SMART BUILDING CONNECTIVITY

SHAPING THE ALWAYS-ON BUSINESSES OF TOMORROW

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Photo: Robert Agua, Telikom

WELCOME TO A SMARTER, MORE EFFICIENT ENTERPRISE

Intelligent buildings bear that label for more than one reason. On a literal level, the networked connectivity between a building's systems make it possible for the enterprise within to automatically regulate security, environmental conditions, lighting, communications and other factors—helping maintain a welcoming atmosphere conducive to the work performed there. These networks of systems have become more critical to the efficiency, effectiveness and economy of an enterprise's operations.

Using a broader definition, intelligent buildings are also an effective means for an enterprise to increase efficiency, reduce costs and streamline operations. This is a "smart" approach to reducing operational expenses and facilitating a flexible growth model. So, what powers the connectivity of an intelligent building in the early 21st century? It is an integrated communications infrastructure that supports wired and wireless networks and applications.

CommScope has long been a leader in these enterprise communication infrastructure all over the world, and, in the process of developing and receiving feedback, we see three consistent needs emerging as enterprises embrace the efficiencies of intelligent buildings:

1. The need for mobile connectivity within the enterprise, as fewer employees are bound to desks but need ubiquitous wireless coverage
2. The need to lay a future-ready infrastructure foundation for the still-evolving, ever-growing internet of things (IoT)
3. The need to converge many disparate or proprietary networks onto a single, unified IP over Ethernet physical network layer

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CommScope has created this updated volume of information and recommendations to help our customers address these three needs—and others—by building on the bedrock of decades of experience and successful deployments in more than 100 countries.

Each chapter includes specific recommendations you can put to work in your enterprise network to create a more intelligent, more efficient building that better serves the needs of your growing business.

CHAPTER

1 The internet of things

CHANGING HOW WE WORK, TRAVEL AND LIVE

The internet of things (IoT) is expanding so quickly it's hard to stay current on its latest applications. There seems to be no limit to the ways connected devices and services help us all operate more efficiently and effectively.

Soon, any discussion of intelligent buildings will include the internet of things. With 8.4 billion devices online today and another 17 billion devices expected by 2020[1], the impact of the IoT is already being felt in our daily lives at home, in the office and on the road.

While the largest percentage of IoT devices is expected to be deployed in factories, smart cities and, eventually, autonomous vehicles, IoT devices will also play a significant role in commercial buildings. Devices that enable applications such as LED lighting, space utilization, HVAC, IP security/access control systems, along with traditional IT equipment are already being deployed in commercial buildings to improve operational efficiency.

What is…
the internet of things (IoT)?

It's an ecosystem of networked electronic devices—from home appliances to commercial sensor networks to autonomous vehicles—that rely on connectivity to share and receive information.

THE IOT IS HELPING DRIVE THE CONVERGENCE OF TRADITIONAL FACILITY AND IT INFRASTRUCTURES

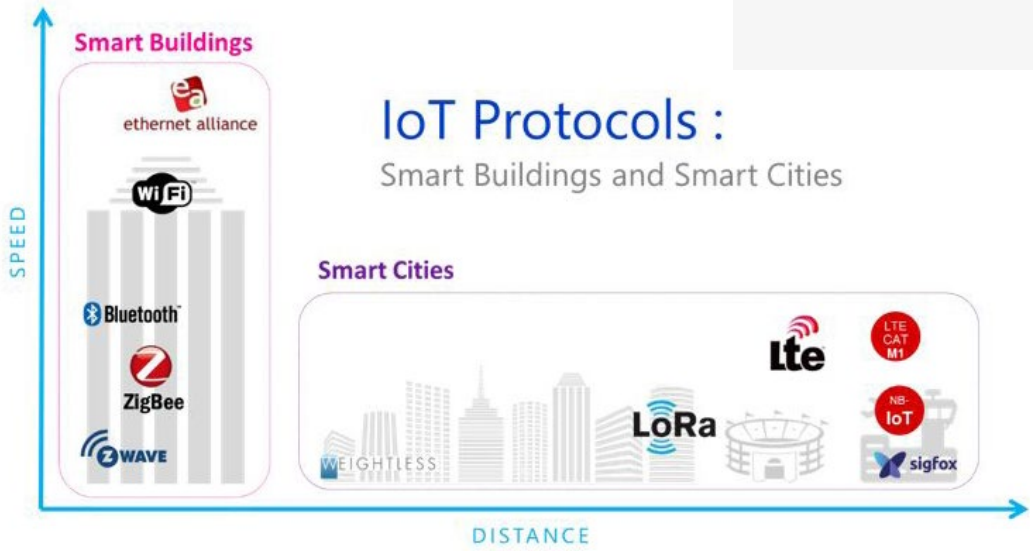
Today, only a small fraction of the devices in buildings are actually connected to the network. To fully realize the potential of the IoT, the challenge is to connect these standalone devices via Ethernet, cellular, Bluetooth® Low Energy, Zigbee®, Wi-Fi or other protocols, depending on the application and the device. Doing so leverages the main benefit of the IoT, which is its ability to collect data, process it, and analyze it to drive more informed, intelligent decisions.

According to McKinsey, the impact and value of the IoT is expected to exceed $11 trillion annually by 2025[2]; connectivity is absolutely essential to ensuring this value can be achieved.

As illustrated, there are vast applications being developed for the IoT today. While it is clear that no single protocol will be used for all applications, there are some that are more likely to be deployed in smart city applications, where low power rate, low data rate, and long-distance support are required. Similarly, there will be other protocols that will be more prevalent in smart buildings that do not have extended distance coverage requirements.

Wireless connectivity will be prevalent, but a robust wired backbone will still be needed to ensure that backhaul transmission can be supported.

Throughout this book, we will explore the means of providing this connectivity. For example, in the next chapter, we will discuss how the deployment of a universal connectivity grid (UCG) can be used to support wireless protocols that exchange limited range for improved battery life in low-power remote sensors.



The majority of IoT applications are expected to arise in smart cities, factories and transportation systems, with enterprise and commercial spaces representing a large part.

1 Gartner Says 8.4 Billion Connected "Things" Will Be in Use in 2017, Up 31 Percent From 2016, Gartner 2017

2 The Internet of Things: Mapping the Value Beyond the Hype, McKinsey 2015

The IoT in the enterprise and commercial space

The greatest IoT benefit for enterprises is in the increased efficiency of their security, fire detection, lighting, HVAC, elevators and other connected systems.

The largest enterprise segments to see these benefits are office space, retail, healthcare, worksites and industrial spaces.

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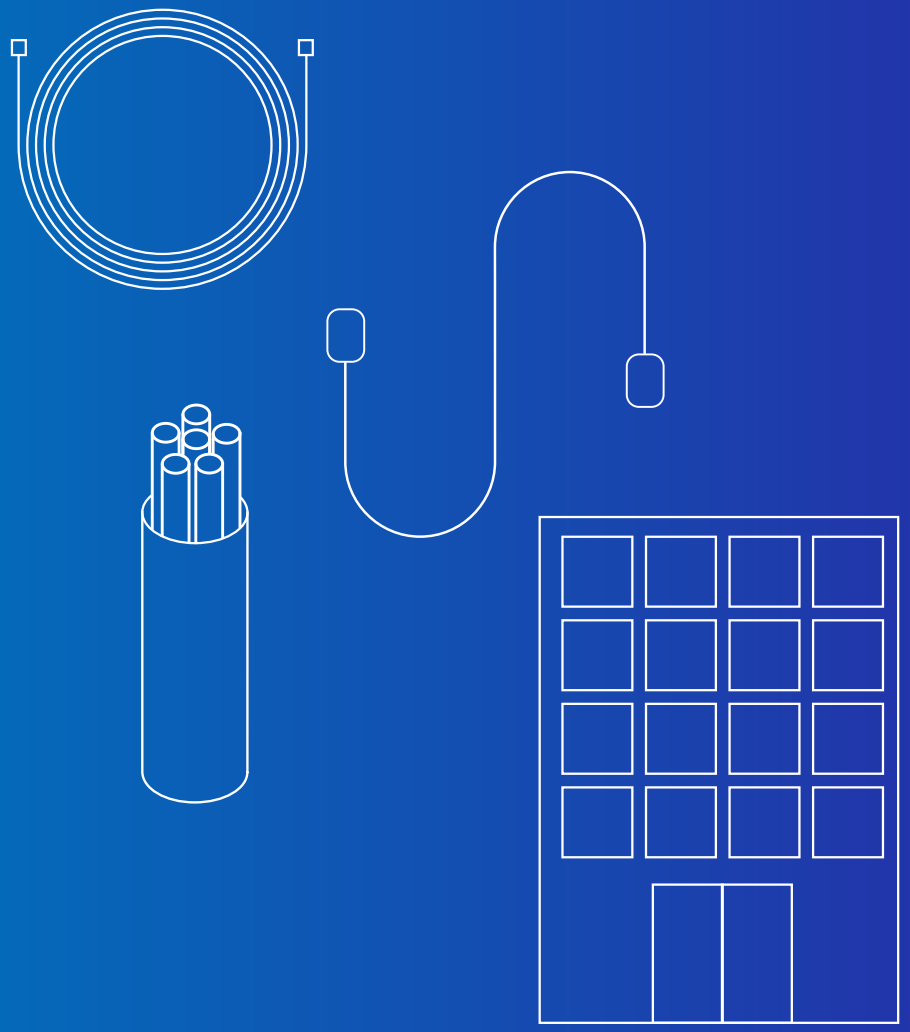
CHAPTER

2 Converged infrastructure

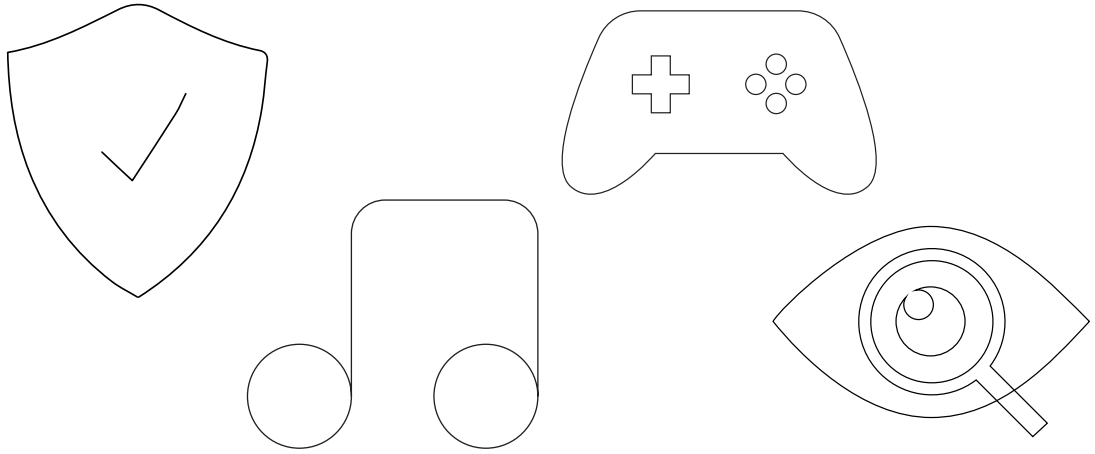


THE CONVERGENCE OF PROGRESS BLURS THE DISTINCTIONS

Networking applications and technologies—like 2.5G/5G/10G Ethernet, Power over Ethernet (PoE), and HDBaseT—are continuously evolving. Yet, their evolution is bringing them all closer to a single converged infrastructure.

As this convergence becomes more pronounced, new opportunities emerge to integrate real estate, IT and building management and facilities applications into a single, simplified network infrastructure running on twisted-pair copper cabling—Ethernet cabling. Today, it can support such diverse applications as:

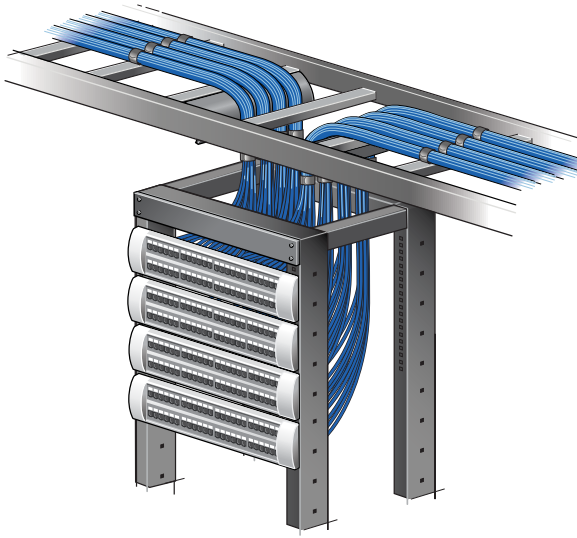
- Wi-Fi networks
- In-building wireless (IBW) solutions
- Intelligent LED lighting and sensor networks
- Audio/visual systems
- Security and access control
- Building automation
- Sound masking audio systems



What is… converged infrastructure?

It's a unified system of cabling capable of supporting many diverse applications and devices, with future-ready flexibility to support emerging wired and wireless applications as well.

THE ADVANTAGES: IMPROVED COST, RELIABILITY AND AGILITY



From an operational standpoint, this integration is a highly preferable alternative to maintaining a collection of discrete wired and wireless topologies, each requiring its own materials, expertise and management. Alignment to a single, intelligent network infrastructure that can manage all on-site traffic in the enterprise can reduce installation costs by as much as 50 percent, and reduce operational expenses over the long term.

Reducing the number of separate networks helps ensure greater reliability and availability. Since the framework is flexible and adaptive, it's simple and economical to change or expand the systems it supports as changing business needs dictate, while maintaining maximum uptime.

Convergence of technologies onto a converged infrastructure of twisted-pair copper is a solution to many of our world's most pressing business challenges. Fast-changing enterprise environments depend on these three advantages—cost, reliability and agility—to run efficiently and competitively.

Additional resources:

White paper: Fiber backbone cabling in buildings

IMPLEMENTATION RECOMMENDATIONS

Twisted-pair cabling provides a flexible foundation for all kinds of enterprise building systems. Category 6A cabling is at the forefront of these capabilities, boasting the bandwidth and speed for future applications as well. Here's how to make converged infrastructure even more economical and powerful in your enterprise:

Know your convergent systems

Recent advances have added more applications to the network. All these and more can run on converged infrastructure:

- Voice and data services
- In-building wireless solutions for cellular service
- Access control—both physical and network
- Security monitoring and surveillance
- Building environmental control automation
- LED lights, occupancy and environmental sensors

Horizontal and backbone cabling

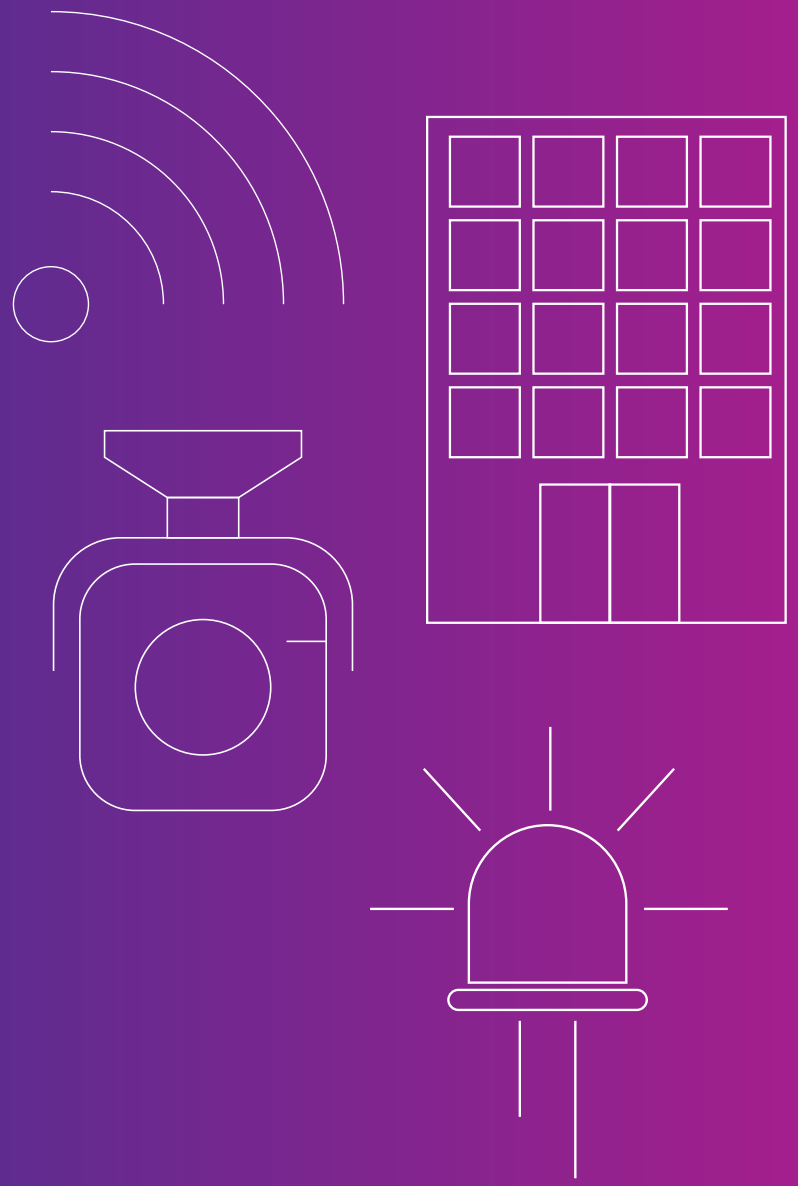
A converged infrastructure needs sufficient capacity to move data from diverse systems. It also needs the bandwidth to support future applications and their higher requirements. To ensure your network is ready, horizontal cabling (e.g., covering a particular floor) should be Category 6A. Backbone cabling (linking horizontal segments to the main server) should be OM4, OM5 or OS2 fiber-optic cable. The choice will depend on the distance.

Follow the standards

Converged infrastructure doesn't mean all its connected services and devices share common standards. Since application standards typically drive cabling standards, it's critical to observe the relevant standards of those applications you expect to run. ISO, TIA and IEEE publish these application standards—you will learn more about these in Chapter 11.

CHAPTER

3 Universal connectivity grid



CONNECTING FLOOR TO CEILING AND END TO END

The modern workplace is changing. It's more dynamic and connected than ever. In an enterprise space, there are big advantages to deploying a converged infrastructure to support real estate, facilities and IT services in a single architecture, as we explored in Chapter 2. Ensuring this architecture reaches every user and device—even when they're on the move—is what the universal connectivity grid (UCG) approach is all about.

Driven by new applications in wired and wireless technology, the workstation-centric model is giving way to a distributed device-centric model. The most efficient way to ensure ubiquitous connectivity is to locate access points in or near the ceiling, where they can easily reach a DAS antenna, a user's workstation, a security camera or a building's HVAC equipment. The UCG zone cabling architecture provides a uniform yet agile way to ensure structured cabling is always where it needs to be, without expensive and troublesome modifications. With UCG, an enterprise can integrate any number of wired and wireless technologies, like:

- Wi-Fi, DAS or small cell networks
- Security cameras and access control systems
- LED lighting, HVAC control and occupancy sensors
- Digital displays, phone stations or other PoE devices

What is… the universal connectivity grid (UCG)?

UCG is an approach to deploying cable infrastructure in the enterprise that provides maximum flexibility and scalability over the long term.

Zone cabling relies on a hierarchy of infrastructure to connect the telecommunications room (TR) to each zone's consolidation point (CP), which acts as an intermediary between the core network and the telecommunications outlet (TO).

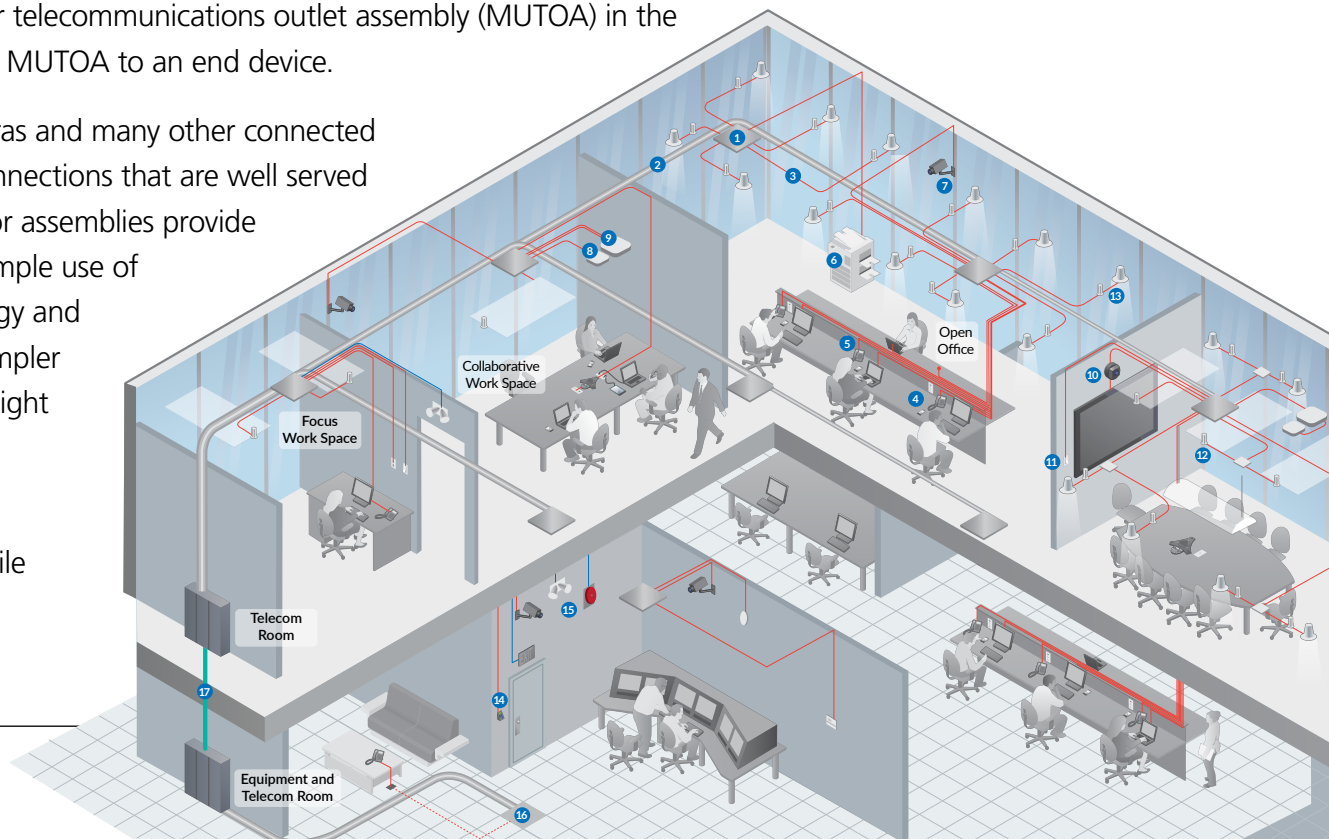
THE FREEDOM TO MOVE, ADD AND CHANGE

In an enterprise space, the infrastructure for communications networks consists of two basic segments: the backbone (also known as the vertical, or riser) and the horizontal. The backbone connects telecommunications rooms (TRs) to a centrally located equipment room (ER). Backbone media is typically OM3, OM4 or OM5 multimode or singlemode fiber-optic cable to support high-bandwidth applications, although copper cabling may also be deployed for low-bandwidth applications.

The horizontal section of the network includes the connection between a patch panel in the TR or ER and a telecommunications outlet (TO) or multi-user telecommunications outlet assembly (MUTOA) in the work area, and the connection between the TO or MUTOA to an end device.

Wi-Fi, in-building wireless solutions, security cameras and many other connected devices and services are examples of horizontal connections that are well served by ceiling-based drops. The UCG's ceiling connector assemblies provide a flexible way to connect these devices with the simple use of insulation-displacement connection (IDC) technology and factory-terminated patch cords, making it much simpler and quicker than performing field terminations in tight spaces such as those found above a drop ceiling.

Because of this architecture, modifications can be made without extensive material or labor costs while minimizing productivity-reducing disruptions.



IMPLEMENTATION RECOMMENDATIONS

To ensure the UCG provides both connectivity and efficiency, consider several important design and deployment guidelines.

Maximum cell size

- TIA-162-A grid recommendations specify square cells no larger than 60 feet by 50 feet (18.3 meters by 18.3 meters).
- ISO/IEC TR 24704 provides similar dimensions for hexagonal cells, specifying a radius of 40 feet (12 meters) or less.

Spacing and connection counts

- Cells should be evenly spaced to support easy deployment of connected devices.
- The number of cable drops in each cell depends on the applications supported and the size of the cell.

Applications	Ports per endpoint	Notes/additional considerations	Ports per cell
Workstation	Two ports per desk	Assumes 36 workstations per 60-foot x 60-foot cell	72 ports
Wi-Fi	Two ports per WAP	Plan for two access points per cell to accommodate future capacity increases	Four ports
In-building wireless	Two ports per AP	Plan one spare port to accommodate future needs	Two ports
Paging and sound masking	One to four ports per system	System architectures vary. Reference manufacturer's requirements	One to four ports
Low-voltage lighting with integrated occupancy sensors	One port per fixture and wall switch	Assumes 9.5-foot ceiling height with connections for wall switches or sensors in common areas	40-48 ports
Occupancy sensors	One port per sensor	Plan one sensor per desk, with additional sensors in hallways and other common areas spaced roughly 10 feet to 15 feet apart	36-48 ports

Additional resources:

Design guide: CommScope universal connectivity grid

Brochure: CommScope universal connectivity grid

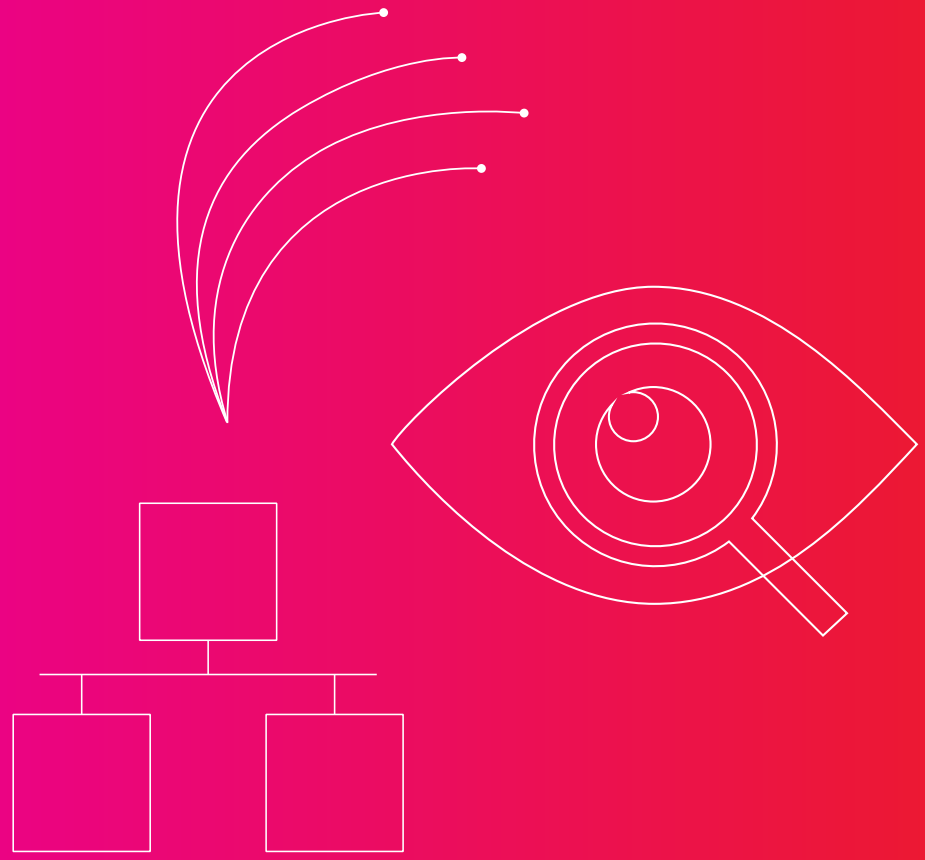
CABLING CHOICE

While several kinds of cable may support current applications and demand, Category 6A cable is recommended to ensure ongoing support for the applications specified in the following cabling standards:

Application	Standards	
	TIA	ISO/IEC
Intelligent Buildings	TIA 862-B	ISO 11801-6
WiFi	TIA TSB-162	ISO TR 24704
2.5G/ 5GBASE-T	TIA TSB-5021	ISO 11801-9904
Power over Ethernet	TIA TSB-184-A	ISO 14763-2
Healthcare	TIA 1179	
Data Centers	TIA 942-A	ISO 11801-5
Education	TIA 4966	

CHAPTER

4 Automated infrastructure management



AUTOMATING FOR EFFICIENCY

The emergence of intelligent building systems means more devices and applications are integrated within the same enterprise network.

Automated infrastructure management (AIM) is a combined hardware/software solution that manages and enhances operational efficiency for each system it touches.

KEEPING TRACK OF EVERY MOVE, CHANGE AND ALERT

AIM systems are particularly useful in keeping track of what's going on across the environment. AIM monitors and records changes to device connections and automatically generates alarms to alert staff to any unauthorized or problematic events—usually by sending an email or text message to the appropriate personnel.

ANSWERING THE HELP DESK CALL

AIM is vital in "help desk" applications that handle user incidents:

- AIM tracks the request process cycle from the opening of a trouble ticket to its resolution
- It also provides critical physical connectivity information to assist in troubleshooting

CONTROLLING CAPITAL EXPENSES

In addition to reducing operational expenses (OpEx), deferring capital expenditures (CapEx) for as long as possible is a top priority for every enterprise. Because AIM identifies and tracks the physical location of each networked device, it can also reveal underutilized resources that may have otherwise been missed—preventing unnecessary investment in additional resources.

What is…

automated infrastructure management (AIM)?

An integrated hardware and software system that automatically detects the insertion or removal of cords. It also documents the cabling infrastructure, including connected equipment—enabling infrastructure management and data exchange with other systems.

AIM AND POWER OVER ETHERNET (REMOTE POWERING)

AIM can help with assignment of circuits to reduce heat generation and improve heat dissipation

- Cables should be linked to bundles to facilitate accurate record keeping of remote powering installation configurations
- The intent is to keep track of the heat generation within a cable bundle and avoid over heating of any cables in the bundle
- AIM systems can track cable bundle sizes and total power carried by each bundle to optimize assignment of circuits for remote power delivery
- Automatically tracks cable bundles and issues alerts when numbers of cables exceed threshold
- Automatically detects and tracks maximum power source connected to each cable

Additional resources:

imVision® introduces Power Over Ethernet (PoE) features

Standards:
ISO/IEC AIM document (18598)

Standards:
TIA 606-B standard

Standards:
ISO/IEC 14763-2

IMPLEMENTATION RECOMMENDATIONS

The realization of AIM benefits depends on understanding the systems to be managed. To ensure proper implementation, it is necessary to work with an AIM-accredited partner who follows these practices:

Design and specification

Define the business, operational and system requirements:

- List of features to be enabled
- Naming conventions
- Define system backup and failover mechanisms
- Reports to be configured
- Requirements for integration with external applications (if any)
- AIM hardware configuration, including recommendation for using cross-connect topology

Installation

- Configure AIM software with customer-specific information
- Activate AIM hardware by powering and synchronizing it with AIM software
- Implement patch connections after activation of AIM hardware
- Conduct user acceptance tests

Operation

The AIM system shall be configured, tested and operational on the day the customer takes ownership.

- Identify user groups and provide training based on each user role
- Integrate AIM system into the existing operational workflow
- Get an official sign-off form that acknowledges system's handover to the customer

CHAPTER

5 Power over Ethernet

THE TECHNOLOGY POWERING THE CONNECTIVITY REVOLUTION

The proliferation of IP-connected network devices in modern enterprises has not only driven the need for faster data rates, but also increased power draws.

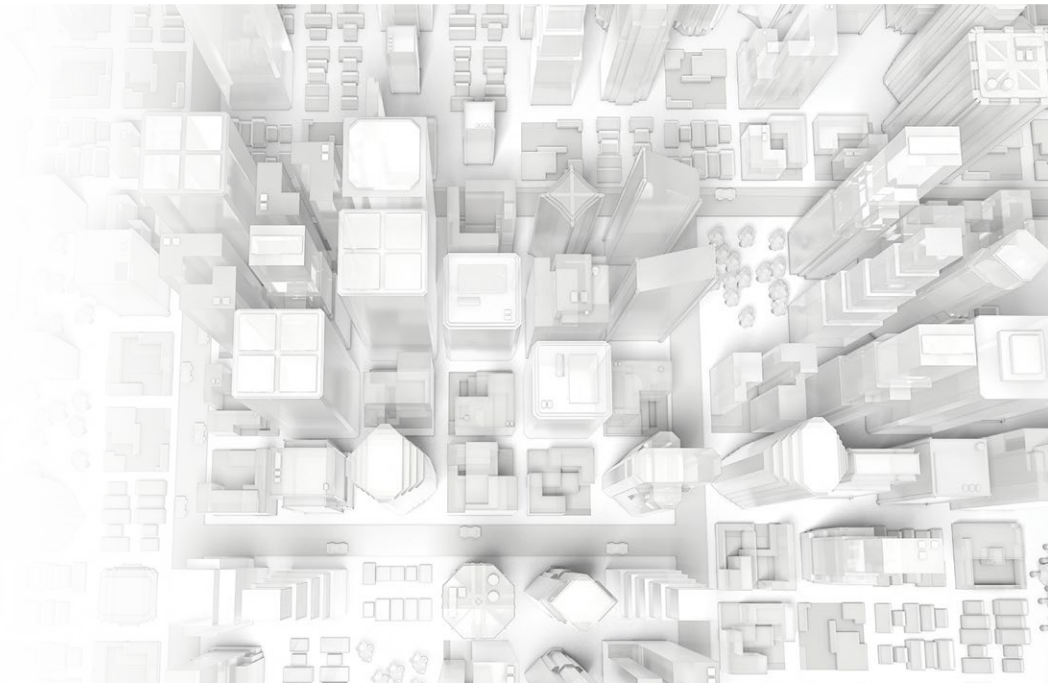
Power over Ethernet (PoE) is the technology that allows these devices to share data and power connectivity over a single copper Ethernet cable, streamlining infrastructure and simplifying operations.

In one form or another, PoE has been present in the enterprise space since 1999, but it has also continued to evolve. There is a race going on—a race between new, higher-wattage PoE devices and the PoE standards capable of supporting them. These devices include common enterprise fixtures such as desktop telephones, security cameras, video monitors and wireless access points for Wi-Fi or in-building wireless services, among others.

What is...

Power over Ethernet (PoE)?

PoE is the technology that enables both Ethernet data and low-voltage dc power connectivity for IP-connected devices on a network.



GREATER POWER, GREATER POSSIBILITIES

The evolution of PoE technology mirrors the evolution of the devices it can support—from its precursor standard powering devices such as telephones, to the first PoE standard in 2003, to the latest IEEE 802.3bt standard that supplies at least 71 watts over structured cabling. It is not uncommon for the introduction of various connected devices to predate the standards.

The symbiotic evolution of PoE capacities and IP-connected devices in enterprise networks

FOUR-PAIR POE OFFERS MORE PERFORMANCE AND FLEXIBILITY

The latest standard increases PoE capacity without compromising data bandwidth. The IEEE 802.3bt standard supports legacy 10 Mbps, 100 Mbps and 1 Gbps as well as 2.5, 5 and 10 Gbps connectivity, utilizing all four pairs to deliver up to 71 watts to the powered device. It also supports power scaling between Ethernet switches and connected devices—even allowing unused devices to remotely power down for increased energy efficiency.

However, given the higher power levels associated with four-pair PoE (4PPoE), specific cabling infrastructure and cable bundles should be managed to ensure adequate heat dissipation. Category 6A cabling is recommended in the relevant cabling standards for remote powering.

IMPLEMENTATION RECOMMENDATIONS

To maximize the vast—and growing—potential of PoE in the enterprise, follow these important practices.

Build for the future

The race between PoE capacity and device demand is not over. Deploy Category 6A cable to provide maximum headroom for future growth and include two cable runs per connected device to economically double the number of zone distributions available in the future. Also consider adopting the universal connectivity grid architecture as described in Chapter 3—particularly for ceiling-based devices.

Thermal loading and bundling

More current means more heat—and that limits the number of cable runs allowed in a single bundle. Based on extensive modeling and measurement work done during the development of CENELEC TR 50174-99-01 and TIA TSB 184-A, the recommended bundle size is 24 cables. For more details, consult the additional resources.

Choose the right management tools

Chapter 4 explored how automated infrastructure management (AIM) offers powerful, intuitive control over network systems like PoE. The right AIM solution can manage how many cables in a particular bundle are powered—providing optimal flexibility, performance and efficiency. It can also provide valuable troubleshooting information, real-time connectivity documentation and other important benefits.

Higher power, more applications supported

Thermal balancing is an important consideration especially in higher-wattage PoE. Bundle size becomes increasingly important.

Category 6 and 6A cables are preferred in part because they offer lower dc resistance and improved heat dissipation over Category 5e.

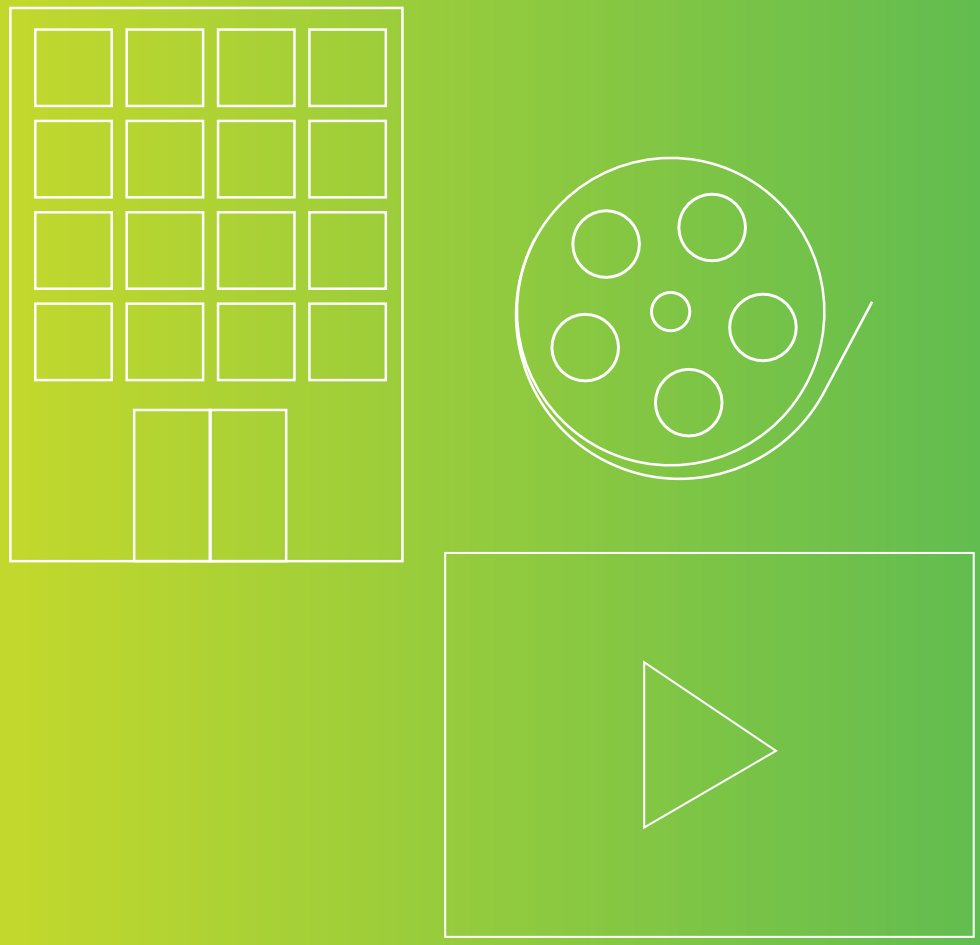
Additional resources:

PoE Implementation Guide

Laying the groundwork for a new level of Power over Ethernet

CHAPTER

6 A/V and HDBaseT



EXTENDING THE REACH OF AUDIO/VISUAL DEVICES

High-definition video screens are becoming more and more commonplace in enterprise and commercial environments.

You see them everywhere: in transportation hubs, retail stores, malls, hotels, conference centers and elsewhere. They're a great way to communicate important information, provide an interactive context, and enhance employee productivity and comfort.

One might assume these screens are getting their signals via HDMI or other ordinary A/V cables like a home screen typically does, but the fact is that reliable HDMI connectivity is limited to just 12 or 15 meters of cable length. HDBaseT, on the other hand, can carry high-definition audio and video over a 100-meter structured cabling channel.

What is…HDBaseT?

It's a point-to-point connection protocol used to distribute high-definition A/V signals, control signals, and power over standard Category 6 or 6A structured cabling through the ubiquitous RJ45 network connector.

A UNIVERSAL INTERFACE

HDBaseT is also gaining popularity for its connection interface. Because it runs on IT infrastructure with the trusted, universal RJ45 connector, HDBaseT doesn't require expensive legacy cables with proprietary connectors, such as HDMI, DVI, VGA, coaxial, RCA or other conventional A/V cables have.

The flexibility and bandwidth available with HDBaseT is the reason it is being standardized by the IEEE under IEEE 1911, which will only accelerate its adoption in the market.

IMPLEMENTATION RECOMMENDATIONS

Flexible and powerful, HDBaseT offers incredible simplicity and functionality for an efficient and connected enterprise or commercial space. Nevertheless, optimizing your HDBaseT solution depends in large part on solution selection and installation practices.

Choose Category 6A

HDBaseT is sensitive to alien crosstalk. While HDBaseT can theoretically run on lesser cabling standards—even Category 5—Category 6A exhibits the alien crosstalk performance specified in TIA and ISO standards.

This means it can support bundling and cable tray installation practices typical in commercial buildings—making it the recommended choice.

Watch the thermal loading

HDBaseT can deliver up to 100 watts by powering all four pairs within the cable.

While this supports connectivity and power over the same cable, it comes with the additional thermal loads described in Chapter 5.

Cable certifications count

For optimal performance, use cables certified by the HDBaseT Alliance.

It's also important to know which vendors support only the use of shielded cabling with their equipment, since that will impact other purchasing decisions.

The single-cable solution

HDBaseT allows one Category 6A cable to support transmission of:

- Uncompressed ultra-HD video and audio, including 4K
- 100BASE-TX Ethernet
- Device control
- Power over HDBaseT (PoH), up to 100 watts of dc power

Additional resources:

HDBaseT homepage

CHAPTER

7 In-building wireless

IN-BUILDING WIRELESS (IBW) SERVES TODAY'S UNIVERSAL CONNECTIVITY EXPECTATIONS

Most cellular calls originate indoors—where the macro network can't effectively reach.

Whether we're looking at employees at work or shoppers on the go, there's no question that there now exists a universal expectation of ubiquitous, always-on cellular coverage, indoors and out, for data and voice alike.

Wi-Fi is part of that picture, of course. But users also need cellular services for voice calling—and for data access when they aren't logged onto the building's Wi-Fi network. Therefore in addition to Wi-Fi, an enterprise space needs to bring the cellular network indoors.

WI-FI AND THE CLOSING WIRELESS GAP

Wi-Fi cabling infrastructure has established guidelines (TIA TSB 162-A and ISO/IEC TR 24704) defining a grid network to place outlets for potential Wi-Fi access points, as shown in Chapter 3. Wi-Fi continues to evolve, with speeds reaching 10 Gbps, along with the advanced cabling and switches needed to support that speed.

These new standards for IT structured cabling, such as Category 6A copper, OM5 multimode and singlemode fiber-optic cable, have also provided an exciting point of convergence for Wi-Fi and IBW (i.e., cellular) solutions in the enterprise.

Many IBW solutions, chiefly among them distributed antenna systems (DAS), were once considered viable only in very large venues. However, new DAS solutions share the same IT

Why include IBW?

It all comes down to the numbers.

- 80 percent of mobile calls terminate indoors
- 2 percent of commercial spaces have an IBW solution
- 75 percent of callers have to hunt for good reception

infrastructure used by Wi-Fi, which many enterprises already have installed. This evolution has flattened the cost and complexity curves to the point where true "IT-convergent" IBW solutions now exist for enterprises.

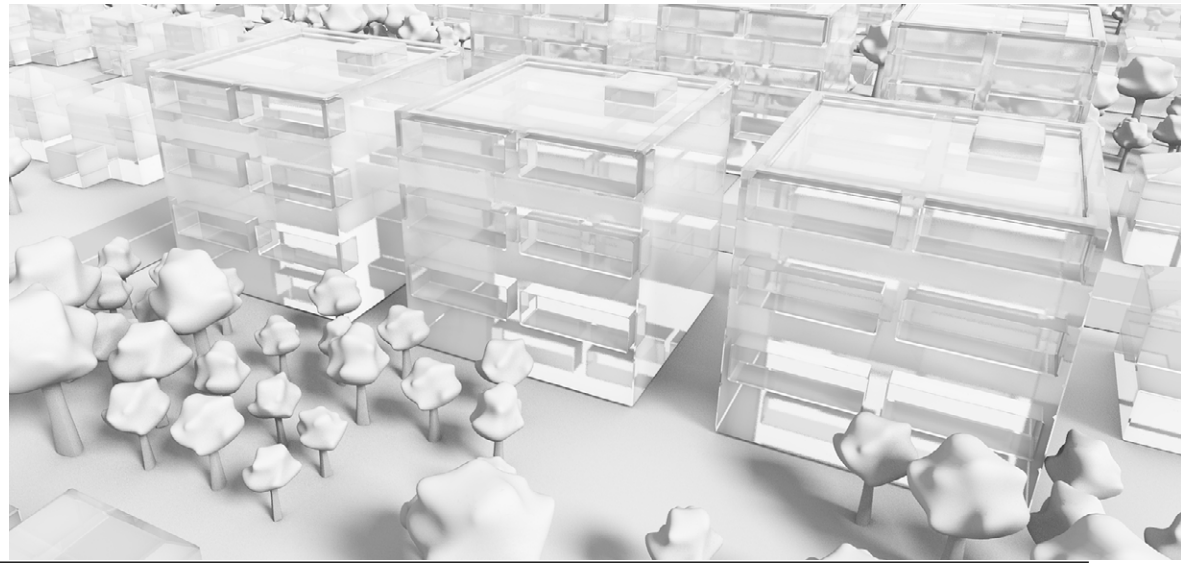
IBW OPTIONS: DAS AND SMALL CELLS

IBW solutions like DAS and small cells are distinct from Wi-Fi in that they operate on licensed frequency bands used by wireless operators in their macro networks.

DAS is a technology- and operator-agnostic solution, which means it can support different cellular signals like 2G, 3G and LTE, and connect indoor callers to any number of wireless operator networks.

Small cells are generally specific to a particular operator. From a coverage perspective, both technologies provide an indoor-generated signal, delivering the same experience to the user as if they were standing outside near a cell tower.

Depending on the circumstance of the environment, a DAS deployment may be handled by the enterprise, by the building owner, the mobile network operator or by a third-party "neutral host" company that specializes in deploying and operating these systems. All these factors make an IBW solution an increasingly attractive proposition for an enterprise. As the newest IT-convergent solutions help reduce costs, the benefits become even more apparent.



What is… an in-building wireless (IBW) solution?

It's the seamless extension of macro wireless networks into indoor space where signals would otherwise struggle to reach.

Additional resources

White paper: DAS and small cells – a view from the leading edge

IMPLEMENTATION RECOMMENDATIONS

While there are multiple ways to deploy IBW solutions in buildings, increasingly the most advanced IBW options are embracing an IT-convergent architecture that allows the solution to share a single, cost-effective infrastructure with Wi-Fi, security cameras, remote sensors, video screens and other IP-connected devices. Here's how to prepare and deploy such solutions:

Plan ahead with UCG

A precabled grid such as the UCG, discussed in Chapter 3, helps simplify wireless deployments, additions and expansions as needs change.

- Define a grid layout based on TIA-162-A or ISO/IEC 24707
- Install two Category 6A cables per cell for Wi-Fi
- Install two additional Category 6A cables per cell; one for IBW plus a spare

Cover all the bases

Consider how many wireless operators you'll need to support. DAS solutions typically integrate with all operators' networks while small cells are typically operator specific, but may be lower cost.

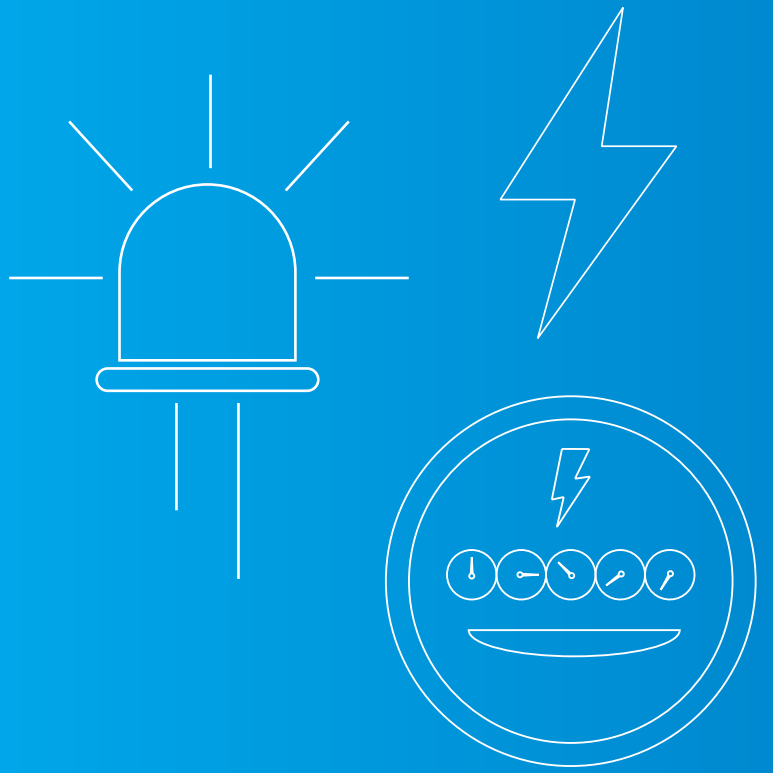
Also keep in mind that some jurisdictions require that IBW solutions support public safety frequencies. We will explore this in more detail in Chapter 11.

Cabling choice

Category 6A is recommended for horizontal runs because of its ease of installation and support for 10G backhaul. An OM5 fiber-optic backbone capable of migrating to 40G and 100G is recommended for vertical cable runs to aggregate 10G horizontal links.

CHAPTER

8 Low-voltage lighting



What is…
low-voltage lighting?

High-efficiency LED lighting designed to operate on low-voltage dc current instead of conventional ac line voltage.

EFFICIENT NEW OPTIONS COME TO THE FOREFRONT

Low-voltage dc lighting systems are generally implemented as a complement to, rather than as a replacement for, conventional ac electrical infrastructure. Low-voltage lighting also offers the potential for greater insight—and therefore greater efficiency—for an enterprise environment interested in lowering costs.

Low-voltage lighting control systems use low-voltage dc current to power networks of LED lights. Such systems are much less expensive to install and operate than conventional line-voltage ac lighting options, in regard to materials and expertise; low-voltage deployments do not require licensed electricians to install or maintain.

In addition, a low-voltage dc network's connectivity allows the integration of several other important features that can increase efficiency far beyond simply using less electricity.

LIGHTS—AND INSIGHTS

Low-voltage LED fixtures can also provide building intelligence because networked sensors can be integrated to measure occupancy, temperature, humidity or other factors an intelligent building needs to know in order to operate efficiently.

It's this added intelligence that allows the LED lights to deliver more granular, responsive, real-time control over lighting levels, security access, environmental controls and more. A total enterprise solution, such networks can provide better monitoring and management for real estate, facilities and IT services, all at the same time.

Lighting controls system	Topology	Attributes
Wireless overlay	Wireless control network manually connected to independent ac line voltage power infrastructure	• Requires licensed electrician • Costs more to install/recommission than low-voltage wired system • Subject to radio interference, latency and bandwidth contention • Minimal install limited to smaller scale deployments
Wired overlay	Wired control network manually connected to independent ac line voltage power infrastructure	• Requires licensed electrician • Costs more to install/recommission than low-voltage wired system • No radio interference, latency or bandwidth contention
Low-voltage wired	Wired control network integrated with low-voltage dc power infrastructure	• Enables simple, low-cost install using low-cost wiring • No radio interference, latency or bandwidth contention • Scalable for mission-critical performance across enterprise • Measured energy savings • Centralized driver enables improved thermal management

IMPLEMENTATION RECOMMENDATIONS

Low-voltage lighting is all about efficiency and cost reduction. To help realize its full potential, consider how you plan your infrastructure.

Significant energy savings

Moving from traditional lighting to an LED lighting system running on low-voltage cabling can significantly reduce energy costs. Case studies have shown savings of 75 percent or more over traditional line ac lighting methods.

Combine control and power

One wired infrastructure can carry control and power—eliminating many hassles associated with wireless controller deployments, such as:

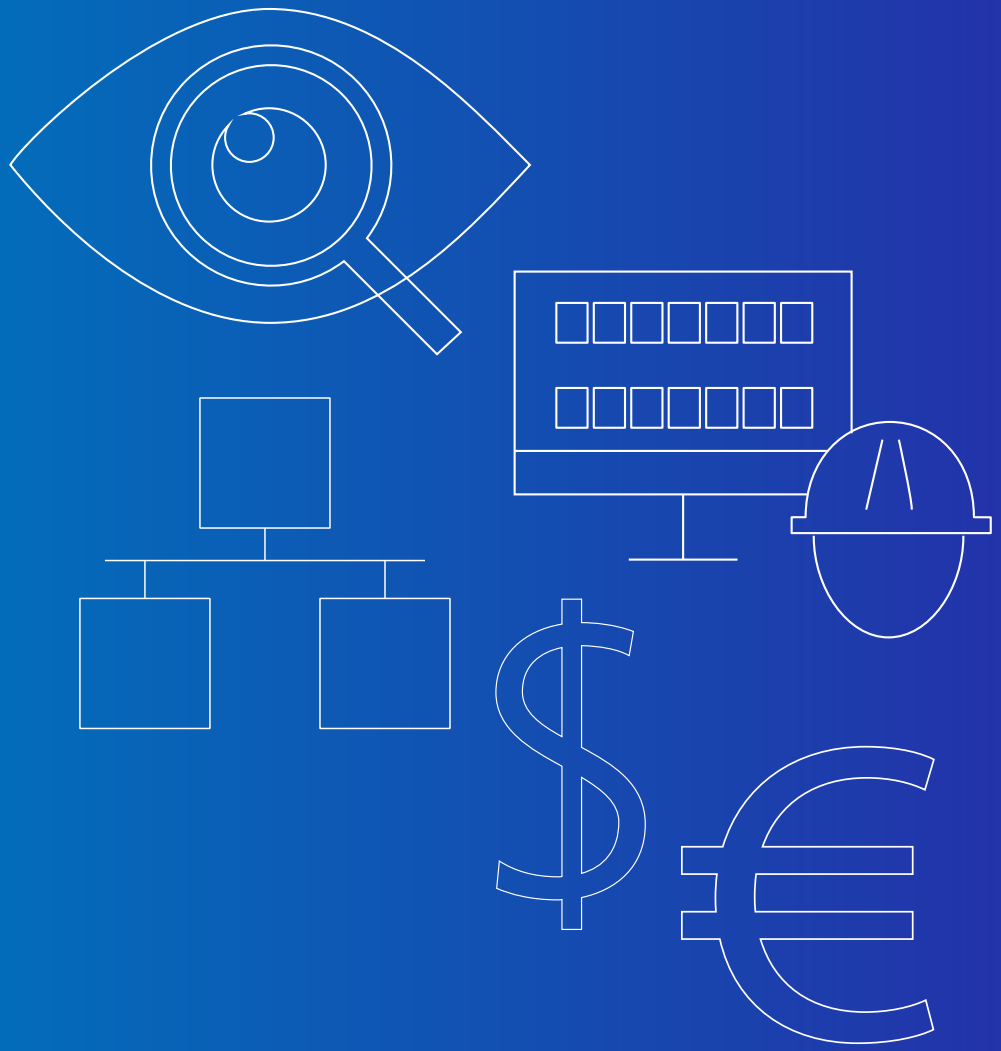
- Interference and bandwidth competition from other equipment and signals in the area
- Maintenance costs incurred from battery replacement schedules
- Reduced reliability due to corrupted control signals that are not understood by devices

Use real-time data to cut costs

Because LED lighting fixtures can be fitted with any number of sensors, they can automatically detect occupancy and light levels in real time, and respond accordingly. This is a big part of the reason CommScope studies reveal up to 75 percent reduction in lighting costs with low-voltage lighting.

CHAPTER

9 Building Information Modeling



PLANNING A SMARTER BUILDING FROM THE GROUND UP

The construction of any new commercial structure is a complicated undertaking—getting a holistic view is essential.

More than ever, the systems and controls of various building functions and applications are intertwined. At the same time, there are significant financial and regulatory pressures to create the most efficient building possible, with the smallest carbon footprint.

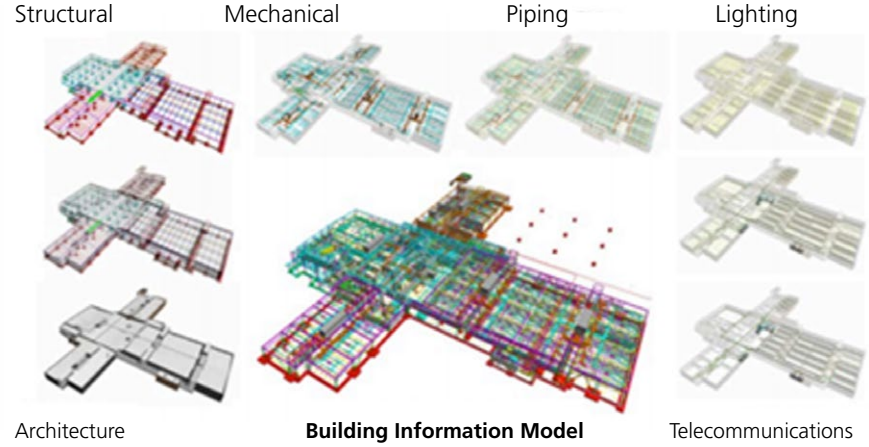
Enter building information modeling (BIM). BIM's unified, three-dimensional model of the completed building can simulate its entire lifecycle. BIM is estimated to reduce construction costs by 20 percent and total costs by up to 33 percent over the life of the building.

What is… building information modeling (BIM)?

A business process for generating, leveraging and managing building data to design, construct and operate the building during its lifecycle in order to optimize efficiency and sustainability.

A COMPLETE PICTURE

Typically, BIM software models five main systems: architectural, structural, mechanical, electrical and plumbing. Unlike a simple 3D CAD drawing of overlaid systems, BIM also integrates time and cost—overlaying construction schedules and deployment/operation costs. What is often missing from these models is the network infrastructure. As more and more building services are connected via network cabling, it becomes more important to figure the network infrastructure into BIM models.



IMPLEMENTATION RECOMMENDATIONS

A useful and powerful tool, BIM is rapidly becoming a mandatory requirement in the United Kingdom, United States and other regions of the world. We strongly recommend that you become familiar with it.

Get to the next level

BIM model complexity is defined by levels ranging from 0 to 3.

- Level 0: Simple CAD drawings—now considered obsolete
- Level 1: 2D and 3D drawings—currently the most common approach
- Level 2: Modeling includes time and cost factors—rapidly becoming the new standard
- Level 3: Integrated BIM allows modeling against carbon targets—expected to be implemented in the UK by 2025

IT matters

Intelligent buildings consolidate many key functions into standard network infrastructure, so inclusion in BIM models is becoming essential.

- New PoE standards introduce more stringent thermal loading standards governing space and number of cables per bundle
- Universal sensor networks that coordinate with intelligent building functions (lights, HVAC and so forth) must have ubiquitous access
- Ideally, UCG should be planned into the construction phase to reduce cost and avoid disruption

Sharing and securing BIM data

To remain accessible to the many parties involved in construction, BIM data is often stored in the cloud, introducing security concerns.

Security depends on the energetic applications of cyber-security policies and awareness efforts, along with robust technical processes to resolve any perceived threat.

The UK Institution of Engineering and Technology (IET) publishes guidelines on security of BIM data—and the UK British Standard Institute is developing a standard for BIM security under BS 1192-5.

COBie: How information is shared

Construction Operations Building Information Exchange (COBie) is a specification defining how BIM data is stored and shared between the many parties involved in the construction and operation of the building. COBie is also a checking tool to ensure efficiency and carbon targets are met.

The current specification, COBie-UK-2012, is part of British Standard BS 1192-4 and may be adopted as an ISO standard as well.

Additional resources:

Video:
Building information modeling

White paper:
Building information modeling

CHAPTER

10 Security

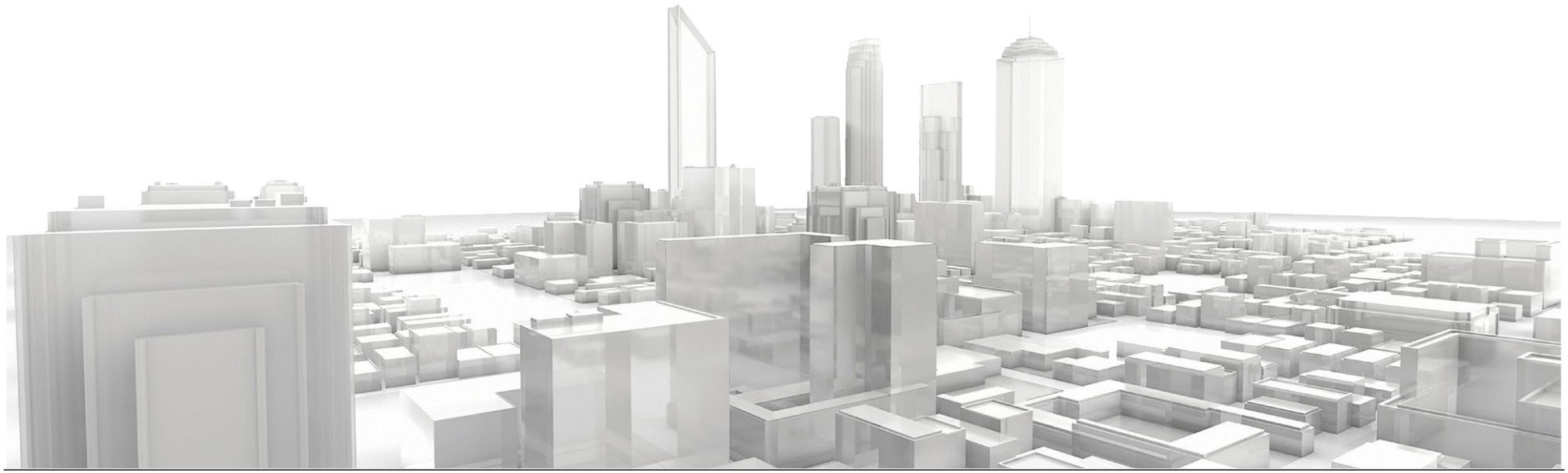
THE IMPORTANCE OF A SECURE NETWORK

Network security is essential in connected enterprise spaces

Networks seldom make the news apart from when they are down or compromised. We rarely consider the networks driving our favorite online retailer or our preferred airline until a hacking incident exposes our sensitive financial data, a checkout page refuses to load or a wave of unexpected flight cancellations occurs. While the causes of downtime are wide ranging, network security is a key concern. It's something that must be addressed at all levels—from encryption at the application level, to authentication, virtual private networks (VPNs), firewalls and, finally, physical layer security. As with every element in the network, the physical layer infrastructure is a critical part of proper planning against intrusion or other worst-case scenarios.

AIM: The network's automatic eye

Automated infrastructure management (AIM) systems constantly monitor all network connectivity in the physical layer, automatically document all changes and can even alert personnel in the event of an unscheduled new connection, such as an intruder plugging in a laptop to gain unauthorized access.



SECURING THE NETWORK AS WELL AS THE BUILDING

Beyond the prevention or mitigation of a disaster such as a fire, the right connectivity solution can also help protect the enterprise from the more likely threat of unauthorized network access and data theft. These security concerns generally fall into two categories:

- Unauthorized access by an unauthorized person can be 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. Firewalls can likewise prevent remote unauthorized access attempts.
- Unauthorized access by an authorized person can be more difficult to detect and repel since physical security may not be effective. In these cases, automated infrastructure management (AIM) solutions can automatically record and report the attachment of any unauthorized network device, including its physical location.

Additional resources

CommScope Information Security Network Solutions guide

IMPLEMENTATION RECOMMENDATIONS

The right connectivity strategy can greatly assist in the preservation of property and information. How well these functions are fulfilled depends on the design, management and composition of the enterprise network. Here are some examples.

Security monitoring and sensors

Enhanced connectivity like that found in intelligent buildings allows for networks of IP security cameras and occupancy sensors that help spot intruders or help locate trapped personnel in the event of an emergency. With the right cabling infrastructure, these power-over-Ethernet (PoE) devices can be placed just about anywhere they're needed for optimal coverage.

Physical port-level security

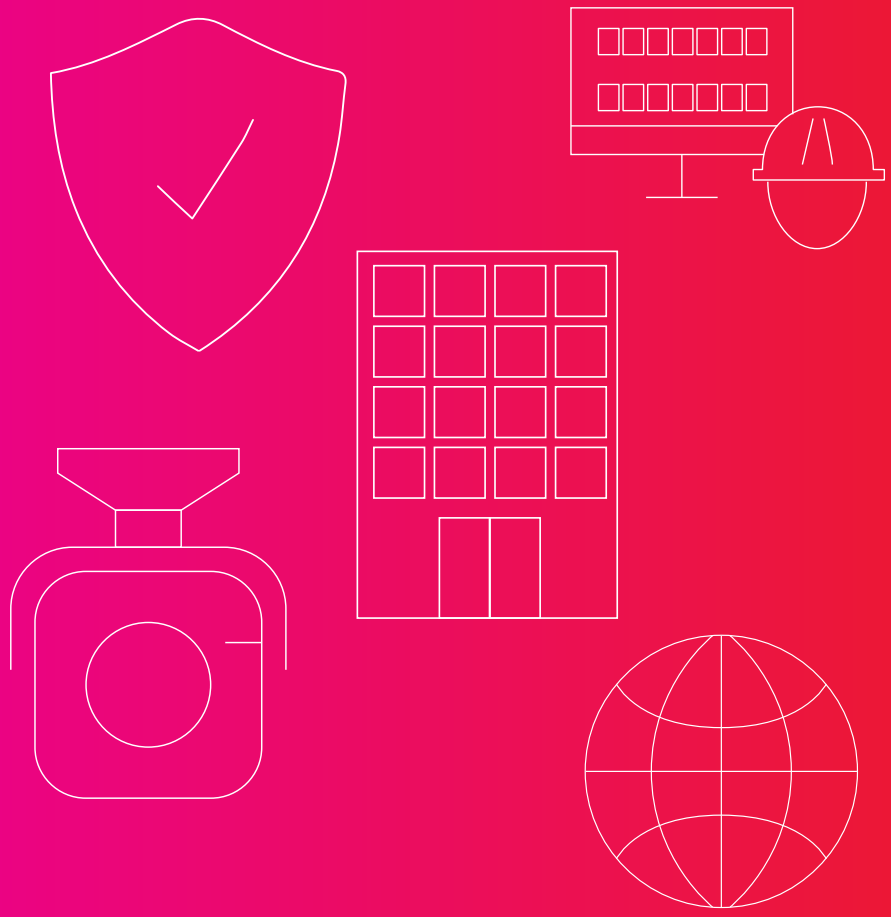
The RJ45 and LC connectors have emerged as the industry's standard interfaces for copper and fiber, respectively. While this has greatly simplified IT architecture, it also allows anyone with a standard patchcord to attempt to access the network. Keyed connectors prevent this. Color-coded, they have special molded features that will enable a connection only if the connector and adapter match—an ordinary connector simply won't fit the port. Similarly, port blocking technologies also exist that would physically lock out RJ45 or LC ports when not in use.

Standards

Standard ANSI/TIA 5017, provides guidelines for security system cabling deployments in enterprises with an integrated security approach.

CHAPTER

11 Safety



PROTECTING LIVES AND PROPERTY

The right intelligent building solutions can help prevent or mitigate a disaster

One of the most intelligent things one can do is plan against the worst possibilities. This is also true for the design of an intelligent building's networked systems, which can help emergency personnel coordinate their efforts, allow trapped employees to call for rescue, slow the spread of fire or even spot trouble before it begins.

Connecting when seconds count

One of the most important capabilities of the cellular in-building wireless (IBW) solutions explored in Chapter 7 is the ability to support emergency response personnel's frequencies while they are in the building. Specialized IBW solutions support dedicated public safety frequency bands. These include terrestrial trunked radio (TETRA), VHF/UHF bands and, more recently, LTE bands such as FirstNet in the U.S.

Public safety frequency bands and system requirements vary by country and region, but, in a growing number of jurisdictions worldwide, support for local public safety bands is a regulatory requirement and may be required in order to obtain occupancy or building permits, especially for large buildings.

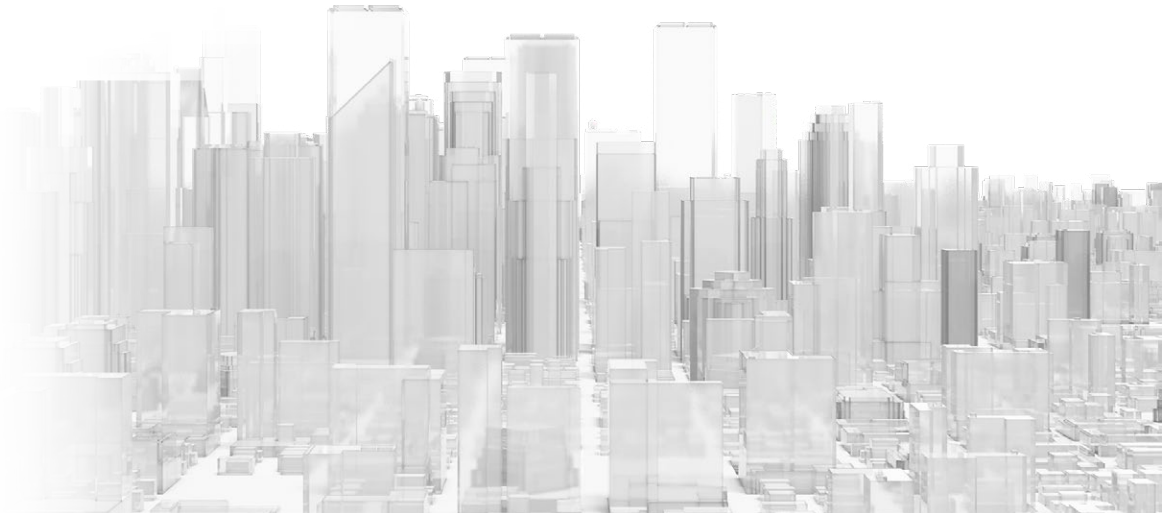
IBW solutions also provide critical cellular connectivity to employees or other building occupants who may find themselves unable to escape from an emergency situation in the building. Since the outdoor cellular network has difficulty penetrating buildings, getting a reliable connection may well depend on the presence of an IBW solution in the enterprise. This is particularly true in locations like elevators, basements or other interior spaces that are notoriously hard to reach from the outside network.

SPOTTING TROUBLE EARLY

In Chapters 1 and 5, we explored how the internet of things (IoT) and enhanced power over Ethernet (PoE) have allowed the expanded use of connected devices to improve monitoring and management of various building systems and spaces. This impacts safety because it simplifies the installation of thorough video surveillance equipment that can help find trapped occupants. With networked sensors integrated into low-voltage lighting fixtures, as discussed in Chapter 8, environmental hazards like fire can be spotted and addressed before they get out of control, helping save lives and property.

MATERIALS MATTER

Most jurisdictions now enforce fire ratings for various building materials, and the structured cabling that supports an enterprise network in an intelligent building is no exception. Ratings are intended to ensure the materials used in various IT and A/V cabling meet minimum thresholds for how long they survive in fire conditions, what temperatures they can endure and what kind of chemicals are released when they burn.



Additional resources:

CPR: the new EU Construction Product Regulation for cables

IMPLEMENTATION RECOMMENDATIONS

The choice of solutions in an intelligent building can have a tremendous impact on the outcome of an emergency or disaster. Here are some of the ways you can best make use of the technology available to you right now.

In-building wireless solutions

Different regions specify different public safety frequencies, so the IBW solutions supporting those frequencies comply with the local "authority having jurisdiction" or AHJ. Other specific requirements will apply depending on the kind of structure where the IBW solution is operating. Some regions are migrating from TETRA frequencies to the 700-800 MHz range of the LTE spectrum, but the migration will take years to complete and not proceed at the same pace in all parts of the world.

Security monitoring and sensors

Enhanced connectivity like that found in intelligent buildings allows for networks of IP security cameras and occupancy sensors that help spot intruders or help locate trapped personnel in the event of an emergency. With the right cabling infrastructure, these ower-over-Ethernet (PoE) devices can be placed just about anywhere they're needed for optimal coverage.

Fire safety

All network cable is rated by its fire performance. Wherever it is deployed, infrastructure must meet or exceed minimum fire ratings. These can vary significantly by location, so it is important to consult the local authority having jurisdiction. A good example is the recently-published Construction Product Regulation (CPR) enacted by the EU to standardize fire ratings for all permanently-installed IT and video cables. Other regions have their own fire rating requirements.

CHAPTER

12 Standards

Additional resources

Link to CommScope Standards Advisor

KEEPING YOUR OPTIONS (AND YOUR ARCHITECTURE) OPEN

A connected enterprise space is one where all systems communicate freely, accurately and securely on a unified network architecture.

Published industry standards make possible an open architecture that does not limit the enterprise manager to working with specific vendors or technologies, as proprietary specifications often do.

Combining systems sometimes means combining rulebooks.

Standards are important not merely because they directly inform specific solutions, but also because they influence broader technologies, solutions and standards.

For instance, ISO/IEC standards for channel performance are written to dovetail with IEC standards governing the components used in those channels. If these two sets of specifications were not coordinated, the solution may not perform to expectations—or, indeed, at all. More importantly, channel performance specifications are written in collaboration with applications standards groups such as IEEE. This ensures that the overall system performance is maximized, while supporting legacy and future applications and reducing total cost of ownership.

Seamless handoffs between technologies and specializations are possible only by adopting and adhering to published standards.

WHO ARE THE BIG NAMES IN STANDARDS?

Here are some of the most prominent and widely-respected examples, along with links to their online resources.

- **ISO:** International Organization for Standardization, an independent organization promoting industrial, commercial and technological standards worldwide.
- **IEEE:** Institute of Electrical and Electronics Engineers, a global organization drafting electronics and telecommunication standards.
- **TIA:** Telecommunications Industry Association, operating 12 committees publishing guidelines for RF, cellular and satellite communications and data centers, VoIP and smart building networks.
- **IEC:** International Electrotechnical Commission, publishing electrical and electronic standards for fiber optics, telecommunications and other fields.
- **INCITS:** InterNational Committee for Information Technology Standards, writing standards for many fields—from communications to cloud computing to transportation.
- **CENELEC:** European Committee for Electrotechnical Standardization, an organization publishing standards for wired and wireless interconnection and network technologies.

IN CONCLUSION

This book has provided you with some key understanding about the systems and infrastructure that empower intelligent buildings to host more productive, efficient enterprises. The diversity of applications is vast, and growing by the day—adding new possibilities, efficiencies and benefits. To take advantage, an enterprise must adopt an agile, flexible, scalable strategy that maximizes the number of ways intelligent building systems can be added or integrated, while minimizing the initial and ongoing cost structures.

A dependable partner in a fast-changing field

CommScope is a trusted partner to enterprises all over the world, helping them adapt and evolve to meet the challenges of competitive markets. Our culture of innovation means we are always pushing the envelope of what's possible—often surpassing standards even before they are finalized. As an expert in the enterprise space, we believe in a collaborative working relationship that focuses on the customer's needs, budget and future plans.

No one knows for certain just what the future holds; but, with CommScope in your corner, your enterprise can be assured the future can be met with confidence. Contact your CommScope representative now to see all the ways we can unlock the potential of intelligence in your enterprise.

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CO-109520.3-EN (03/18)