SMART FROM CORE TO EDGE:

NEXT-GEN NETWORKING FOR THE DIGITAL ENTERPRISE

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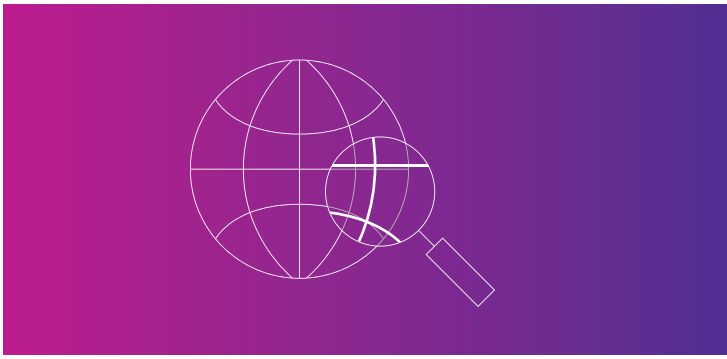
Pervasive digital transformation has turned almost every organization today into a technology organization. The sharing economy, for example, was made possible through platform businesses – a business model that facilitates the buying and selling, delivery, tracking, exchange and transfer of as well as payment for assets and services via apps and APIs.

These evolving digital business models and the continuing effect of consumerization of IT on business and government organizations have fueled demand for greater data security and privacy; safety of people and organizations; data intelligence; e-commerce and cloud services; inclusive financial services; and most of all, reliable and efficient end-to-end communications networks.

This e-book presents use cases that are helping enterprises seize opportunities to sharpen their competitive edge via digital transformation amid competition and thinning margins. A key theme is the complementary advantages presented by advances in the Internet of Things (IoT); multi-gigabit access and switching connectivity; Citizens Broadband Radio Service (CBRS); Wi-Fi 6; network convergence; and fiber and copper cabling.



CHAPTER 1

NETWORK CONVERGENCE EMPOWERS THE INTERNET OF THINGS

As the number of connected IoT devices looks set to exceed 40 billion by 2025, enterprises in every industry stand to harness and extract value from the zettabytes of data that will be generated. R&D investments of organizations in the developed and well-established economies of North America have promoted digitization and adoption of smart connected devices in Smart City initiatives. Demand for robust connectivity will increase, as will impact on network infrastructure. Leading hubs of IoT development have sprouted across North America, impacting industries such as transportation, manufacturing, agriculture, government, healthcare, and retail.

IoT sensors will generate intelligent data to drive new analytics and services. Over the next five years, the expanding edge computing environment featuring greater processing power, storage and other advanced capabilities will establish robust communications back to centralized services.

Multi-access edge computing deployments are moving processing power to the end-points to enable lower-latency applications. Simultaneously, wireless networks using both licensed (4G/5G) and unlicensed (e.g., Wi-Fi, Bluetooth, LoRa, Zigbee) spectrum find themselves co-located. For example, smart buildings are already being served by reliable cellular coverage along with ubiquitous Wi-Fi and support for IoT wireless net-works. With CBRS-based private cellular networking added to the mix, even more networks will be converged under one roof in the future.

These trends rely on the convergence of broadband fiber, copper and wireless as well as powered connectivity onto a network that connects data or processing sources, and business, industrial and consumer endpoints.

THE EFFICIENCY MANDATE

Mobile network architecture is evolving and creating more capacity with 4G/LTE densification and 5G. The deployment of small cells with 250-meter spacing between outdoor cells means more bandwidth per square meter while the promise of fixed wireless 5G in the sub-6 GHz range and millimeter wave band (i.e. 28 GHz) creates still more bandwidth per unit area.

In tandem with this evolution, the converged network that IoT devices rely

on must yield efficiencies not possible with standalone networks if the benefits of IoT solutions are to be fully realized.

POWER

Developments in Power over Ethernet (PoE) technology will see a convergence between power and bandwidth delivery. IEEE 802.3bt – the 4-pair PoE standard also known as 4PPoE – increases the highest average power at the Power Sourcing Equipment output to about 90W without compromising data bandwidth.

4PPoE can power a wide range of devices – lighting, Wi-Fi routers and access points (APs), IP cameras and industrial sensors; and even enterprise small cells, retail point-of-sale terminals and digital signage systems. Grand View Research predicts that the global PoE market will reach US$3.77 billion by 2025 as more applications and devices utilizing 4PPoE technology, which is compatible with data rates of up to 10GBASE-T, are introduced.

FUTURE-PROOFED

Whether it's laying the groundwork for wireless and wired infrastructure, for data analytics, or for cabling within a building, decisions are being made today for sites that are going to be around for another 20 years. As such, organizations need to prepare now to take advantage of technology trends such as the IoT, 5G, Multi-access Edge Computing (MEC), and new standards in PoE.

SUCCESS STORY: THE ROYAL PARK HOTEL, MICHIGAN, U.S.A

STRATEGIC IOT APPROACH LAYS FOUNDATION FOR FUTURE INNOVATION

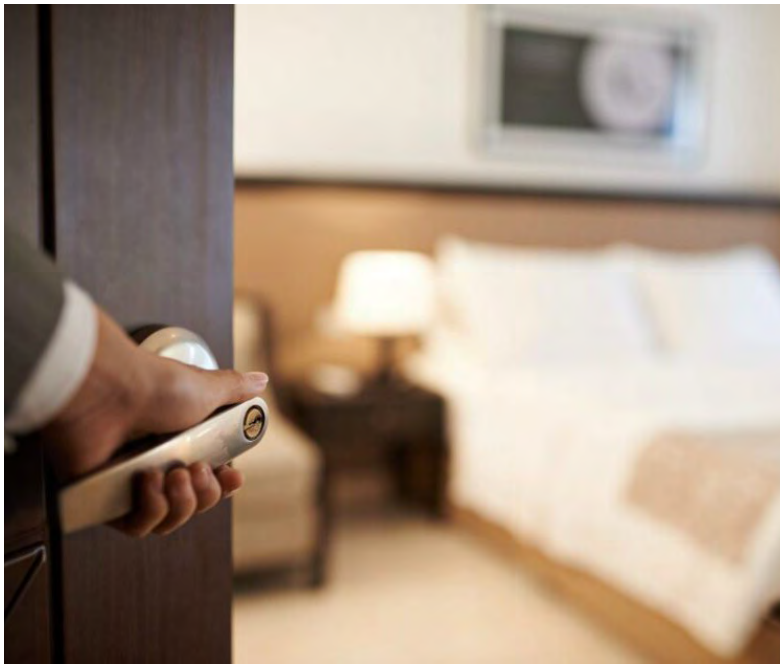
The IoT offers the hospitality industry an opportunity to continually innovate and en-hance guest satisfaction. Building on its delivery of award-winning guest experience, the luxurious Royal Park Hotel in Rochester, Michigan aims to further raise the bar on convenience and safety via the use of IoT.

The hotel required a cohesive and strategic approach to integrating IoT capabilities. Specifically, it planned to replace standalone door locks with an online door lock system for added security and guest convenience while avoiding the cost and complexity of an overlay network to support the connected locks.

ASSA ABLOY Global Solutions and RUCKUS collaborated on an integrated solution to bring the door locks and future IoT technologies online.

SOLUTION

Both organizations agreed that connecting the online door locks through the RUCKUS IoT Suite over the RUCKUS Wi-Fi was a better approach than having an overlay network, which typically requires additional cabling, switches and gateways for each IoT device. That would drive up cost and complexity.



The joint integration includes the RUCKUS IoT Suite and Visionline wireless locking system by ASSA ABLOY Global Solutions along with its wireless Zigbee door locks.

Each door lock is now an IoT endpoint on the network. It transmits and receives information to an IoT-enabled AP, which connects to the RUCKUS IoT controller. The IoT controller manages and controls the APs, and it connects to the Visionline server, which manages the connected entry system.

SUCCESS STORY: THE ROYAL PARK HOTEL, MICHIGAN, U.S.A

BENEFITS

Authorized hotel staff can view the status of every guest room door instantaneously from a single dashboard and be alerted to anomalies that might indicate problems or potential security concerns. The hotel can create automated policy-based actions like deactivating a keycard after several unsuccessful access attempts.

Guests not only enjoy added security but also added conveniences like check-in via mobile device, soft key download to smart phone, and stay extension or room change without requiring new keycards.

The RUCKUS IoT Suite leverages the cabling, switches and IoT-ready APs to create a converged IoT network – supporting Bluetooth Low Energy and Zigbee standards – at a fraction of the cost of overlay IoT networks.

Importantly, it paves the way for other possibilities, including wearable panic buttons for workplace safety, and asset tracking to keep track of things like room service trays. These capabilities enhance safety and productivity for staff as well as convenience and security for guests.

CHAPTER 2

5G-IOT NETWORKS FLOURISH ON EFFICIENT STRUCTURED CABLING

> Enterprises must be mindful that deploying individual networks for myriad IoT and cloud services not only adds complexity and cost but also may impact network performance.

Faced with the impact of emerging IoT and 5G applications, IT network managers must seriously consider infrastructural efficiency. Key challenges include network densification for more usable floor space; cabling system performance to meet future bandwidth demands; and important connectivity drivers such as Wi-Fi; PoE-enabled devices; and in-building wireless (IBW) systems.

OPTIMIZING SPACE UTILIZATION FOR NETWORK DENSIFICATION

The relatively high cost of real estate across many large metro areas is driving renewed focus on cabling for efficiency and performance, especially as the enterprise network supports more IoT and 5G devices as well as applications and use cases.

CommScope's Universal Connectivity Grid (UCG) aims to optimize space utilization by dividing floor space into evenly sized areas. By deploying consolidation points in the ceiling of each area, connections to the core network and access to other wired and wireless networks are made easy.

Indeed, more connected devices are being deployed in the ceilings with facilities and IT networks converging onto IP/Ethernet. The Ceiling Connector Assembly (CCA) high-quality cable interconnection, which is available as a standalone unit or pre-terminated to an RJ45 plug, simplifies installation of these devices.

STRUCTURED CABLING PERFORMANCE FIT FOR 5G, WI-FI 6

The 5G networks of the future herald sophisticated connectivity to myriad smart edge IoT devices. These high-speed networks will meet bandwidth, efficiency and latency requirements of more machine-to-machine connections.

Within the enterprise, category 6A cabling delivers high bandwidth and remote power to support a common connectivity platform for wired LAN and wireless technologies, occupancy sensors, intelligent lighting,

audiovisual services, building automation, and access control to enable the IoT.

Meanwhile, early implementations of 400G fiber uplinks and backbones are happening, even as migration to 100/200G from 40G continues.

Building backbones have traditionally been designed to exceed the horizontal requirements by a factor of 10. With upcoming Wi-Fi 6 (802.11ax) APs offering theoretical speeds of up to 10 Gbps and more efficiently serving multiple devices, any new or retrofitted backbone infrastructure should be specified to support backhaul bandwidth of 100 Gbps.

The fiber-optic infrastructure capable of this speed is OM5 wideband multimode fiber. CommScope's SYSTIMAX structured cabling, featuring single mode, multimode and OM5 wideband multimode fiber, is certified to meet or exceed industry standards.

As the number of switches and assets to support 5G-IoT requirements grows, CommScope's structured cabling approach ensures scalability and standardizes implementations of complex networks in intelligent buildings, campuses and data centers. This approach, which adheres to established standards for deploying cabling within a building or a group of buildings, delivers very low latencies and improves overall network efficiency to reduce CapEx and OpEx in the long run.

IOT CONNECTIVITY DRIVERS

CommScope's structured cabling is also designed to power connected IoT devices and sensor-driven technologies.

With the advent of the IoT, managing PoE-enabled links has become increasingly difficult. The latest IEEE 802.3bt PoE standard, also referred to as 4PPoE, enables the remote powering of a broader range of connected devices.

To this end, CommScope is contributing to new cabling standards based on bundle size recommendations and building physical cable bundles subject to a variety of power and environmental conditions. CommScope also offers a powered fiber cable system to connect and power devices that are located more than 100 meters from the PoE switch.

To help manage CommScope's SYSTIMAX structured cabling portfolio of UCGs, fiber optic backbones and PoE solutions, the imVision automated infrastructure management (AIM) system provides network administrators a holistic view of the network from which to optimize the allocation and use of resources.

SUCCESS STORY: DALLAS COWBOYS, TEXAS, U.S.A.

DALLAS COWBOYS HQ FUTURE-PROOFED WITH SMART STRUCTURED CABLING

The Ford Center at The Star is the Dallas Cowboys' headquarters and training facility in Frisco, Texas. Boasting retail, entertainment and office space, including two outdoor practice fields and the Cowboys Club, The Ford Center features a 12,000-seat indoor stadium and multi-use event center to host Cowboys training as well as local high school football games.

Ensuring visitors can text, email, make calls, and send pictures and videos seamlessly within the 25-acre complex requires a network with the flexibility to adapt to wide traffic swings. The network must be able to power the team's day-to-day operations while minimizing strain on its data server; reduce energy consumption and promote the Cowboys' sustainability efforts; and build scalability and redundancy into all systems.

CommScope and AT&T installed solutions that include an optical distribution system. This solution was designed to be scalable and to provide maximum performance while reducing total cost of ownership.

SOLUTION

The Ford Center at The Star includes the indoor training stadium and outdoor practice fields, 5,000-person-capacity Cowboys world headquarters building, an underground parking garage, and an open plaza connecting the buildings. The complex also includes the 16-story Omni Hotel, office and commercial space and medical buildings.

Along with 683 miles of CommScope fiber and copper cabling, an optical distribution solution for The Star's facilities can transmit frequencies from 800 to 2500 MHz, enabling

SUCCESS STORY: DALLAS COWBOYS, TEXAS, U.S.A.

them to rapidly adapt to shifting network traffic levels as fans and visitors upload and download data from any mobile device.

BENEFITS

The Star's Wi-Fi network utilized CommScope's GigaSPEED X10D Cat 6A cabling for all wireless APs, which provides up to 10GB Ethernet performance and PoE support for the facility's dynamic environment. To support remote powering technology, the recommended cabling design is a minimum of two Cat 6A cabling links to each AP.

This addresses the challenge of Wi-Fi 5 (802.11ac), Wi-Fi 6 (802.11ax) and future wireless technologies exceeding the connection performance of Gigabit Ethernet (GbE) switch ports. CommScope's optimized wired and wireless multi-gigabit solutions deliver 10 GbE access capacity over existing cable plant, alleviating costly forklift upgrades and disruptions. These include APs and switches optimized for 2.5/5/10 GbE connections.

Additionally, rollouts of 5G and Wi-Fi 6 (802.11ax) wireless technologies enable new IoT applications that require greater bandwidth and lower latencies. These technologies are designed for high-density wireless deployments in locations such as stadiums and convention centers. Data has to be sent from the edge APs to central data storage or processing centers.

Smart network cabling is poised to complement these initiatives to deliver exceptional user experience to high concentrations of people and smart devices. It will also ready The Star to meet evolving connectivity needs.

CHAPTER 3

BUILDING THE FUTURE-PROOFED AND EFFICIENT DATA CENTER

Faced with surging demand for cloud-based services and data storage; and fueled by the rapid pace of digitization, rising affluence and an increasingly tech-savvy young population, big corporations are expanding their cloud infrastructure footprint.

CLOUD-DRIVEN EXPANSION

Such expansion activities are driving the global co-location data center (DC) market to grow at a compounded annual rate of 10.92% over the next five years to hit $58.28 billion by 2025. North America continues to be the largest market due to the presence of a large number of DCs and the rapid adoption of cloud computing. Growth has also been driven by the increasing need to reduce CapEx when commissioning new DCs and for achieving business continuity via resilient and safe co-location facilities.

A study by IDG found that about two-thirds of organizations already store at least some of their data in a co-location center. Even among organizations that rely exclusively on on-premises facilities, over 70% have made plans to migrate some data into a co-location facility. With growing server virtualization and cloud deployments, the flexibility and reliability of co-location DCs enable organizations to utilize the high-performance resources of third-party facilities while also maintaining control over valuable assets.

Often referred to as co-location DCs, multi-tenant DCs (MTDCs) configure and physically connect network services to a new enterprise tenant quickly and efficiently. They provide the required cabling infrastructure to support multiple generations of equipment and speeds. Specifically, organizations have ready access to high-density, low-optical loss cables; simplified infrastructure management; and floor-mounted fiber entrance cabinets to maximize compute and storage density.

5G IMPACT AT THE EDGE

The advent of 5G, the fifth-generation cellular network technology that exploits new spectrum and can provide single-digit millisecond latency, will alter how DCs are designed and operated. By some estimates, DCs will be spending over half their operating budget to support 5G-related services and applications by 2025.

Amid rising demand for 5G-driven cloud-scale services, high-performing MTDCs may be re-located closer to the network's edge where the users, data and connected devices are found. The move is to fulfill the low latency and reliability requirements of applications that 5G will enable, such as self-driving vehicles, industrial automation, machine-to-machine communications and more.

Innovative solutions needed to support these applications include a flexible migration platform; pre-terminated fiber and copper connectivity; and an automated infrastructure management (AIM) solution.

RISK-FREE MIGRATION

The ability for DCs to support 25G/40G/100G and beyond, with up to five 9s of availability, is needed in today's hyper-connected and always-on digital age.

CommScope's High Speed Migration platform uses modular building blocks to support the growing speeds and densities that new applications and architectures demand. The platform is complemented by the SYSTIMAX portfolio of connectivity and structured cabling solutions to deliver agility, manageability and scalability for growth.

For example, space-saving high-density (HD) and ultra-high-density (UD) panels provide up to 72 duplex Lucent Connectors (LCs) or 48 Multi-fiber Push On (MPO) ports per rack unit (RU) – single mode or multimode – to align with the high density of fiber ports in the spine switch layer of today's leaf-and-spine networks.

Pre-terminated and pre-tested fiber assemblies increase deployment speed and accuracy. Ultra-low-loss, pre-terminated components for single mode and multimode enable longer link spans and support for attenuation-sensitive applications.

CommScope's imVision AIM solution, available with HD and UD panels, enables DCs to monitor and manage infrastructure at port level and in real time. imVision automates the planning, implementing and documenting of moves, adds and changes; accelerates mean time to repair; and triggers alerts in real time to unplanned or unauthorized changes in the physical layer.

As enterprise and co-location facilities continue to grow in complexity, the ability to pivot quickly and easily to take advantage of new market opportunities starts with the right physical layer infrastructure and an experienced partner who can help build it.

CommScope is maximizing efficiency and performance in MTDC deployments with copper and fiber infrastructure solutions as well as AIM. Spaces are also enhanced through optical distribution frames and fiber raceway solutions for outside plant (OSP), entrance facilities, meet-me rooms and cages. These aside, CommScope's alliances with top-performing MTDC providers ensure that DC efforts drive organizational needs.

SUCCESS STORY: EQUINIX, GLOBAL

COMMSCOPE AND EQUINIX DEMONSTRATE POWER OF MTDC ALLIANCE

Equinix has maintained the pole position in seven consecutive Cloudscene Data Center Ecosystem Leaderboards based on connectivity and density of its DCs.

After collaborating on numerous MTDC projects, Equinix became the first partner to sign on to CommScope's MTDC Alliance, a cooperative program that now includes six of the largest MTDC providers and nearly 100 service, installation and integration partners worldwide.

Equinix provides MTDC space and interconnection services for the world's top forex service providers. In forex trading, ultra-high-speed platforms move trillions in trades across the globe daily. In every network link connecting institutional traders to their markets, milliseconds mean millions.

Trading partners look to forex platform providers to provide latency equalization for a level playing field. CommScope helped one forex service provider upgrade the links from its trading partners' DCs to a matching engine, ensuring identical latency performance regardless of location. The platform's matching engine was in one building; the partners' were in two separate buildings.

SOLUTION

The project entailed installing an underground OSP without the ability to test before deployment. And so, CommScope had one shot to get it right and a short timeline of a few weeks to install and turn up the intra-campus links.

As CommScope engineers worked through the technical issues, Equinix focused on logistics and ensuring the service provider's team was kept up to date. The solution consisted of multiple runs of high-count ribbon fiber, rack-mounted fiber panels, and connector assemblies. In addition to

SUCCESS STORY: EQUINIX, GLOBAL

precise measurement of the spooled cabling, the end-to-end optical distance of each link had to be precise.

A highly sensitive optical backscatter reflectometer (OBR) was used for precision measuring of in-building equidistant links. One trunk cable each was terminated inside buildings A and B, and one at the customer's matching engine where both cables were terminated at the OBR.

BENEFITS

The successful project demonstrates that latency equalization in the OSP is doable. The project reaffirmed the value of working partnerships such as those between CommScope and Equinix, and within the MTDC Alliance.

The forex service provider's infrastructure is now deployed on Platform Equinix, a co-location and interconnection platform that places controls closest to users, clouds and networks. The organization can connect with other trading partners for decreased latency; and scale the business up or down based on shifting market needs.

CHAPTER 4

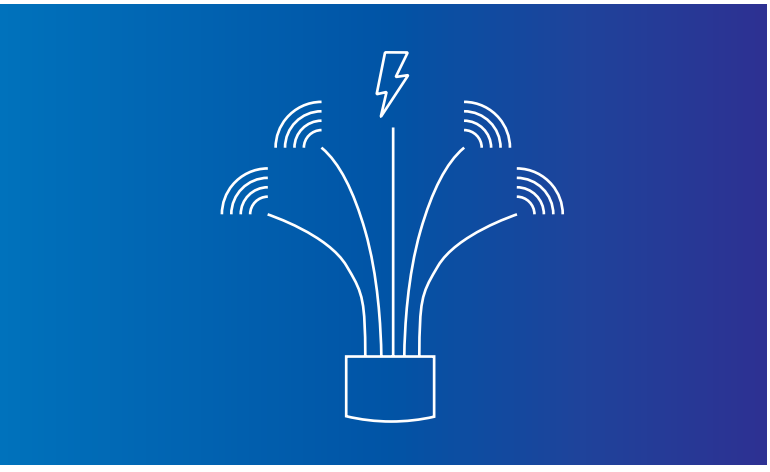
THE WI-FI-6 PROMISE OF EFFICIENCY AND EXCEPTIONAL USER EXPERIENCE

User experience is crucial in today's digital, hyper-connected environment. Beyond poor user experience, every minute of unplanned downtime can cost enterprises anywhere from $5,600 to $9,000. More worrying for network managers is the growing volume of reported outages that hinder organizations from accelerating digital innovations.

For organizations that operate networks that serve not just employees but customers, students or subscribers, all the analytics that an organization embarks on to help improve the customer experience would be pointless if Wi-Fi network performance were poor. In the hospitality sector, for example, studies show that nine out of 10 guests will not rebook a hotel if their Wi-Fi experience was bad. The same would likely be true for venues.

Indeed, readily available Wi-Fi is a foundation of the digital economy. It is not only a productivity tool that empowers employees to work and collaborate better but also a platform that enables organizations to interact directly with their customers via apps, websites and other digital services on the Internet and the Intranet.

Hence, business and IT leaders – particularly within the hospitality, healthcare and retail industries – mostly agree that a bad Wi-Fi experience will negatively affect brand reputation. This is where Wi-Fi 6 offers the critical advantage of dramatically increased wireless bandwidth and network efficiency compared to legacy Wi-Fi 4 or 5.



WI-FI 6

Wi-Fi 6 made its way into new installations in 2019. It is designed to allow for wireless data rates up to 10 Gbps – with real-world throughput of up to 5 Gbps – and to operate in today's increasingly busy and crowded environments, such as airports, stadiums, hotels, apartment and commercial buildings and entertainment venues.

With an expected four-fold capacity increase over its 802.11ac Wave 2 predecessor, Wi-Fi 6 deployed in dense device environments supports higher service-level agreements to more diverse and concurrently connected users and devices.

Wi-Fi 6 networks enable IoT devices to work better and more efficiently. And they make possible a new wave of IoT devices. Significantly, features such as Wi-Fi 6's Target Wake Time provide the battery efficiency that allows the consolidation of services onto

a single Wi-Fi or IP infrastructure and the handling of ever-increasing load being put on networks.

Wi-Fi networks have been useful in alleviating the strain on LTE networks in high-density areas to enhance customer experience. Wi-Fi 6's support of multi-user, multiple-input, multiple-output (MU-MIMO) technology enables any compatible access point (AP) to handle traffic from up to eight users simultaneously at the same speed.

Still, enterprises will only realize the full benefit of Wi-Fi 6 with the right cabling infrastructure to serve as backhaul for the AP. The data rates of APs are increasing quickly with the Ethernet interface advancing from 1 GbE to 2.5 GbE and 5 GbE. To deliver the bandwidth needed for current and future applications, the TSB-162-A standard recommends running two Category 6A cables to each service outlet supporting an AP.

Further, the ISO/IEC 11801-6 standard lists typical indoor ranges of an AP that should be used based on the frequency band and data rate of Wi-Fi services. The list helps to determine the coverage of an average grid and placement of cabling and service outlets.

SPECIALTY ACCESS POINTS

Every network deployment has its own unique requirements. Providing Wi-Fi in every room of a hotel or a university residence hall, for example, requires a different form factor and feature set from serving an office environment. Deploying Wi-Fi outdoors, or in a large stadium, demands still other considerations.

CommScope, with RUCKUS in its fold, offers a large portfolio of indoor and outdoor AP options to suit any type of deployment. This includes wall-mounted Wi-Fi plus Ethernet switch APs for hospitality and multi-dwelling unit environments, as well as APs that make use of a building's existing coaxial cabling for backhaul.

The CommScope Ruckus R750 802.11ax indoor Wi-Fi AP for ultra-dense client environments is one the first APs to be Wi-Fi CERTIFIED 6. This certification from the Wi-Fi Alliance validates the use of the R750 in environments such as stadiums, hotels, convention centers and schools. Being Wi-Fi CERTIFIED 6, more connected R750 APs can achieve peak performance simultaneously in these environments while supporting the Wi-Fi CERTIFIED WPA3 security protocol.

SUCCESS STORY: HUNTINGTON INDEPENDENT SCHOOL DISTRICT, TEXAS, U.S.A

RELIABLE, HIGH-PERFORMANCE WI-FI WIDENS E-LEARNING POSSIBILITIES

The Huntington Independent School District (ISD) serves more than 1,600 high school, middle school, intermediate school and elementary school students on five campuses. Teachers and administrators have been committed to supporting the students' needs and they expect the district-wide wireless network to do the same.

However, when the Wi-Fi network crashed district-wide while 400 middle-school students were logged onto digital learning courseware, the vendor's response was slow. Problems continued even after replacing APs and patching software. Costs mounted.

Having a small IT staff, maintaining separate wired and wireless networks was time intensive. The administration agreed to replace the existing infrastructure given its severe limitations and poor vendor support. The Huntington ISD's priority was to seek a network partner with top-notch support and technology that would take the district far into the future.

SOLUTION

For starters, CommScope enabled the school district IT to converge its wired and wireless networks onto a single management platform. With the RUCKUS SmartZone network controller, the team could manage every AP and switch from a single console.

The Wi-Fi 6 certified RUCKUS indoor APs and stackable multi-gigabit ICX switches enabled the school district to ramp up internet speed to 2 Gbps. The Ruckus 802.11ax APs are geared with patented technology to fit any unique budget, performance requirement, or deployment scenario. They overcame issues such as high client density and Wi-Fi-unfriendly building materials to enhance network reliability.

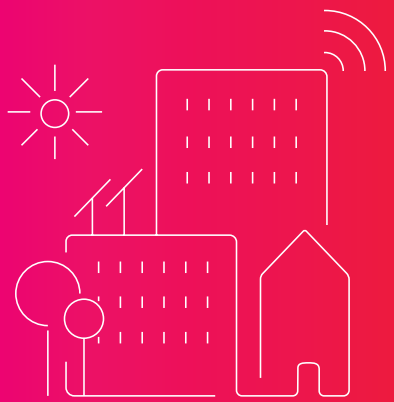
The network provided a clear and easy upgrade path to higher speeds. CommScope engineers worked closely with the IT staff to integrate legacy switches with the ICX stackable switches as the former were gradually replaced.

SUCCESS STORY: HUNTINGTON INDEPENDENT SCHOOL DISTRICT, TEXAS, U.S.A

BENEFITS

The new network is significantly easier to manage and update. For example, an ICX switch added to a stack automatically inherits the stack's existing configurations. Each AP can be configured for 2.4 GHz or 5 GHz on the fly from the SmartZone console. IT can check the Wi-Fi status in every school from a dashboard.

To strengthen safety, security and emergency communications, IT can easily set up SSIDs on the Wi-Fi to open secure parts of the network for users or events. The network's rock-solid Wi-Fi performance has made district-wide online testing feasible again.



The school district could also consider RUCKUS Cloudpath Enrollment System to manage the onboarding of students and device authentication as well as RUCKUS Analytics cloud-based network monitoring to look at network utilization and optimize performance.

CHAPTER 5

MULTI-GIGABIT ACCESS AND SWITCHING TO MAKE THE MOST OUT OF WI-FI 6

Communications networks are more complex than ever before. High-bandwidth, media-rich applications, bring-your-own-device (BYOD) culture and the IoT have hastened organizations toward 802.11ac Wave 2 Wi-Fi implementations, even as 802.11ax (Wi- Fi 6) begins to gain awareness.

While more apps are being migrated to the cloud, the edge has become increasingly wireless. Wireless APs have essentially become part of a converged access platform where multiple functions – ranging from IoT gateway to firewall – are performed. Access is established through radios operating over different air interfaces, from Wi-Fi to Blue-tooth Low-Energy (BLE) to Zigbee.

Regardless, Wi-Fi networks in particular will have to be more efficient, flexible and intelligent than ever before. The networks will utilize sensors and machine data combined with innovations such as artificial intelligence to automatically provision for added capacity and proactively solve potential problems before it impacts the user.

Concurrently, increased dependence on data-intensive wireless and cloud-based applications has driven demand for multi-gigabit connectivity between wireless APs and Ethernet switches at the edge.

MULTI-GIGABIT CONNECTIVITY

With the 802.11ac (Wi-Fi 5) and now 802.11ax (Wi-Fi 6) standards, an AP has the potential of more than one-gigabit throughput. Wi-Fi 6 was built to handle more devices and bandwidth-hungry applications. But a single Wi-Fi 6 client can quickly overtax existing 1 GbE backhaul links on a typical AP. This has generated interest in multi-gigabit connections between APs and switches.

Bridging the performance gap between gigabit and multi-gigabit Wi-Fi is becoming necessary in demanding environments such as stadiums, exhibition halls, hotels and even primary and K-12 schools.

Most 802.11ac APs are equipped with two 1 GbE ports, with some featuring 2.5 GbE ports.

The new 802.11ax (Wi-Fi 6) APs can easily achieve 5 Gbps speeds in real-world operations, so these APs will be equipped with 5 GbE ports.

APS AND SWITCHES

Ruckus Networks, now part of CommScope, has been deploying Wi-Fi in challenging venues with unusually high capacity requirements, such as stadiums and arenas. CommScope RUCKUS offers multi-gigabit options that include APs and switches optimized for Wi-Fi 5 or Wi-Fi 6 with 2.5 GbE connections, or Wi-Fi 6 via APs or ICX Z-Series switches with 2.5/5/10 GbE ports.

These multi-gigabit solutions allow organizations to balance cost, performance and Wi-Fi client density. For example, the RUCKUS R750 802.11ax indoor AP for ultra-dense client environments is Wi-Fi CERTIFIED 6 from the Wi-Fi Alliance.

Meanwhile, the RUCKUS ICX 7150-C10ZP, ICX 7150-48ZP and ICX 7650-48ZP provide rich options for 2.5/5/10 GbE Ethernet switching fit for different deployment scenarios with the R750. Additionally, the RUCKUS ICX 7850 switch is designed to deliver 100 gigabit core switching capacity for large campus networks.

To maintain a consistent Wi-Fi 6 user experience, the combination of RUCKUS multi-gigabit switching, Wi-Fi technology and unified network controller, with CommScope's portfolio of structured cabling, provides a comprehensive end-to-end network solution.

CABLING, POE TO OPTIMIZE WI-FI

The cabling infrastructure needed to support the latest Wi-Fi APs must be

upgraded to handle bandwidth-hungry devices and applications such as virtual reality, 4K video streaming and wearables. Critical connectivity is also needed to support operational use cases like IoT devices, video surveillance, asset tracking, climate control systems, smart locks and point-of-sale.

Generally, multi-gigabit technology leverages commonly deployed Cat 5e (for 2.5 Gbps) or Cat 6A (for 5 Gbps) cabling. Hence, enterprises can maximize the performance of their Wi-Fi networks and obtain multi-gigabit access capacity over an existing cable plant.

To ensure optimal performance of these APs, Category 6A cabling infrastructure and multi-gigabit switches that support the 802.3bt PoE standard to its full 90W should be installed. RUCKUS multi-gigabit switches already offer up to 90W per port and up to 1500W of total PoE budget along with uplinks of up to 100 Gbps to future-proof the network.

SUCCESS STORY: RICHARDSON INTERNATIONAL, WINNIPEG, CANADA

AGRIBUSINESS STREAMLINES SWITCHING NETWORK FOR BIG EFFICIENCY GAINS

Richardson International is Canada's leading agribusiness. Its food products – grains, oilseeds, canola and oats – are sold to customers worldwide. During a period of extraordinary growth in its history along with expansion through strategic acquisitions in North America and Europe, the organization's IT team decided to replace its unreliable switching network to help gain the trust of acquired organizations and make standardization of technology easier for them.

Technology recommendations must improve the operations of their business and plants. The small IT team required switches to be efficiently managed from the corporate data center in Winnipeg. Downtime required to standardize switches had to be minimized.

With agility and efficiency in mind, the switching infrastructure had to be easily scalable and offer low cost of ownership, high performance and rock-solid reliability. Other key considerations included ease of deployment and seamless transitions toward standardization.

SOLUTION

As Richardson International's network grew to support more remote locations, the organization deployed more than 500 RUCKUS ICX switches across Canada, the U.S. and the U.K. while actually decreasing the cost of that support.

The multi-gigabit RUCKUS ICX fixed form-factor or stackable switches enhance security, minimize troubleshooting, and make upgrades easy. This is critical because reliable Wi-Fi requires a well-matched wired infrastructure that provides high performance and high reliability. The infrastructure must be easily managed, and can scale to meet ever-increasing Wi-Fi demands.

SUCCESS STORY: RICHARDSON INTERNATIONAL, WINNIPEG, CANADA

Hence, ICX switches work seamlessly with RUCKUS Wi-Fi APs, RUCKUS SmartZone network controllers and RUCKUS Cloud to improve responsiveness to organizational needs while reducing IT overhead.

Additionally, the advent of Wi-Fi 6/6E APs is playing a major role in driving the de-mand for multi-gigabit connectivity.

BENEFITS

Post-deployment, three network engineers based at Richardson International's head-quarters in Winnipeg are responsible for managing the 500 RUCKUS ICX switches deployed across 140 farflung locations. For the team, network performance entails not just bandwidth and throughput but also simplified management.

Management simplicity is integral to the RUCKUS high-performance switches. Unnecessary steps associated with configuring and monitoring a large network of distributed switches are reduced. Documentation is clear and thorough to ease deployments.

RUCKUS Cloud has further extended this advantage to enable management of single-site or geographically distributed multi-site wired and wireless network from anywhere using an intuitive web interface or a mobile app. Administrators get a unified view of all venues, as well as connected APs, switches and clients.

CHAPTER 6

UNIFYING INFRASTRUCTURE FOR 5G WITH CITIZENS BROADBAND RADIO SERVICE PRIVATE LTE NETWORKS

Healthcare, transport and logistics, manufacturing, large venues, municipalities, and utility sectors will be major spenders in private LTE and 5G networks from 2020 to 2025, according to ABI Research. With the arrival of Citizens Broadband Radio Service (CBRS), enterprises and other organizations have a readily accessible means of deploying private LTE/5G networks.

Unlike traditional cellular spectrum, CBRS is not owned by mobile operators but, rather can be accessed on a localized basis, enabling enterprises and a new wave of managed service providers (MSPs) to deploy private networks to address business and mission-critical use cases that are unaddressed or poorly addressed by alternative connectivity methods. Dozens of devices already support CBRS capability and handsets are in the pipeline.

SPECTRUM

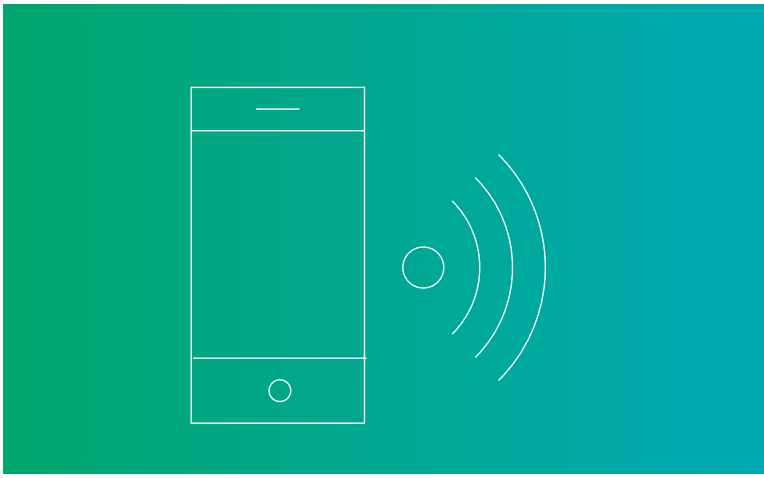
CBRS provides 150 MHz (3550 to 3700 MHz) of spectrum and offers the ability for organizations to acquire spectrum when needed, in a local area at nominal cost, making enterprise-owned private cellular networks possible.

Private network solutions such as the RUCKUS CBRS portfolio make use of the dedicated spectrum to allow enterprises to build a local, private LTE network in-building or outdoors. These private LTE networks enable cellular-like reliability, mobility, security and quality of service but are managed like Wi-Fi networks. The CBRS Alliance, in coordination with the U.S. FCC, has released specifications to expand CBRS spectrum allocation to 5G.

CBRS COMMERCIAL DEPLOYMENTS AND PORTFOLIO

In 2019, the US Federal Communication Commission certified CommScope's spectrum access system (SAS) to support CBRS for initial commercial deployment. CommScope's Environmental Sensing Capability (ESC) sensor also passed the Institute for Telecommunication Sciences' testing.

While CBRS opens the 3.5 GHz band to wireless networks, neutral hosts, broadband providers and other networks, all operators



need to access a SAS to tap into this new spectrum. SAS allows efficient frequency sharing, interference reduction and the prioritization of the traffic from incumbent users, such as government radar installations.

With the addition of RUCKUS CBRS-band LTE APs and associated cloud services, CommScope's end-to-end solution consisting of SAS and ESC gives organizations the ability to deploy LTE-based wireless solutions quickly and confidently.

Ruckus Networks was a founding member of the CBRS Alliance and CommScope RUCKUS has offered the industry's first FCC-certified CBRS-band LTE APs. RUCKUS equipment has been deployed across a wide variety of enterprise verticals.

CommScope is not just a developer of CBRS technology; we are also a user of it. At a manufacturing facility in the US, CBRS devices managed by the CommScope SAS provide high-bandwidth, low-latency connections to remote video equipment monitoring the facility while select IoT devices are also connected to the private LTE network.

SIGNATURE SHOWCASE:

COMMSCOPE/RUCKUS DEMONSTRATES CBRS FOR PRIVATE LTE

In 2019, CommScope demonstrated the RUCKUS Citizens Broadband Radio Service (CBRS) portfolio and Attabotics' 3D robotic supply chain automation system as part of Microsoft Azure capabilities for private LTE networks. The demo also highlighted how IoT applications can take advantage of the security, latency and bitrates provided.

Integration of the RUCKUS portfolio with Microsoft Azure's networking and edge connectivity solutions paves the way for dedicated, secure, ultra-high-quality private LTE networks that feature end-to-end encryption.

Ruckus Networks also showcased a CBRS-based private LTE network in partnership with Amazon Web Services, Athonet, and Federated Wireless in late 2018. The CBRS networks enabled the rapid deployment of industrial IoT applications, such as real-time surveillance devices, smart meters, and worker safety monitoring.

More than 120 programmable Amazon DeepLens video cameras were configured and set up in a matter of hours. DeepLens runs deep learning analyses locally on the camera to take action on what it sees.

The FCC-certified RUCKUS Q710 3.5 GHz indoor APs enabled access to CBRS shared spectrum for private 4G and 5G applications with Athonet BubbleCloud as a mobile core. The network delivered a plug-and-play experience that made it easy to connect, monitor and manage IoT assets at scale.

Typically, network congestion can be an issue with many devices trying to share the wireless bandwidth simultaneously. However, the LTE network was able to do this seamlessly with no performance impact.

Such demos inspire possibilities of other applications using DeepLens and similar devices leveraging AWS applications running locally and in the cloud.

CHAPTER 7

SECURE DEVICE ACCESS AND CLOUD-MANAGED NETWORKING

Enterprises are developing intuitive self-service workflows with streamlined network onboarding so bring-your-own-device (BYOD) users, guests and IT-issued devices can gain network access simply and securely without IT intervention.

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The global BYOD market is expected to register a compound annual growth rate of over 15% between 2019 and 2025, with the trend most pervasive in North America. BYOD adoption is being driven by increasing use of mobile devices in everyday life to access information anywhere and everywhere, be it work related or personal information. Other related factors include work-from-home culture; and government Smart City initiatives.

Moreover, failure to secure network access is a risk that many organizations cannot ignore. Aligned with simple ways to improve security related to wired and wireless access, the CommScope RUCKUS portfolio of solutions bolsters data security with increased visibility and control over devices and users allowed on the network.

SECURE ONBOARDING

Expectations of enterprise end-users, especially for self-service, have been shaped by their experience as consumers. Users are familiar with the common set-it-and-forget-it experience of activating a new cell phone at the carrier retail outlet or connecting to a home Wi-Fi network.

But in the enterprise environment, IT organizations typically rely on cumbersome methods for device onboarding and authentication, like MAC authentication and conventional pre-shared keys (PSKs) that are built into their networking infrastructure.

A better fit for onboarding is self-service with the right mechanism in place so that it is easy and intuitive for users. This calls for a purpose-built system for secure network access where users only have to go through the onboarding process once without IT intervention.

CLOUDPATH ENROLLMENT SYSTEM

RUCKUS Cloudpath Enrollment System software streamlines network onboarding for BYOD users, guests and IT-owned devices. It enables IT teams to define and manage policies for role-based access; delivers visibility and granular control over what devices users can access on the network; and reduces help desk tickets related to network access.

Cloudpath secures every connection with WPA2-Enterprise, protecting data in transit between the device and the AP with encryption. Internal users can self-provision any device for network access using their existing login credentials. A digital certificate for network authentication ensures that after the initial connection, users do not need to hassle with Wi-Fi passwords.

Guest users access a self-service login portal and receive credentials for internet access via email or SMS. Be it cloud-based or virtualized on-premises deployment, the solution supports any user, device, and network infrastructure.

IOT ENDPOINT ONBOARDING

Secure device onboarding is also a challenge for organizations seeking to deploy IoT solutions in the face of a fragmented ecosystem of standards, devices and services. Common IoT access addresses these issues by consolidating multiple physical-layer networks into a single converged network.

This common network establishes uniform security protocols and converges IoT endpoint management and policy setting. The RUCKUS IoT Suite simplifies the creation of such an access network through the reuse of LAN and WLAN infrastructure, thus shortening deployment duration and reducing cost to support multiple IoT solutions.

This concept has been applied in various verticals such as manufacturing, hospitality, healthcare and education. In hotels, an increasing number of wireless devices and systems for both guests and staff connect to Wi-Fi as well as other forms of wireless protocols such as Zigbee, LoRa or BLE. Unifying these wireless protocols within a single AP enables hotels to save physical space and streamline secure device on-boarding.

RUCKUS CLOUD

The CommScope RUCKUS Cloud converged network management-as-a-service platform enables IT departments to provision, monitor, optimize and troubleshoot an enterprise-grade Wi-Fi and switching network via a single web dashboard or mobile app.

Using advanced artificial intelligence (AI) and patented machine learning techniques, RUCKUS Cloud gives IT the troubleshooting tools to react quickly to service-affecting issues and to stop network anomalies from rising to the service-affecting level. It even classifies issues by severity, so IT knows where to focus first.

SUCCESS STORY: DEL MAR COLLEGE, TEXAS, USA

CLOUD-MANAGED NETWORKING ELEVATES LEARNING EXPERIENCE

Del Mar College (DMC), located in Corpus Christi, Texas, has been at the leading edge of digital learning with its innovative education programs and models, including its nationally recognized nursing program's clinical simulation lab.

However, the community college's existing Wi-Fi network was lagging in performance. Students had difficulty finding an adequately consistent Wi-Fi signal to complete assignments. They could not register multiple mobile devices on the campus network. Neither could the Wi-Fi network support bandwidth-intensive applications such as the live-streamed video-based instruction used by the nursing program. The CIO mandated a modernization of the Wi-Fi infrastructure to address these challenges and to reduce infrastructure and management costs.

SOLUTION

DMC's IT team deployed RUCKUS APs that could each support up to 100 concurrent users. This translated to far fewer APs per classroom and building and lower associated costs like cabling and electrical.

The RUCKUS Cloud service simplified management of DMC's Wi-Fi network covering 45 buildings and 25,000 users across two campuses; new buildings under construction then; and two off-campus centers.

BENEFITS

The superior performance and coverage of the RUCKUS APs delivers high-quality Wi-Fi to students, faculty and visitors. At the clinical simulation lab, complaints about connectivity, download speeds, or stability became a thing of the past.

The network also promoted the BYOD trend, allowing students to access the Wi-Fi network using multiple devices, and faculty to experiment with new teaching models.

SUCCESS STORY: DEL MAR COLLEGE, TEXAS, USA

The IT team began spending less time on monitoring and troubleshooting; just two network specialists manage the rapidly growing Wi-Fi network. In the nursing program, the network supports more patient stations equipped with cameras and audio systems while faculty can send video to any classroom in the building.

In line with IT's initiative to move strategic applications such as learning management and ERP systems to the cloud, the RUCKUS Cloud platform easily extended the cloud-managed network to distributed locations.

Unlike the high manual overhead with the old network, RUCKUS APs handle high-density environments with ease while cloud-managed Wi-Fi makes it easy to set up guest networks. At the DMC's off-campus Center for Economic Development, which is available for rent to community and business organizations for large meetings, just two RUCKUS APs are needed to serve the Wi-Fi needs of up to 250 people. A new SSID can be assigned for each event within a minute through the RUCKUS Cloud dashboard from a mobile app.

CHAPTER 8

PHYSICAL-LAYER DATA SECURITY REDUCES THREAT OF UNAUTHORIZED ACCESS

In today's hyper-connected smart buildings, every network connection is a path into a corporate or mission-critical network. At the same time, the size of the attack surface when it comes to insider threats varies directly with the number of people who have access to the data being protected.

PHYSICAL-LAYER SECURITY

The cost of a data breach in the enterprise network goes beyond financial damage; it can take years for a business to regain trust and rebuild its reputation. It is estimated that 60% of data security breaches were carried out by insiders with either malicious or inadvertent intent. The physical layer infrastructure is clearly a critical a part of any data security plan against internal and external threats.

In industries such as healthcare and finance, the issue of network security has spawned regulations and compliance requirements regarding data storage. Network infrastructure security concerns generally fall into two categories:

- Unauthorized access by an unauthorized person can be reduced or prevented through the deployment of IP-connected cameras, occupancy sensors, access controls and other connected elements of physical security. Physical cabling security such as keyed connectors, secure patch cords and port blockers can be deployed to reduce the threat of unauthorized access. Similarly, AIM solutions can record and report activity on the physical layer.
- Unauthorized access by an authorized person can be more difficult to detect and repel. Given the depth and complexity of the enterprise network, an AIM system enables network managers to monitor and manage network connections from the inside. Using intelligent cabling, connectors and patch panels, it automatically detects and maps all physical layer activity at the port and device level, in real time. If an authorized user connects or disconnects a device, an AIM solution like CommScope's imVision automatically alerts IT personnel.

SECURITY MONITORING AND POWERED FIBER/ POE CABLING

Networks of IP security cameras and occupancy sensors commonly installed in intelligent buildings are helping to spot unauthorized intruders. With the right cabling infrastructure, these PoE internal security monitors can be distributed throughout the building or campus.

While an AIM system can locate a would-be hacker, cameras provide corroborating visual proof. Low-voltage powered-fiber or PoE network supports these connected sensors, cameras and controllers. If the main power fails, the AIM system and all connected security devices continue to function because they draw their power from the switches, which are typically backed up by UPS batteries and generators. This power structure is inherently more resilient and secure.

GLOBAL SUCCESS STORIES

CONSTANT MONITORING AND ALERTS MAKE A TRULY SECURE NETWORK

Establishing a secure network infrastructure and reliable connectivity performance is a key priority across all industry sectors. Examples include resilient connectivity for a stock exchange's critical infrastructure systems, and secure and reliable networks for research efficiency at major research establishments.

Intelligent infrastructure management is needed to provide systems managers a real-time view of the network physical layer, speed up troubleshooting, and improve security while reducing network downtime and making maintenance more cost effective.

SOLUTION

CommScope, a leading supplier of structured cabling, has helped IT organizations to meet these requirements with its SYSTIMAX iPatch system, consisting of the System Manager software, iPatch Manager, and iPatch intelligent copper and fiber panels.

For physical security and video surveillance, the infrastructure connects CCTV and access control systems while SYSTIMAX cabling connects servers with a storage area network within the data center.

Additionally, the SYSTIMAX 360 solutions-based network infrastructure connects data systems and supports extra-low-voltage systems, including building management, security, voice-over-IP and lighting control. These critical applications depend on copper and fiber cabling with high performance and reliability. CommScope's installations are backed by a global support network and industry-leading 20-year guarantees.

BENEFITS

These solutions provide IT administrators with real-time visibility and control of the physical layer. Copper and fiber connections

in the installations are managed using iPatch panels that allow monitoring of network connections and attached devices.

The iPatch software also alerts administrators immediately of any changes by detecting and locating unauthorized APs while the System Manager software helps to document and monitor the infrastructure through a standard web browser.

IMVISION AIM PLATFORM

Beyond the iPatch System, CommScope's imVision AIM solution drives actionable insights as well as real-time intelligence and visibility into events that impact the network's physical layer and the devices connected to it.

An AIM solution uses intelligent cabling, connectors and patch panels to monitor the connected environment in real time. Should it detect an unauthorized or authorized device attempting to access unauthorized information, the system issues an immediate alert.

The System Manager tracks all devices, even those operating wirelessly, as they move about a network. The software also integrates with PoE devices, verifying that power is available to a connection. Further, the iPatch intelligent panels initiate real-time alerts whenever they detect unexpected changes to the network.

Deploying PoE and powered-fiber technology using Category 6A cabling also increases the resilience in security systems such as IP security cameras and AIM-based intelligence.

CONCLUSION

Communications networks are more complex than ever before. CommScope, now including the Ruckus Networks and ARRIS portfolios, is well positioned to help digitally transformed organizations seize opportunities and take advantage of long-term growth trends, including network convergence, fiber and mobility everywhere, 5G, IoT and rapidly changing network and technology architectures.

The technology breakthroughs and customer stories presented in this e-book have highlighted how new customer initiatives push boundaries and drive immediate innovation in the core, access layer, and edge of their network.

COMMSCOPE

CommScope pushes the boundaries of communications technology with game-changing ideas and ground-breaking discoveries that spark profound human achievement. We collaborate with our customers and partners to design, create and build the world's most advanced networks. It is our passion and commitment to identify the next opportunity and realize a better tomorrow.

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