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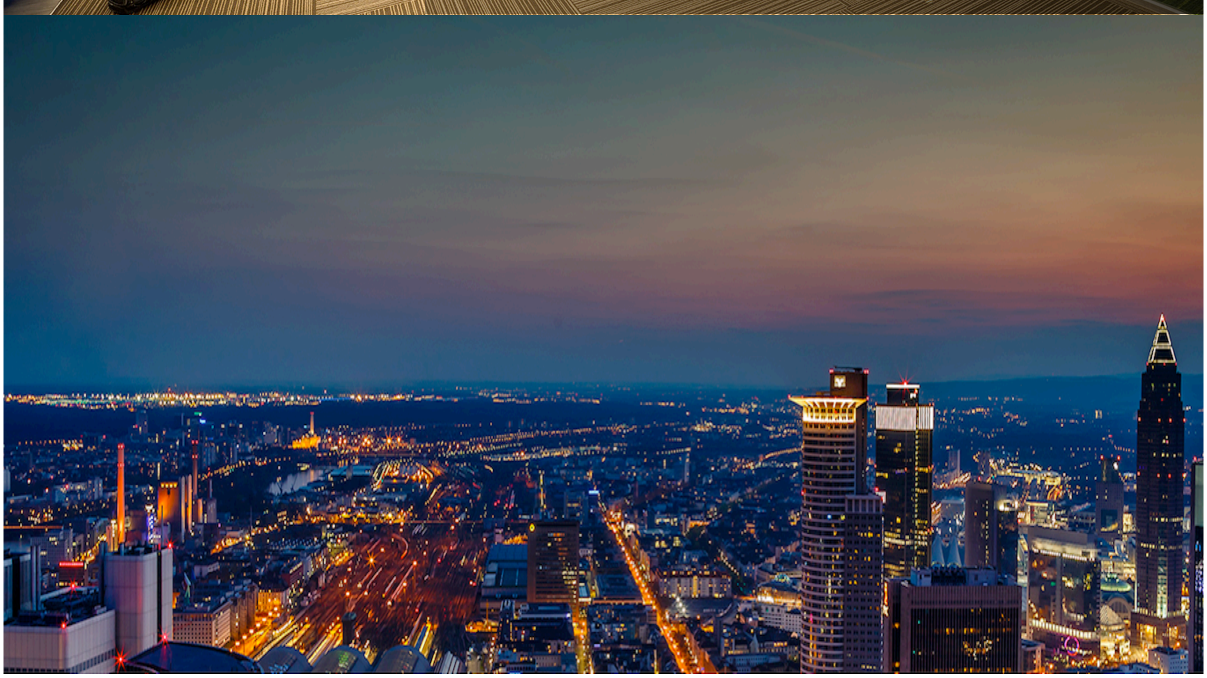
Cisco Digital Building Design Guide



Introduction

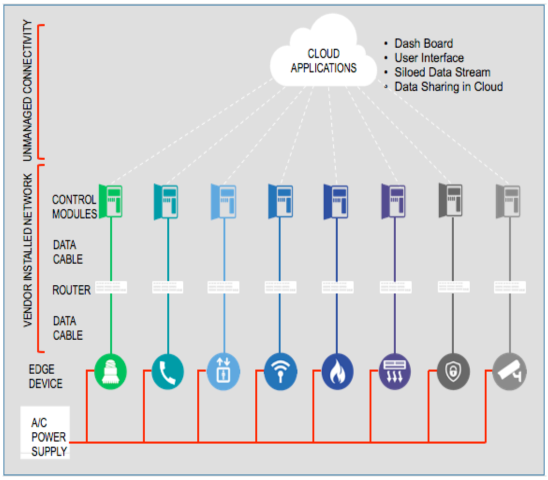
Concept

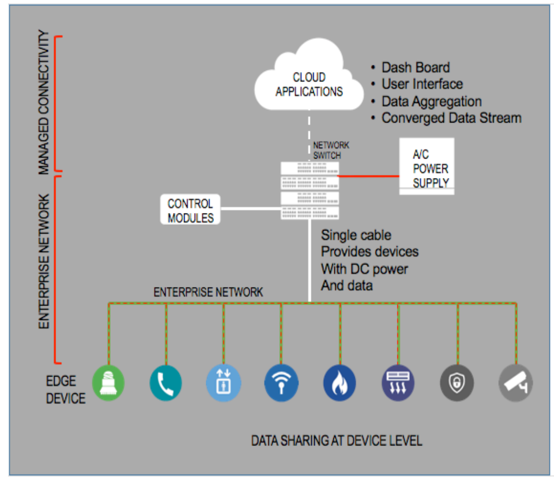
Cisco® Digital Building encompasses the proliferation of data through the consolidation of traditionally siloed building systems into a converged base building network and embracing Power over Ethernet (PoE) technology to create an expansive network that can power and share data between various building technology systems. Consolidating multiple networks allow easy and secured access to data from multiple building systems that can improve building operation as well as provide new experiences within the building. Utilizing a single infrastructure allows designers to move beyond describing systems as individual elements, and start looking at them in the context of a unified building. By providing control, data exchange and device power over a single infrastructure, the designer is increasing the value of these systems while reducing the cost to install and operate them.

PoE technology is an approved (UL, CE, CSA) way to safely transfer electrical power, along with data, to remote devices over standard networking cables in an Ethernet network. The technology was first developed by Cisco in 2000. When IEEE Standards advanced in 2003, IT components, telephony providers and security system manufacturers immediately embraced PoE technology as a faster, cheaper way to deploy their devices. Because PoE uses the data cable to additionally provide power, complete installation simply requires running a single data cable. The need to provide midrange power junctions and run a second set of power cables to individual devices no longer exists. The result is that almost all office phones, WI-FI access points, and security cameras specified today are PoE enabled, and designers are now finding that building technology has begun to follow the same path. Although LED lighting is the most prominent, other devices and controls systems that are commonly specified within buildings have options to use PoE technology. Examples include HVAC controllers, digital signage, audio/visual equipment, TV monitors, and access control devices. To find additional information about design guidelines and standards, see reference section at the bottom of this document.

Figure 1 represents traditional systems that might be installed in a building today. Systems are siloed and very little data is usable across the isolated silos. Both a power system and a communication system to have any level of data collection or automation in a traditional system.

Figure 2 represents a fully converged Cisco Digital Building. Power is supplied over the same cable as control and data collection. This eliminates the need for multiple cable systems and collapses control and data collection onto the same infrastructure.





Traditional System Diagram
Figure 1

- Multiple and redundant infrastructures to distribute power and data to edge devices
- Vendor-installed networks can create security risks
- Data sharing only happens at an enterprise level

Cisco Digital Building Diagram
Figure 2

- Single infrastructure to distribute power and data to edge devices
- Enterprise-level network for all systems
- Data sharing is available at the

Value Proposition for Designers

A new dawn of technology is driving unprecedented change in how buildings are being used, operated, and maintained. Requirements for mobility, visualization, data analytics, and media-rich collaboration tools are rapidly converting traditional buildings into digital workspaces. Designers who understand the benefits of a robust flexible technology infrastructure, one that not only can handle not only the requirements of today's technology, but also can anticipate the needs for future technology, will provide building owners key advantages in achieving and sustaining real estate market leadership.

When considering the Cisco Digital Building approach, designers can talk to building owners about:

- Reducing the cost of required infrastructure during construction and over the life of the building
- Reducing the operational costs by consolidating technology
- Managing the cyber security risks by eliminating unsecure networks
- Promoting data collection across systems to make better business decisions
- Providing a flexible infrastructure that is poised to take advantage of future technology

Value Proposition for Owners

As affordable new technologies are introduced, building occupants and tenants are beginning to request and expect smart building technology. Cisco Digital Building combines the building systems, which owners have already identified, with a flexible smart building infrastructure that simplifies system installation and reduces overall 'first-in' costs of these systems. Building owners who construct these types of buildings will become real estate market leaders by providing building users with built environments that promote flexibility, enhance user experience, and accelerate adoption of current and future technologies, all while reducing facility operation and improvement costs.

As evidence continues to emerge that deploying smart building technology makes sense for property owners and tenants alike, real-estate market leaders are realizing benefits that allow them to:

- Continuously drive down operational expenses to manage and maintain real estate portfolios
- Improve the decisions and actions taken from the information provided by their real estate systems and successfully monitor KPIs throughout the organization
- Lower energy demand, reduce energy spending and downtime, and decrease their carbon footprint while seeing a measurable and rapid return on investments
- Differentiate their property from their competition; being seen as sustainable and green and increasing customer satisfaction and growing their market value and reputation compared to their competition
- Take advantage of PoE systems, which are safer and reduce the risk of shock or fire because of to the inherent design and negotiation of power by individual devices
- Be part of a global community of real estate professionals, vendors, integrators and consultants involved in driving smart building technologies
- Share information about their best practices, technical operations, use cases, equipment, and hardware information and allowing them to take advantage of information from others within the community
- Form relationships with the global leaders within their industry

Operational Effects

Today's building technology systems (HVAC, lighting, security, telephony, and so on) require power and use some form of IT networking for communication, monitoring, management, and control. Powering each device requires individual electrical connections, which increases the cost of the electrical infrastructure needed to support typical building operations. IT networking requires a data connection at each device. And if the IT network design is not controlled throughout the development of the building's design, multiple vendor-installed networks will duplicate infrastructures and increase IT security risks. Cisco Digital Building converges these requirements into a single, secure, open standards-based, service-oriented architectural framework designed to deliver both communications and data through a single cable. Cisco Digital Building creates a secure managed infrastructure that will reduce costs throughout the life of the building.

Table 1 and Table 2 presents typical CapEx and OpEx examples to build a persuasive business case to include Cisco Digital Building in the project's design:

Table 1. Financial Effects on Capital Expenses (CapEx)

Goal	Benefit	Effect
Aggregate all low-voltage and fiber optic cabling requirements	Enhance reliability, building system efficiency, and convergence	Industry trends indicate potential to reduce cabling installation costs by up to 10 percent by converging networks at design phase to reduce number of networks, cables, and associated contractors.
	Reduce material costs (less connectivity, baskets, conduits, and so on)	
	Have fewer siloed systems to install and manage	
	Eliminate multiple levels of (sub)contractor markup/ reduce supervision requirements	
	Increase pricing use/simplified contact management	
Use PoE to reduce need for line voltage power installation	Reduce construction cost by eliminating traditional equipment power connections and downsizing step down transformers	Reduce outlet/drop requirements and infrastructure to support them by up to 25 percent
Use cable management to converge systems and IT footprints	Optimize infrastructures to connect smart building technologies	Potential to reduce space required by up to percent

Table 2. Financial Effects on Operating Expenses (OpEx)

Goal	Benefit	Effect
Manage energy use	Networked HVAC, lighting controls, energy system metering	Industry trends indicate potential to reduce energy usage by an additional 40 percent by more effectively converting energy and adding advanced controls as well as sharing data across different systems.
	Continuous commissioning and optimized performance configuration for HVAC and lighting systems	
	Support and report on sustainability initiatives	
Reduce maintenance costs	Real-time information sharing improves system diagnostics and reporting	Trends show the potential to achieve maintenance savings up to 10 percent.
	Intelligent fault detection extends life of system	
Optimize staffing	Fewer expert technicians required to operate/maintain open (that is, non-proprietary) systems	Industry data suggests increased staff productivity up to 24 to 30 percent is possible.
	Centralized/remote management enables efficient oversight of multiple properties by same staff	
Simplify adoption of future technology	New applications utilize converged network backbone	System designers see the potential to reduce reconfiguration costs up to 20 percent.
	Less abandoned cabling to remove	
	Established methodology for infrastructure	

Capital expenses (CapEx): A capital expense is an expense for a newly purchased capital asset or an investment that improves the useful life of an existing capital asset. Capital expenditures require a company to spread the cost of the expenditure (the fixed cost) over the useful life of the asset.

Operating expenses (OpEx): An operating expense is an expense incurred through normal building operations. Operating expenses include maintenance, equipment, utilities, payroll, and funds allocated toward day-to-day operations.

Getting Started

Start a Cisco Digital Building solution design by:

- Meeting with the owners and project decision makers. Review the benefits and design considerations of using the Cisco Digital Building solution.
- Helping the owner develop an "owner's performance requirements" (OPR) document that requires exploring the use of Cisco Digital Building for power and communication.
- Identifying the design and construction team stakeholders and assessing what they care about. Discuss design considerations and determine if additional consultants are required.

Design Considerations

Consider the people in the design team who are affected by the decision to pursue a smart building design, those who have a stake in its successful completion, or those who will be responsible for overseeing the implementation and construction.

Developing a simple roles and responsibilities chart like the one in Table 3 will help set expectations and define responsibilities early in the design process.

Stakeholders

Table 3. Roles and Responsibilities

Core Design Team	Phases	Influence on Project	Required Action
Board of directors/investor	Strategic planning	• Identify targeted client base • State desired level of technology • Define lifecycle expectations for technology	• Established technology goals • Targeted tenant profile
Owner	Design planning-construction	• Set functional goals • Develop uses cases to drive design • Set operational goals	• Clear direction on desired function or user experience • Regular design reviews/updates to discuss use case integration

Architecture	Design planning-construction	• Overall control of design • Coordination of extended team	• Greater coordination efforts between core team and specialty consultants • Regular team meetings to make sure of coordination of technology
MEP engineer	Design planning-construction	• Building system design and selection • Develop design documents to include use case functionality	• Work closely with system vendors to define communication parameters • Greater coordination with system vendors to understand how system will integrate to Cisco Digital Building
Technology consultant	Design development-construction	• Network architecture design and selection • Specify network equipment • Assist with system integration	• Design network architecture to support systems needed to implement use cases • Understand communication and power requirements • Capture owner's network requirements in Division 27 specification

Specialty Consultants	Phases	Influence on Project	Required Action
Access control	Design development-construction	• Design and specify access control system • Define integration parameters and data sets available	• Provide inventory of devices • Define networking connection points and communication requirements
Building controls designer	Building controls designer Design development-construction	• Design and specify building control systems • Define integration parameters and data sets available	• Provide inventory of devices • Define networking connection points and communication requirements
End user: key tenant, owner occupied	Design development: construction (any point during design)	• Define uses cases for spaces • Identify technology needs and growth plan	• Use case catalogue • Provide inventory of connected devices
Facilities management	Strategic planning: construction	• Identify systems required to efficiently operate the building • Designate data sets needed from systems	
Fire engineering consultant	Design development-construction	• Design and specify fire alarm and fire control systems • Define integration parameters and data sets available	• Provide inventory of devices • Define networking connection points and communication requirements
Health and safety consultant	Design development-construction	• Design and specify health and safety systems • Define integration parameters and data sets available	• Provide inventory of devices • Define networking connection points and communication requirements
Interior designer	Design planning: construction	• Design of interior and specialty features • Lighting and device selection/approval	• Greater coordination with architect and engineers to understand how selections affect Cisco Digital Building design

Master technology integrator	Design planning: construction	• Defines technology needed to support use cases • Oversees technology integration • Specify how data is to be handled	• Building technology PoE riser diagram • Building technology communication riser diagram • Data handling strategy
Security consultant	Design development: construction	• Design and specify fire alarm and fire control systems • Define integration parameters and data sets available	• Provide inventory of devices • Define networking connection points and communication requirements
Specification writer	Design development: construction	• Oversee specification development including: Division 23 (HVAC), Division 25 (system integration), Division 26 (electrical), Division 27 (communications), and Division 28 (electronic safety and security)	• Greater coordination with architect and MEP engineers to understand how selections affect Cisco Digital Building design

System Considerations

Although nearly all building control systems utilize IP networking, design and engineering firms must possess the latest knowledge about technology options and requirements. There is an opportunity to use IT-specific design experience and provide owners and developers with the knowledge to understand system connectivity requirements while allowing traditional trades and contractors to focus on their core business. Owners and developers gradually become more proficient in the following areas:

1. Converged physical infrastructure that enables the integration of control systems with the IP network, and extends the reach of the IP-based network to all Internet-enabled devices
2. Logical network for connecting all control systems and IT applications
3. Middleware for integrating building infrastructure and IT applications over a common IP network to enable true system interoperability and limit proprietary service requirements
4. Data center sized for building systems, which organizes previously disparate systems' servers and related equipment in an efficient footprint

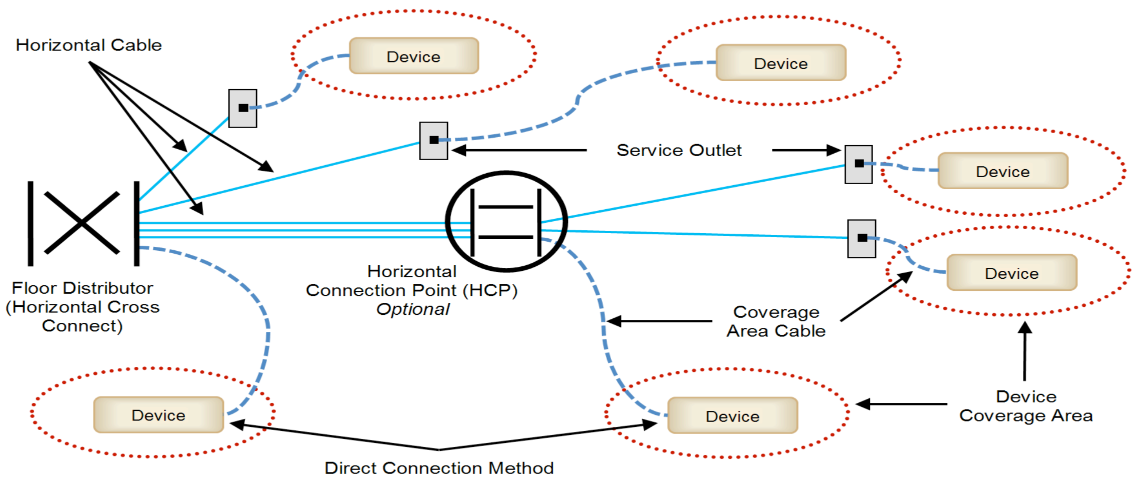
Converged Physical Network Infrastructure

Digital building architectures provide a platform for secure, scalable and interoperable systems throughout an enterprise. Most systems can be physically converged through shared conduit, cable trays, and building pathways; others will converge logically through a switched IP network. It becomes possible to implement global facility policies, by transporting operational and services data over a single physically converged network infrastructure.

The common denominator for converged building systems is the expansive reach of the cabling infrastructure and physical connectivity. This converged multitechnology backbone is composed of copper, optical fiber, coaxial, and fieldbus cabling, to connect a wide range of endpoint devices including surveillance cameras, climate controls, and energy management sensors. Owners can optimize building energy use and manage risk into the future by connecting and harmonizing critical systems and devices.

The layout and selection of the cable infrastructure should incorporate the deployment of multiple building systems, such as access control, security cameras, building automation, audio/visual, wireless access points, network powered lighting, control panels, and any other applications utilizing an IP network. Figure 3 outlines the premise of a horizontal cabling layout.

Figure 3. Source: ANSI/BICSI 007-2017



Horizontal cable run can extend from the floor distributor to a horizontal connection point (HCP), which is usually an enclosure in the ceiling, wall, or floor panel. HCP's, also referred to as zone enclosures, and allow for shorter cables to service outlets for device connections. Horizontal runs may also terminate from the floor distributor to a service outlet close to the device. Finally, the horizontal cable run may be directly connected from the device located in the floor distributor to the end device. All connections mentioned are defined in the corresponding ANSI/TIA/ISO/IEC/ cabling standards listed in the "Standards" section, later in this document.

Such design strategies affect the layout of electrical, mechanical, and telecommunications rooms by optimizing layout space and reducing cooling and electrical requirements. With each additional building system routed within the same pathways and enclosures, network cabling becomes easier to locate, manage and maintain while eliminating abandoned cables in ceilings.

Additionally, such strategies should be applied to outside plant (OSP) facilities, with the OSP managed as a real estate asset that considers right of way and easement policies.

Logical Network

The IP network will be as flexible and scalable as the physical infrastructure and accommodate nearly all IP and fieldbus connectivity between controllers, management servers and building systems. Each endpoint device that requires an Ethernet port can be tallied to estimate initial requirements for physical network port capacity. Each device also requires a defined level of bandwidth. For example, lighting control commands and temperature control readings use very little bandwidth, whereas security surveillance requires substantially more.

Additional network flexibility can be realized by taking advantage of PoE technology. PoE extends the capabilities of Ethernet by delivering both data and reliable low-voltage DC power over the same cables to endpoint devices such as VoIP phones, access control modules, surveillance cameras, and wireless access points. PoE converges data and power together over the same cable to each device attached to the local area network. Devices no longer require a dedicated AC outlet, providing a more flexible installation without additional midrange or high-voltage electrical oversight while still adhering to electrical codes and requirements. This saves money by eliminating the cost and time associated with AC outlet installations and inspections, while providing the flexibility to install PoE devices where it is optimum in a safe and speedy manner.

PoE Infrastructure

PoE describes technologies that pass electric power along with data on twisted pair Ethernet cabling. Deployed as part of a holistic building infrastructure (Cisco Digital Building), PoE creates a consolidated low-voltage DC power grid that prolificates the secure collection of data and integration of systems through a single cable.

Middleware

Intelligent middleware technology transforms building operational data into information that provides the owner deeper visibility into building systems. When integrating building infrastructure and IT applications over the same logical IP network, intelligent middleware technology enables sophisticated monitoring of energy consumption. The collected information allows building stakeholders to make knowledgeable business decisions, achieving greater energy savings and improving operational efficiencies.

Note: It might be necessary to augment existing systems or predetermined system protocols with middleware appliances or services to normalize proprietary protocols and to enable them for back office system consumption and analysis.

Data Center

A converged infrastructure for Cisco Digital Building may use global data center standards, as listed in the "Standards" section, as best practices to organize previously disparate building systems' servers and related equipment in an efficient footprint. This represents a new step forward in the evolution of building system IT infrastructure design rather than leaving servers, demarcations, and connectivity points scattered across utility closets in ceiling tiles and hung on boards. Network equipment needed to support building systems should be organized with a goal of minimizing the effects on leasable areas while maximizing reductions in power distribution and in heating and cooling system infrastructures.

Unlike traditional data centers that run applications to handle the core business and operational data of an organization, such as ERP and CRM systems, these designs are sized to maintain continuity among critical building systems; they can be incorporated into an existing data center space or can be defined and operated separately.

Information security is still a primary concern. For this reason a digital building data center must be in a secure environment that minimizes the chances of security breaches or system downtime.

Power Design Considerations

When users operate a wall control switch, they expect the lights to come on the instant the switch is activated. Consistently delivering the correct level of PoE power has a direct effect on the ability to provide important services such as instantly turning on the lights. Designers must consider power requirements when selecting the proper network equipment and power supplies used to deploy the Cisco Digital Building.

Commonly, power budgets for information technology systems use power management modes that dynamically assign power by device class or link layer. Allocations of 50 percent utilized power factors may be applied to determine the correct power supply. Unlike information technology devices, building system devices, require an instant response and often cannot wait for power negotiations. Therefore, the technology designer will be confronted with the need to calculate a series of power characteristics to set the appropriate power management strategy. Power calculations will need to be shared with the mechanical engineer to coordinate cooling or appropriate heat dissipation strategy. Engaging the technology consultant early in the design process will define performance parameters and assist in system selection

Common Terms:

- **PoE power budget:** The PoE power budget is the total amount of power that the PoE switch has available to allocate to its PoE ports. The PoE controller cannot exceed its PoE power budget and does not allocate power to a PoE port if the allocation would exceed the PoE power budget.
- **PoE port power allocation:** The maximum power for a PoE interface is the maximum amount of power that can be provided by that interface. If the actual power consumption of a powered device connected to a PoE interface is less than the maximum power allocated to that interface, the interface could negotiate for less power to reduce the overall power consumption. Likewise, as a built-in safety feature, if the actual power consumption of a powered device connected to a PoE interface exceeds the maximum power allocated to that interface, the switch turns off power to the interface.
- **Power sourcing equipment (PSE):** The equipment that supports PoE function such as PoE switch, PoE injector (midspan) and so on. PSE equipment grants power requested by the powered device. A PSE can also revoke power if necessary.
- **Powered device (PD):** PoE endpoints such as IP/network cameras in video surveillance systems. A PD can request up to the maximum power consumption needed. It does not need to consume all the power allocated, and it cannot consume more than what is allocated.
- **UPOE:** Universal Power Over Ethernet (UPOE) extends the IEEE Power over Ethernet Plus (PoE+) standard to double the power per port to 60 watts.
- **Governing standards:** Designers should also reference the IEEE 802.3 Standards for additional power design considerations.

Maximizing Value

How can designers help owners maximize the value of the Cisco Digital Building?

In recent years, technology has increasingly standardized to IP network infrastructures. PoE is one of the mostly widely deployed technologies to provide power to networked devices, with the following primary benefits:

- High availability for power, which can guarantee uninterrupted services, a requirement for critical applications (emergency lighting, life safety)
- Lower OpEx by providing network resiliency at a lower cost by consolidating backup power into the wiring closet
- Faster deployment of new campus IT, access, HVAC control and lighting networking infrastructures by eliminating the need for a power outlet for every endpoint

- Better insight and control, which help achieve corporate sustainability, energy management goals and certifications, such as Building Research Establishment Environmental Assessment Methodology (BREEAM), International WELL Building Institute (WELL), and Leadership in Energy and Environmental Design (LEED)

As the technology evolves to support more end devices for communication, collaboration, security, and productivity, the need of PoE is also evolving to support newer end devices with increased power requirements. To reinforce the decision to use the Cisco Digital Building, designs can help maximize value by:

- **Use case development:** One of the strengths of the Cisco Digital Building is to look at building technology systems holistically, supplying an infrastructure that promotes the openness of standard protocols and data. Having data shared across disparate systems and platforms allows for use cases that allow building owners to deliver enhanced user experiences
- **System selection, promoting better visibility:** Modern building operators are looking to deploy applications that visualize building performance and simplify operations. These applications only succeed when replacing the multitude of interfaces an operator must manage. Cisco Digital Building can help maximize the effectiveness of any application by converging the building systems into a single accessible network. Systems to consider:

• Lighting devices and lighting controls • Access control systems • Security systems	• Video surveillance • Building automation devices and controls • Fire alarm and protection systems	• LCD monitors and TVs • Clocks and time clocks • Automated window shades • Vertical transportation

- **Low-voltage DC microgrid:** Migrating devices to the PoE network will reduce the need to install the typical electrical distribution infrastructure. A low-voltage DC microgrid can be developed within the building, while enabling campus access networks and eliminating the need for a power outlet for every endpoint. This grid essentially become the fourth utility in the building and should be considered as part of the design phase of any project.

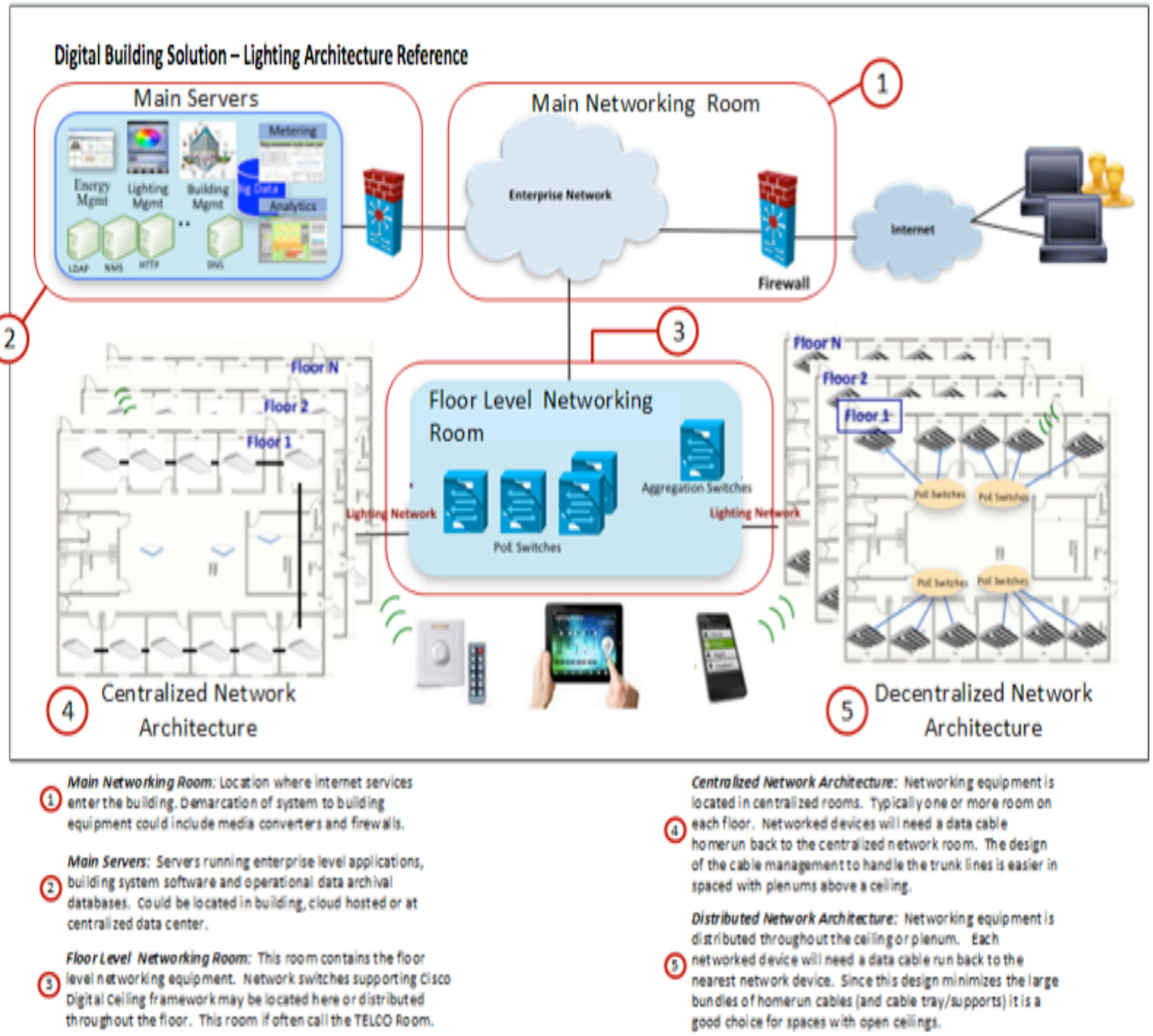
Design and Development

Table 4 uses the project stages to outline typical activities and the decisions or deliverables a design team should be expected to provide.

Table 4. Project Stages

Project Stage	Typical Activities	Decisions or Deliverables
Strategy	• Discuss the desired level of technology • Asses lifecycle expectations for assets • Targeted tenant profile	• Strategic plan for infrastructure to support technology • Document lifecycle plan for asset
Predesign	• Define building scope and performance requirements • Define the use case for using Cisco Digital Building • Identify core technology to support operations • Define relationship of technology	• Vision statement documenting Owner's commitment • Owner's performance Requirements (OPR) • Use cases to support technology selection
Schematic design	• Identify technology needed to support desired use cases • Identify additional technical consultants that might be needed to complete technology design • Hold preliminary discussions with vendors to discuss benefits and design considerations of Cisco Digital Building	• List of building technology that will utilize the Cisco Digital Building infrastructure • Functional requirements for
Design development	• Define power requirements and incorporate into power riser calculations • Outline the Cisco Digital Building network • Draft specifications to define power distribution requirements and networking equipment needed to deploy the Cisco Digital Building infrastructure • Review current building codes to identify if interpretations will be required	• One-line communication network drawing • Power calculations for network PoE equipment • Division 23 draft • Division 27 draft • Presubmittal code review meeting
Construction documents	• Finalize power distribution requirements • Finalize specifications for integration and networking devices (Divisions 23 and 27)	• Building technology PoE riser diagram • Building technology communication riser diagram
Bidding	• Meet with GC and technology vendors to convey desire to use Cisco Digital Building	• Review bids to validate system will integrate with Cisco Digital Building
Construction	• IDF/network closets to be completed earlier in construction process • Network to be commissioned prior to system start up • Review shop drawings for conformance to functional design • IT admin to oversee network installation • IT admin to establish and assist vendors with network configuration	• Modified construction schedule that accounts for needing network connectivity earlier • Network configuration tracking documents

Sample Lighting Architecture



Design Articles and Construction

Incorporating the Cisco Digital Building solution into your design will have a slight effect on the design process. The following are examples of design and construction articles that might be affected and how the design team can anticipate any adjustments.

Coordination

- **Code reviews:** The Cisco Digital Building framework departs from the traditional way of supplying power to devices. Although most codes accommodate this type of installation, the project's field inspector might be unfamiliar with this methodology. Scheduling a meeting for the code reviewers will help them understand how the system will work, allowing the design team to provide additional UL or regulatory information prior to completing the permit set as needed.
- **Conversations with general contractor (GC):** Because the network and network gear will need to be operational to support building system

startups, the installation of structured wiring and network equipment needs to happen earlier in the construction schedule. The GC will need to adjust the construction schedule to plan on completing the networking closets and server rooms (cleaned and conditioned) prior to system start up.

- **Network administrator:** The network will need to be operational prior to startup and the commissioning of equipment and hardware associated with building systems. Network equipment needs to be configured and building system configurations established in time to support building system startup.

- **Design team:** The design team will need to coordinate with the facilities manager, network administrator and any technical consultants to make the building systems are sized to accommodate the changes in construction to accommodate truly connected systems: This includes the size of the telecommunications closets, sizing stepdown transformers to reflect the shift in electrical loading and calculating accurate cooling loads based on PoE switch locations or removal of heat loads in areas such as the plenum space.

Drawings

Designers might find the need to develop additional drawings, including:

- **Network risers:** To accurately convey the Cisco Digital Building solutions to contractors, design teams are encouraged to develop a one-line drawing showing the logical network architecture. This drawing will be like an electric one-line power riser drawing.
- **Data connectivity plan:** Design teams will need to coordinate power to PoE switches and data drops for devices. Developing a data connectivity plan will help coordination with the electrician and the contractor installing the structured wiring.

Specifications

- **Division 23: heating, ventilation, and air conditioning (HVAC***):* Specifications will need to include the desired requirements of building automation controllers and devices that communicate over the Cisco Digital Building network and use utilize PoE power when possible.
- **Division 25: - integrated automation:** This specification can be used to describe how devices will connect to the Cisco Digital Building network, including what data needs to be made available and how that data is to be handled.
- **Division 26: – electrical:** The Electrical specification covers several systems that can take advantage of the Cisco Digital Building infrastructure, including

LED lights, lighting control systems, electric meters, transfer switches and VFDs. The specifications for these systems should include requirements to connect to the network and the project's expectations for using the PoE and communication functionality. Language in this section might aid in making sure the electrical distribution infrastructure is sized to benefit from the PoE and powering many devices that would commonly be powered out of an electrical panel.

- **Division 27: communications:** This specification describes the networking equipment that will be used to support the Cisco Digital Building infrastructure. In the past, development of this section has been left to the Owner or the Owner's IT consultant. Design teams will need to play a more active role in developing the specification language to make sure it supports the additional building systems.
- **Division 28: electronic safety and security:** This specification focuses on the security aspects in the design of systems that need to handle possible sources of disruption, ranging from natural disasters to malicious acts. The constraints and restrictions that form the basis of this specification may be presented to the designer as the end user's security policy.
- **Submittal requirements:** Submittal requirements in each section should be reviewed to confirm the requirements state: providing networking, data, and PoE information needed to support the configuration of the Cisco Digital Building infrastructure.

Best Practices from the Field

The Cisco Digital Building solution has already been deployed, and the design team who has successful implementations has compiled the following list of best practices to help you anticipate and avoid situations that might generate rework or change orders:

- **Network room locations:** There are usually access policies in place limiting who has access to rooms with IT network gear. Using the PoE infrastructure to power lights and other devices will require electrical and mechanical technicians to have free access to the network gear that connects their devices. Before the design of the building core is complete, the design team might want to talk to the IT team to understand the effects on IT room access policies. The IT team might require the network gear that supports building systems to be in a separate closet or in an electric room. After this is determined, the network design consultant will be able to provide space and cooling requirements.
- **System costs:** Actual installations are proving to be 25 percent less expensive, or at least cost neutral, when comparing total cost (off all systems affected). However, the simplest way to justify a value calculation to an owner is to select networked PoE lighting (fixtures and controls) and

PoE security systems (cameras and access control and management systems). These systems are early adopters of building centric PoE infrastructures and there is literature available to create a business case deploying Cisco Digital Building. These systems will also present the biggest shift to installed infrastructure and monetary effects. After making a case with these two systems, adding additional systems (HVAC controls, vertical transportation) will enhance the value and operability.

- **Value engineering:** Contractors might not be familiar with the Cisco Digital Building solution. Be prepared to encounter "value engineering." Contractors might try to "value engineer" projects, sticking with tried-and-true construction techniques to shift costs back to contractors with which they have relationships with and potentially increase their margins. It is important to make sure there is an evaluation of the systems holistically and include the integration benefits, which the contractor might not fully appreciate. The Cisco Digital Building solution uses low voltage versus high/medium voltage. This can reduce installation time and dramatically increase flexibility in regards to when the ballasts can be delivered, installed and adjusted as needed. Flexible delivery of ballasts can reduce the risk of damage or theft to ballasts that sit at the job site for extended periods of time.
- **Network availability:** Because the building systems equipment will be communicating across the Cisco Digital Building network, it is important to get the network installed early in the construction process. Make sure the general contractor understands this is a change to how to traditionally schedule a project. Additionally, the general contractor will need to work with the subcontractors involved to create a schedule that allows for turnover of the network and network rooms before the building is ready for startups and inspections.

Design Resources

Cisco Digital Building Websites

More information regarding Cisco Digital Building can be accessed at the Cisco Digital Building website.

http://www.cisco.com/c/en/us/solutions/workforce-experience/digital-building/index.html

Cisco Digital Building Partner Information

The Cisco Digital Building ecosystem includes several leading vendors across multiple segments of building services segments. See the complete list of partners here: http://www.cisco.com/c/en/us/solutions/digital-ceiling/partner-ecosystem.html

These technology partners provide solutions for lighting, analytics, building automation, and more.

Cisco Digital Building Literature

The following case studies and white papers are available for public consumption. For additional case studies that might be helpful to address unique design situations, contact the Cisco Digital Building team at: digitalbuilding@cisco.com

Videos

- Sinclair Holdings

  https://www.youtube.com/watch?v=uomF2xznbB8

- Oxford Properties

  https://www.youtube.com/watch?v=vgtTVaLj3zM

Case Studies

- Launch Fishers with Digital Building PoE LED Solutions

  http://ce.superioressex.com/uploadedFiles/docs/pdf/case-studies/launch-fishers-case-study.pdf

- Central Iowa Power Cooperative

  http://www.cisco.com/c/en/us/solutions/enterprise-networks/upoe/iowa-power-cooperative.html

- Connected Classroom in Mohammed Bin Rashid School of Government

  http://www.cisco.com/c/dam/en/us/solutions/collateral/industry-solutions/case-study-c36-736896.pdf

Standards

- Alpiq InTec

  https://www.cisco.com/c/dam/en/us/solutions/collateral/workforce-experience/digital-building/customer-alpiq.pdf

- Miami-Dade

  http://www.cisco.com/c/dam/en/us/products/collateral/enterprise/operational-efficiency/miami-dade-schools-voc-case-study.pdf

Technical Standards for PoE Wiring:

- IEEE 802.3af (Standard PoE)
- IEEE 802.3at (PoE Plus)
- IEEE 802.3bt (4PPoE)
- IEEE 802.3az (Energy Efficient Ethernet)

Additional Design and Installation Guidelines:

- **ISO/IEC TR 29125:** (Information Technology: telecommunications cabling requirements for remote powering of terminal equipment).
- **ISO/IEC 11801:** (Information technology: generic cabling for customer premises that specifies general-purpose telecommunications cabling systems (structured cabling) suitable for a wide range of applications.
- **TIA/EIA-568:** A set of telecommunications standards from the Telecommunications Industry Association (TIA) that address commercial building cabling standards for telecommunications products and services.
- **EN 50174:** A series of standards specifying the specification, planning, and practices applicable to installation of telecommunications cabling (See also TR 50174-99.)
- **EN 50173-6 (currently in draft):** Information technology: generic cabling systems; part 6: distributed building services.
- **ANSI/NECA/BICSI 568-2006:** Standard for installing commercial building telecommunications cabling (print and download combo)
- **ANSI/TIA-862B, ISO/IEC 11801-6:** Structured cabling infrastructure standard for intelligent building systems
- **ANSI/BICSI 005:** Horizontal cable to directly connected devices
- **ANSI/BICSI 007-2017:** Information communication technology design and implementation practices for intelligent buildings and premises

PoE Device Approval Agencies:

- **CE Marking:** CE marking is the manufacturer's declaration that the product meets the requirements of the applicable European Community (EC) directives.
- **UL:** Underwriters Laboratories (UL) provides safety-related certification, validation, testing, inspection, auditing, advising and training services to a wide range of clients, including manufacturers, retailers, policymakers, regulators, service companies, and consumers.
- **CSA International:** CSA International is a provider of product testing and certification services for electrical, mechanical, plumbing, gas and a variety of other products.
- **CCC:** China Compulsory Certificate (CCC) is a compulsory safety mark for many products imported, sold or used in the Chinese market.

Data Center Standards

- **TIA-942**
- **EN 50600**
- **ISO/IEC 24764**