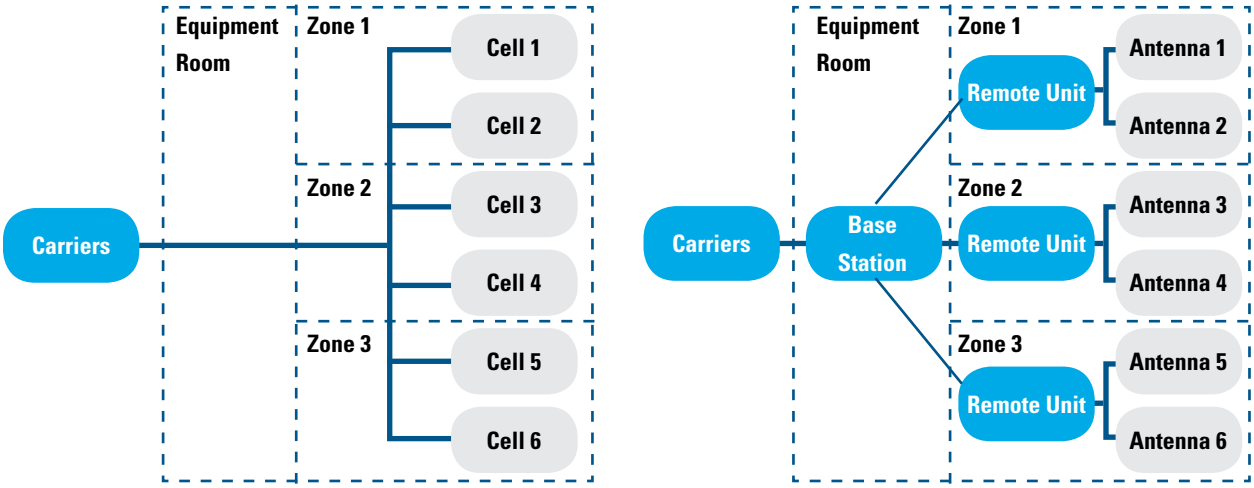

Figure 2: Small cell uses the existing LAN and backhauls through the WAN connection. DAS is a separate overlay with a single base station with multiple carrier connections.

Small cells deploy similarly to a Wi-Fi system connecting to a PoE switch that has access to the site broadband connection. DAS may be active or passive depending on site conditions. Active systems require power and amplify the signal within the building. Components include a base station or donor antenna/amplifier, repeater nodes/remote units and indoor antennas. There may be one or several entry points for connections to exterior donor antennas and this must include lightning protection. Repeater nodes/remote units are located in equipment rooms. The locations of indoor antennas must be carefully determined by a site survey and testing. A mix of fiber and coax cabling connects the system. It may be possible to use existing fiber structured cabling, but DAS is generally a separate network overlay[12].

IEEE 802.11ax and IEEE802.11ac Wave 2: High throughput wireless networking

Wireless networking throughput, or data transfer rate, has increased significantly in the past decade and will continue to increase with the upcoming IEEE 802.11ax amendment to the IEEE 802.11 standard, expected to publish in 2019. IEEE 802.11ax[13] is an Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) proposed amendment for wireless networking (Wi-Fi) that defines high efficiency wireless local area networks (WLANs) for dense environments. IEEE 802.11ax introduces a number of technical improvements over the previous IEEE802.11ac-2013 amendment[14] that will allow wireless access points (WAPs) to support even more devices and provide even faster connections in anticipation of 4K/8K UHD video streaming, augmented and virtual reality (AR/VR) and rapid proliferation of connected devices as part of the Internet of Things (IoT).

As a point of comparison, Table 2 (below) lists some of the technical differences and theoretical maximum throughput for various wireless networking standard amendments. Note that each progressive amendment introduces additional channel width, more spatial streams and higher order modulation, which leads to higher aggregate physical layer (PHY) rate depending on antenna configuration. Actual throughput depends on the specifications of the equipment selected, placement of equipment and other site conditions. 802.11ax may be more than you need, but the point here is that the bandwidth and number of devices supported by wireless networking is increasing.

Comparison of IEEE 802.11 Amendments – Increasing Wireless Networking (Wi-Fi) Throughput				
IEEE Standard	**802.11n – 2009**	**802.11ac – 2013 "Wave 1"**	**802.11ac – 2015 "Wave 2"[1]**	**802.11ax – 2019e (draft)[2]**
Band(s)	2.4 GHz, 5 GHz	5 GHz	5 GHz	5 GHz
Modulation (max.)	64-QAM	256-QAM	256-QAM	1024-QAM
MIMO	Single-user, downstream only	Single-user, downstream only	Multi-user, downstream only	Multi-user, bidirectional
Channel Widths	20, 40 MHz	20, 40, 80 MHz	20, 40, 80, 80-80, 160 MHz	20, 40, 80, 80-80, 160 MHz
Spatial Streams (max.)	4	4	8	8
PHY rate (max./stream)[3]	135 Mbps	390 Mbps	780 Mbps	1201 Mbps
PHY rate (max. aggregate)[3]	540 Mbps	1560 Mbps	6240 Mbps	9608 Mbps
Estimated Throughput (max. stream)[4]	87 Mbps	253 Mbps	507 Mbps	780 Mbps
Estimated Throughput (max. aggregate)[4]	351 Mbps	1014 Mbps	4056 Mbps	6245 Mbps

Table 2: Comparison of the Impact of Amendments to the IEEE 802.11 Standard on Wireless LAN Networking (Wi-Fi) Throughput.

Notes:

1. 802.11ac "Wave 2" is a subset of the 802.11ac, published in 2013. However, vendors developed equipment in phases introducing MU-MIMO and 160 MHz channel width in commercial WAPs at the end of 2015. The distinction is important because "Wave 1" equipment is not forward compatible. Note that 802.11ac "Wave 1" and "Wave 2" amended IEEE 802.11-2012 and are now incorporated into IEEE 802.11-2016.
2. 802.11ax is a draft amendment anticipated to publish in 2019. Huawei announced the first 802.11ax access point in December 2017, the AP7060DN, which will use 1024-QAM modulation.
3. PHY rate in Mbps based on the common 800 µs guard interval. Note that 802.11n and 802.11ac also support a 400 µs guard interval with slightly higher bandwidth. 802.11ax proposes a 1600 µs and a 3200 µs guard interval with slightly shorter bandwidth. PHY rate is based on maximum modulation, channel width and spatial stream, so a device may support an IEEE standard but have lower bandwidth if it has a different specification or is configured differently.
4. Estimated throughput values assume 65 percent MAC efficiency (PHY rate) with highest MCS. Wi-Fi uses radio waves to transmit data, so location of the WAP relative to devices (users) and other site conditions can affect signal strength and throughput.
5. Table abbreviations: Gigahertz (GHz); quadrature amplitude modulation (QAM); megahertz (MHz), megabits per second (Mbps).

The advantage of updating your WLAN is that 802.11ac Wave 2 or 802.11ax provide faster Wi-Fi connections, can support more users/devices/connections per WAP and may have slightly better coverage depending on siting. Both upgrades may allow you to eliminate wired networks for most network users and physical spaces.

Updating your WLAN will require replacement of WAPs because the hardware enables the faster connection speeds. Supporting your new high-bandwidth wireless network may require an update to your LAN switches and your structured cabling. IEEE802.11ac WAPs are best supported with 5 Gigabit per second (Gbps) network connections. IEEE802.11ax WAPs will require 10 Gbps network connections. This probably means an increase in your horizontal network from 1 Gbps connections to 10 Gbps and a corresponding upgrade in your backbone connections from 10 Gbps to 40 Gbps.

Consider a network switch that can deliver up to 10 Gbps to each WAP, supports multigigabit switching per the IEEE 802.3bz-2016 amendment[15] and has an integrated network controller. Multigigabit switching will allow the throughput speed to adjust dynamically between 1 Gbps, 2.5 Gbps, 5 Gbps and 10 Gbps depending on the access point requirements. A network controller, which can be software overlay or a separate hardware appliance, provides a single point for managing all of the access points in the network. If powering WAPs over the network, you will need a Power over Ethernet (PoE) switch. IEEE 802.11ac "Wave 2" WAPs draws approximately 30 Watts.

Additionally, the structured cabling may need upgrade, see Table 3 (below). A multigigabit switch will support network connections up to 5 Gbps over existing Category 5e UTP and Category 6 UTP network cabling. But for 10 Gbps, it is best to use Cat 6A UTP or better. Also, note that some WAPs support two network connections.

Comparison of Copper Cable Types and Maximum Supported Data Speed and Distance				
Cable Type	**Base Data Rate**	**Max. Data Speed**	**Max. Frequency**	**Max. Distance**
Category 5e UTP	1000 Base-T	5 Gbps	100 MHz	328 ft (100 m)
Category 6 UTP	1000 Base-T	5 Gbps 10 Gbps	250 MHz 250 MHz	328 ft (100 m) 164 ft (55 m)
Category 6A UTP	10G Base-T	10 Gbps	500 MHz	328 ft (100 m)
Category 8 F/UTP	25G Base-T 40G Base-T	25 Gbps 40 Gbps	2000 MHz	98 ft (30 m) 98 ft (30 m)

Table 3: Comparison of Copper Cable Types and Maximum Supported Data Speed and Distance for Connecting Wi-Fi Wireless Access Points to Your Network.

Notes:

1. Table abbreviations: Unshielded Twisted Pair (UTP); Foil or Shielded Twisted Pair (F/UTP); Gigabits per second (Gbps); Megahertz (MHz); feet (ft); meters (m).

How to Support these New Technologies in Your Premise Network.

Advancements in Cable Management: Cable runway and cable managers

Although the fundamentals of good cable management have not changed, the structural support components have improved significantly.. Best practices dictates you should support cable to prevent sharp bends, twists and stretching. When making a vertical or horizontal transition, use a smooth 90-degree bend radius that is four-times the diameter of copper conductors and a minimum of 1 inch (25 mm) for fiber conductors.

New structured cabling installations should consider a 25 Gbps or 40 Gbps fiber or Category 8 F/UTP or U/UTP backbone and 10 Gbps Category 6A UTP or Category 8 F/UTP or U/UTP horizontal connections. However, existing Category 5e and Category 6 UTP horizontal cabling can support 5 Gbps network connections and PoE++ under certain conditions.

The new requirement is the need to use smaller bundles and more spacing between bundles to allow airflow around cables with higher power Type 4 POE applications. The alternative is loose fill, but similarly, you would still need to be able to control the potential buildup of heat where cable concentrates in pathways.

There are several advancements in cable management to address these concerns. First, you can easily and quickly align the transitions between vertical cable managers alongside equipment racks and overhead cable trays. Cable runway, or ladder rack, is now available with movable cross members. This lets you adjust the position of a cross member if it interferes with the transition of cables between the vertical manager and overhead pathway, as shown in Figure 3 below. You can place radius drops exactly where they need to be to path cable into the vertical manager. Additionally, easy-to-use tool-less pathway dividers allow you to maintain space between cable bundles within the pathway.

Figure 3: Advancements in cable pathway include cable runway (ladder rack) with adjustable cross members to quickly and easily correct alignment issues and tool-less pathway accessories to separate, guide and support cables. Photo shows CPI Adjustable Cable Runway, Tool-Less Radius Drop.

Second, enhanced vertical cable managers that include internal supports to space cable bundles improve airflow around cables for higher power PoE applications and improve troubleshooting by neatly organizing each bundle, as shown in Figure 4 below. If loose fill is your preference, use high-density cable managers originally developed for the data center to provide additional space within cable managers allowing more space around cables.

Use cable management to support cables and neatly organize and identify connections. Proper cable management helps maintain reliable network connections and helps technicians trace and update connections quickly. Cable management solutions have evolved from a simple trough to hold cable bundles to a mechanical system that adjusts to optimize cable support. Cable management systems like CPI's Adjustable Cable Runway, Motive Cable Management and tool-less accessories provide advanced cable management solutions that are easy to use and adjust and provide precise support.

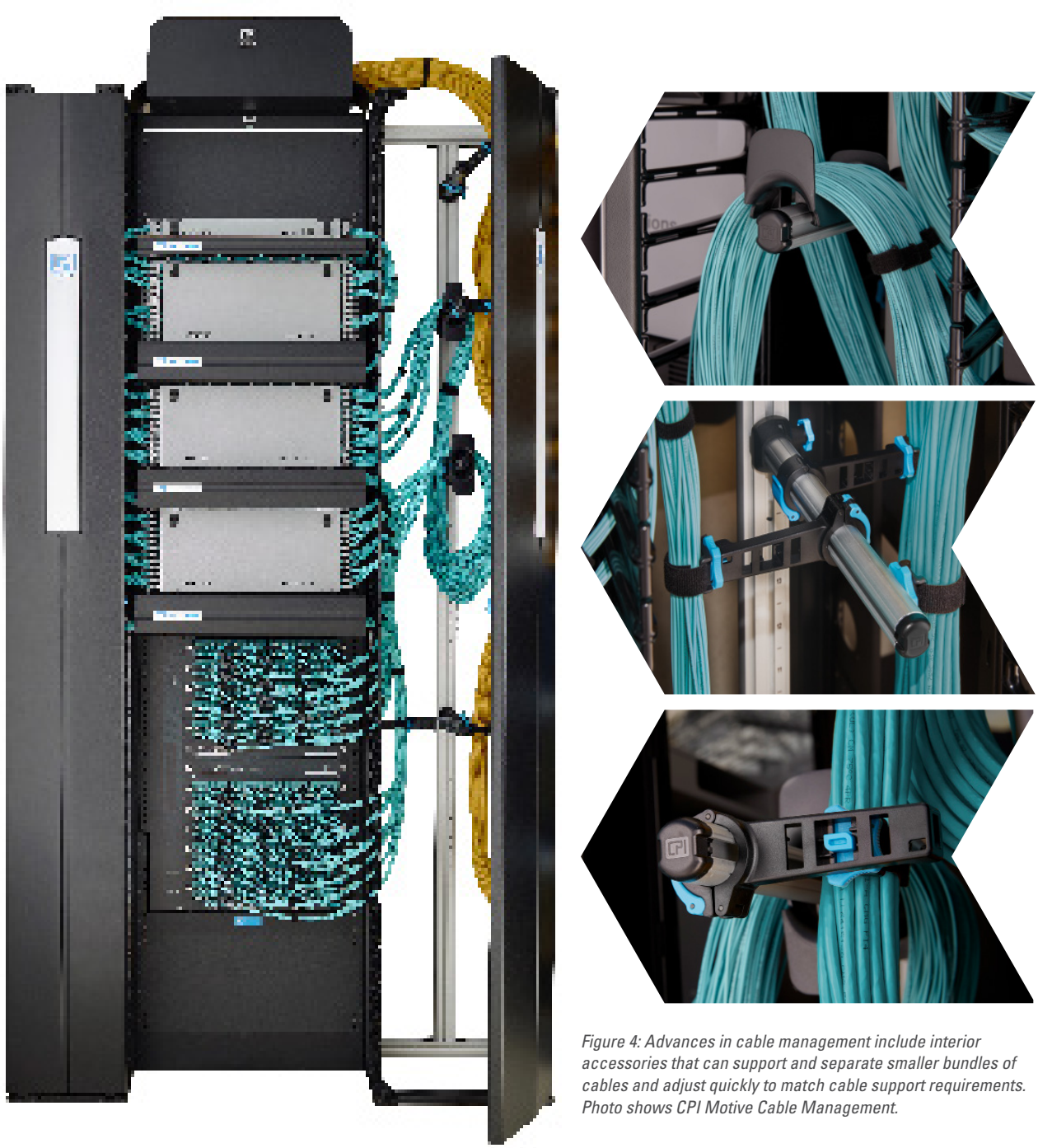

Figure 4: Advances in cable management include interior accessories that can support and separate smaller bundles of cables and adjust quickly to match cable support requirements. Photo shows CPI Motive Cable Management.

Advancements in Equipment Support: Equipment racks and cabinets

The standard premise network today includes a PoE switch with higher speed device connections. These switches are generally heavier than non-PoE switches and require a larger UPS or battery backup to provide longer runtimes with higher power end equipment. That may mean more heat exhausted from equipment. Bonding is more important with PoE switches and F/UTP, U/UTP, STP shielded cables. Physical security for equipment is another growing concern. You may need to place equipment in a shared location or retrofit an enclosure around existing equipment.

There are several advances in equipment support to address these concerns. First, wall-mount enclosures can provide security for network equipment in a shared space. Look for enclosures that are UL Listed under the NWIN category. This means they meet the ANSI/UL 2416, the standard for Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems[16], which requires a load test and integrated bonding. In general, the loads supported by wall cabinets have increased to accommodate the heavier switches, UPS and battery backups that support high power PoE. The integrated bonding point makes connection to the telecommunications bonding bus bar easier so you can bond switches and patch panels.

Next, look for dual-swing enclosures, as shown in Figure 5 below. Dual-swing enclosures open at the front and rear to provide complete access to equipment and cabling. New types of cable openings and removable panels on enclosures allow the enclosures to be placed over existing wall-mounted equipment to retrofit physical security with minimal impact to existing network cabling. Fan technology has improved allowing quieter fans for cooling equipment, so enclosures can be placed in common areas such as conference rooms without adding disturbing background noise.

For retrofit applications, there are wall-mount cabinets with special knockouts that allow placement without replacing network connections. Equipment racks and cabinets like the CPI Universal Rack, Adjustable Rail QuadraRack and CUBE-iT Wall-Mount Cabinet provide advanced equipment support solutions that are easy to use and provide precise support.

Figure 5: Advancements in equipment support include enclosures with increased load ratings for heavier equipment, front and rear access to equipment, retrofit features that allow installation over existing equipment and quieter fans that allow placement of enclosures and equipment in common areas. Photo shows CPI CUBE-iT™ Wall-Mount Cabinet.

Summary of Network Changes

Table 4 (below) summarizes the impact of the four new technologies to IT equipment and structured cabling and makes a recommendation for a CPI product solution discussed in this white paper. Use it as a basic guideline when considering a technology upgrade. Contact CPI for other product solutions.

Summary of Technology Impacts on your Enterprise Network				
Technology	**IT Equipment**	**Structured Cabling**	**Other Consideration**	**Product solution**
SD-WAN	Reduced CPE at branch locations	None	Consider upgrading LAN switch if it does not support software defined networking	CUBE-iT Wall-Mount Cabinet or ThinLine II Wall-Mount Cabinet to secure CPE and LAN switch at branch locations
802.3bt POE++	Upgrade LAN switch to support IEEE 802.3bt Recommend combining requirements with 802.11 recommendations below	Recommend Category 6A UTP or Category 8 F/UTP or U/UTP in the horizontal If using existing CAT 5e or CAT 6 cabling, review heat buildup and adjust cable bundle sizes and pathway spacing if required	Upgrade UPS and battery backup to support longer runtime for higher wattage devices. May require higher power connection for switches or power injectors to supply additional wattage Review thermal requirements if switch is enclosed in cabinet or unventilated room Equipment cabinets may require a fan to increase airflow.	Universal Rack and Adjustable Rail QuadraRack, Motive Cable Management and Adjustable Cable Runway for LAN switch and cross connect in traditional equipment rooms CUBE-iT Wall-Mount Cabinet for LAN switch and cross connect in small network Zone Enclosures to secure WAPs and endpoint network connections
5G Indoor Small Cell or DAS	Deploy new neutral host indoor Small Cell or DAS for 5G: May require upgrade or installation of the following: Base station or outdoor antenna/amplifier Repeater/nodes Indoor antennas External antennas	Recommend fiber Install external cabling connections from outdoor antenna/amplifier to repeater/nodes Install new network connections between repeaters and indoor antennas Upgrade LAN connections for small cells if necessary	Requires engineering consult to determine correct DAS specification and placement of indoor antennas	RMR Industrial Enclosures for exterior connections to outdoor antenna/amplifiers Universal Rack and Adjustable Rail QuadraRack, Motive Cable Management and Adjustable Cable Runway for LAN switch or repeater/ nodes and cross connect in traditional equipment rooms CUBE-iT Wall-Mount Cabinet for LAN switch or repeater/ nodes and cross connect in small network
802.11ac Wave 2 or 802.11ax Wi-Fi	Replace WAPs Upgrade LAN switch if it does not support IEEE802.3bz (NBASE-T) multigigabit switching Consider 10 Gbps device/ horizontal connections; 40 Gbps backbone connections Recommend integrated network controller Recommend combining requirements with 802.3 above	Recommend Category 6A UTP or Category 8 F/UTP or U/UTP in the horizontal Some WAPs will need two network connections, which may require new horizontal cabling Consider additional connections for 5G small cells on each floor, see above	40 Gbps backbone may require changes at fiber enclosure	Zone Enclosures to secure WAPs and endpoint network connections CUBE-iT Wall-Mount Cabinet for LAN switch and cross connect in small network Universal Rack and Adjustable Rail QuadraRack, Motive Cable Management and Adjustable Cable Runway for LAN switch and cross connect in traditional equipment rooms

Table 4: Summary of Network Technologies and Impacts to Enterprise Networks

Recommended Product Solutions

CUBE-iT Wall-Mount Cabinet - dual hinge wall-mount enclosure for class rooms, conference rooms and medium offices protects equipment while providing easy front and rear access for cabling.

ThinLine II Wall-Mount Cabinet - vertical mount enclosure uses minimal space in a small branch office. Supports a single switch and panel for network connections.

Universal Rack - vertical mount for patch panels and fiber enclosures to maximize floorspace in traditional equipment rooms.

Adjustable Rail QuadraRack - vertical mount for modular network switches in traditional equipment rooms

Motive Cable Management - attaches to the side of racks and creates an updated pathway to support and organize premise cable and patch cords

Adjustable Cable Runway - updated ladder rack allows you to move rungs if they interfere with cable egress from overhead pathways

Zone Enclosures - create secure spaces above drop ceilings for network connections and access points in the modern office.

RMR Enclosures - environmental and industrial enclosures provide outdoor protection from water and dirt.

Conclusion

There are a number of new networking technologies to consider for upgrades as you transition your premise network to support an ever increasing demand for bandwidth.

Don't forget to assess your physical network, your structured cabling, cable management practices and physical security as part of the process. Improved cable management products allow you to place supports exactly where they are required and easily separate cables to manage heat. New types of wall-mount enclosures create robust, secure spaces for your IT equipment and can easily retrofit over existing equipment or be placed in meeting rooms and other spaces where stronger network connections are required.

References

[1]*Cisco Systems, Inc. June 2017. Cisco Visual Networking Index: Forecast and Methodology, 2016-2021. White Paper. Downloaded 02/2018. Website: https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/complete-white-paper-c11-481360.html.*

[2]*Gartner, Inc. Gartner Blog Network. Andrew Lerner. July 2015. I hate my WAN … SD-WAN to the rescue. Blog. Website: https://blogs.gartner.com/andrew-lerner/2015/07/07/sdwan/.*

[3]*Network World. Brandon Butler. June 2017. SD-WAN: What is it and why you'll use it one day – An SDN for your branch office. Website: https://www.networkworld.com/article/3031279/sd-wan/sd-wan-what-it-is-and-why-you-ll-use-it-one-day.html.*

[4]*IEEE Working Group WG802.3 – Ethernet Working Group. 2018. IEEE 802.3bt-2018 Amendment to IEEE 802.3-2015, Amendment 2: Power over Ethernet over 4 pairs. Website: https://standards.ieee.org/develop/project/802.3bt.html.*

[5]*National Fire Protection Association (NFPA). 2017. NFPA 70 National Electrical Code 2017. Article 725.144 Transmission of Power and Data.*

[6]*5G Americas. 2017. 5G Network Transformation. Whitepaper. Downloaded 02/2018. Website: http://www.5gamericas.org/files/3815/1310/3919/5G_Network_Transformation_Final.pdf.*

[7]*3GPP. 2018. 3GPP Release 15 ASN.1. Website: http://www.3gpp.org/release-15.*

[8]*5G.co.uk. Kevin Thomas. What is the 5GPPP?. Website: https://5g.co.uk/guides/5gppp/.*

[9]*5G Americas. 2017. 5G Services and Use Cases. Whitepaper. Downloaded 02/2108. Website: http://www.5gamericas.org/files/9615/1217/2471/5G_Service_and_Use_Cases__FINAL.pdf.*

[10]*Wireless 20|20. Berge Ayvazian, Randall Schwartz, Haig Sarkissian. January 2016. The Business Case for Neutral Host Networks. White Paper. Downloaded 02/2018. Website: http://www.wireless2020.com/media/white-papers/NeutralHostWhitePaper01192016.pdf.*

[11]*5G Americas and Small Cell Forum. December 2016. Multi-operator and neutral host small cells. White Paper. Downloaded 02/2018. Website: http://www.5gamericas.org/files/4914/8193/1104/SCF191_Multi-operator_neutral_host_small_cells.pdf*

[12]*Infinigy Networks. An Introduction to Neutral Host Distributed Antenna Systems. White Paper. Downloaded 02/2018. Website: http://infinigy.com/PDF/InfinigyNeutralHostWhitepaper.pdf*

[13]*IEEE Working Group WG802.11 – Wireless LAN Working Group. Project. IEEE 802.11ax Amendment to Part 11 – Enhancements for High Efficiency WLAN – to IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks. Website: https://standards.ieee.org/develop/project/802.11ax.html.*

[14]*IEEE Working Group WG802.11 – Wireless LAN Working Group. 2013. IEEE 802.11ac-2013 Amendment 4 to Part 11 – Enhancements for Very High Throughput for Operation in Bands below 6 GHz -- to IEEE Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks. Website: https://standards.ieee.org/findstds/standard/802.11ac-2013.html.*

[15]*IEEE Working Group WG802.3 – Ethernet Working Group. 2016. IEEE 802.3bz-2016 Amendment to IEEE 802.3-2015, Part 7 – Media Access Control Parameters, Physical Layers, and Management Parameters for 2.5 Gb/s and 5 Gb/s Operation, Types 2.5GBASE-T and 5GBASE-T. Website: http://standards.ieee.org/findstds/standard/802.3bz-2016.html.*

[16]*Underwriters Laboratory and American National Standards Institute (UL and ANSI). March 2015. UL 2416. Standard for Audio/Video, Information and Communications Technology Equipment Cabinet, Enclosure and Rack Systems.*

Contributors

David Knapp | Product Marketing Manager

David Knapp has more than 20 years of experience in the telecommunications industry with CPI as a product-application expert and technical communicator in the roles of Technical Support, Technical Writer and Product Marketing Manager. He is currently focusing on data center, enterprise networking, including industrial networks, and power management solutions.

Duke Robertson | Product Manager, Rack Systems

Duke Robertson joined CPI in December 2007 and has more than 20 years of experience in a broad range of disciplines including design, manufacturing, product management and product development. In his role at CPI, Duke focuses on developing tailored solutions for customer-specific applications, utilizing CPI's unique and extensive design and manufacturing capabilities.

CHATSWORTH PRODUCTS

While every effort has been made to ensure the accuracy of all information, CPI does not accept liability for any errors or omissions and reserves the right to change information and descriptions of listed services and products.

©2018 Chatsworth Products, Inc. All rights reserved. Chatsworth Products, Clik-Nut, CPI, CPI Passive Cooling, eConnect, Evolution, GlobalFrame, MegaFrame, OnTrac, QuadraRack, RMR, Saf-T-Grip, Secure Array, SeismicFrame, SlimFrame, TeraFrame and Velocity are federally registered trademarks of Chatsworth Products. CUBE-iT, EuroFrame, Motive and Simply Efficient are trademarks of Chatsworth Products. All other trademarks belong to their respective companies. Rev.2 05/18 MKT-60020-703