LEVITON
Network Solutions

White Paper

Cabling System Planning and Design for Smart Buildings

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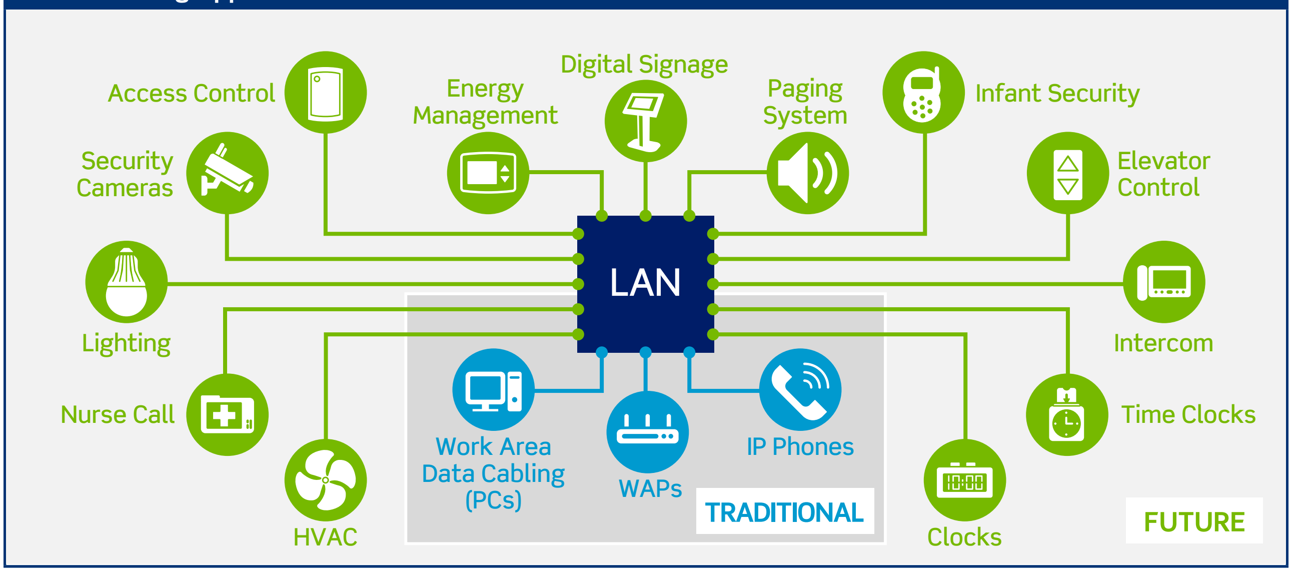
Smart Building Definition and Trends

For decades, conversations about network “convergence” mainly involved the combination of voice and data work area applications onto one network. But in recent years, additional systems and devices found throughout a building have joined the enterprise network, many of which have very different data and power requirements.

As a result of this expansion, the network has become as equally critical as electricity, water and gas to the successful operation of a business and the well-being of building occupants. In fact, 72% of leasing decision makers feel it is extremely critical to have a reliable internet connection in their office space to conduct company business, according to research by the building certification firm WiredScore.

Historically, the local area network (LAN) consisted of work area cabling to support PCs on the desk. Some years later, IP phones were added and more recently wireless access points (WAPs) to support mobile devices like laptops, cell phones, and tablets.

Smart Building Applications



Now, building systems such as HVAC, lighting, security systems, and energy management systems are being incorporated into the LAN, a trend referred to as “intelligent” or “smart” buildings. Therefore, the IP network is being asked to support a much larger footprint of applications and becoming integral to the performance and management of business operations. There are various reasons for a smart building initiative, but primarily it is to allow for better management, improved visibility and increased efficiency of operation.

There are several different key organizations who offer definitions for what makes a building “smart.” The Intelligent Building Institute, TIA and BICSI all offer definitions for buildings, each with a unique take on their makeup. However, they all have some key similarities, which include integrated or interoperable systems, improving building management, and creating cost efficiencies.

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“An intelligent building, or premise, utilizes communication technology to **integrate building systems**, allowing for intersystem connection and coordination that provides an environment which is safer, more comfortable, productive or efficient.”

A smart building uses sensors, actuators and microchips in order to collect, manage and take action on data collected according to a business' functions and services. This infrastructure helps owners, operators and facility managers improve asset reliability and performance, reduce energy use, optimize how space is used and minimize the environmental impact of buildings.

Interest in these smart building initiatives — in various shapes and forms — is gaining momentum around the world. The global smart building market is expected to show a compound annual growth rate of more than 34% between 2017 and 2024, according to the 2018 Global Smart Building Market Report from Zion Market Research.

Benefits and Challenges

The primary drivers behind the investment in smart building technologies can be broken down into three areas: economic, social, and environmental.

- Economic benefits include reduced operating costs from using less power, higher worker productivity, reduced maintenance costs, and improved building marketability.
- Social factors revolve around employees, such as the health and well-being of occupants from improved lighting, or better employee safety and security through integrated security systems and safer power delivery.
- Finally, many companies have initiatives to become more environmentally friendly, and smart building systems can reduce energy use and a building's carbon footprint.

So why aren't all companies running out and investing in smart buildings? The primary reason is that building owners will see a 2-6 percent increase in upfront costs, according to engineering consulting company Aurecon. This is not a trivial amount, as 6 percent premium can become a significant amount on a project.

One of the other reasons companies are apprehensive of smart initiatives comes from the challenge of knowing what data to collect and what to do with it. As sensors are used throughout a building, they generate a significant amount of data. Many professionals state that presents a challenge to managing and interpreting building data, as it requires internal resources and investment to interpret and act on that data.

Lack of resources and investment rank as top challenges to managing and interpreting smart building data

31% believe lack of internal **resources** available is the biggest challenge

39% believe the level of **investment** required is the biggest challenge

Source: 2016 Facilities Management Survey, Schneider Electric

While there are upfront costs to a smart building initiative, many boast a return on investment within 6 – 24 months, according to Aurecon. The company's research uncovered the following benefits:

- 10-50% reduction in HVAC and lighting costs
- 8-12% decrease in maintenance related costs
- 10% increase in employee productivity
- 5% premium when renting or leasing the property associated with preference for these enhanced capabilities

In addition, the University of California and the California Air Resources Board found the potential for up to 30% savings in overall building energy use.

Planning Best Practices

Planning for the creation of a smart building involves more than just connecting the various facilities systems and building functions. It must include a clear definition of the goals and desired outcomes of making the building intelligent. The benefits of a smart building extend to many stakeholders, including the building owner or management, tenant organizations, and the individual building occupants. The impacts on all of these stakeholders should be addressed when designing a smart building and determining what specific functions or systems need to be interconnected.

It is also important to identify who will "own" each specific system and function so that the operation of the new systems can be properly managed and responsibilities assigned appropriately prior to initial implementation. This will avoid any disagreements down the road in regards to who is responsible to support and manage these solutions.

When designing infrastructure for a digital building, it is important to look beyond just "day one" systems and applications and see further down the road and attempt to plan for what the future may hold. While building technology, servers and endpoints are upgraded every three to five years on average, the cabling plant is typically only updated every 10 or more years. So it is quite possible that the cabling you select today will need to support three generations of technology.

There are several different organizations with standards that cover smart buildings. The most applicable standards may depend on where the building is in the world. North American markets typically follow TIA standards, whereas in Europe ISO is the key standard. There are some differences in the recommendations, so care must be taken when implementing your design.

Standards for Smart Buildings

ANSI/TIA-862-B-2016	BICSI 007-2017	EN 50173-6:2018	ISO/IEC 11801-6
Standard for Structured Cabling Infrastructure for Intelligent Building Systems	ICT Design and Implementation Practices for Digital Buildings and Premises	Information Technology — Generic Cabling Systems — Part 6: Distributed Building Services	Information Technology — Generic Cabling Systems — Part 6: Distributed

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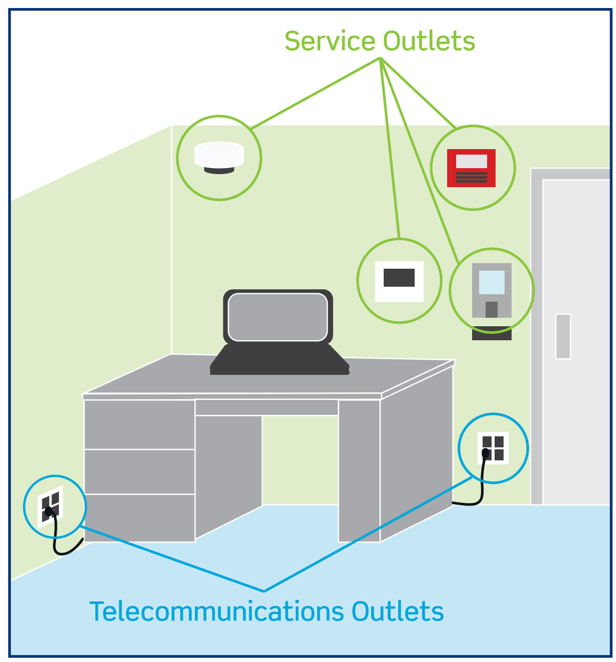
In the past the systems and services connected to the LAN had similar bandwidth requirements. Now with additional devices added, there's a wide range of bandwidth and data-rate needs. Some devices need less than 1 gigabit per second, while others may need 10 gigabits per second or more to support them. In addition, devices have different power requirements. Lighting or wireless access points might require 60 watts or more, while simple badge readers or access control devices may only need 15 – 30 watts.

In addition, looking back 20 years ago, one could assume that all service outlets exist at a desktop or office area. Now devices are no longer all clustered in the office environment: they can be located throughout a building or campus, so more pre-planning and analysis must be completed as part of the design.

Finally, smart technology is evolving so quickly that many of today's designs might not support the new solutions of tomorrow, and new technologies may expand the need for structured cabling into additional areas of the building well beyond what is envisioned today.

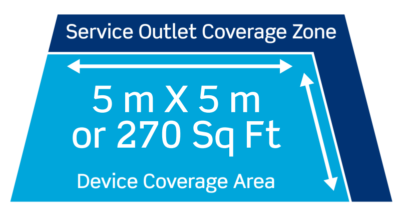
Intelligent Building Design Considerations

TIA standards recommend two telecommunications outlets per work area, and additional service outlets for intelligent building devices such as thermostats, lighting, or fire alarms. The BICSI 007 intelligent building standard defines a service outlet as the location of an intelligent building device. Because the location of these devices can vary, the standard defines a "service outlet coverage area" that will be provisioned with a certain number of outlets to provide for current and future digital building needs.

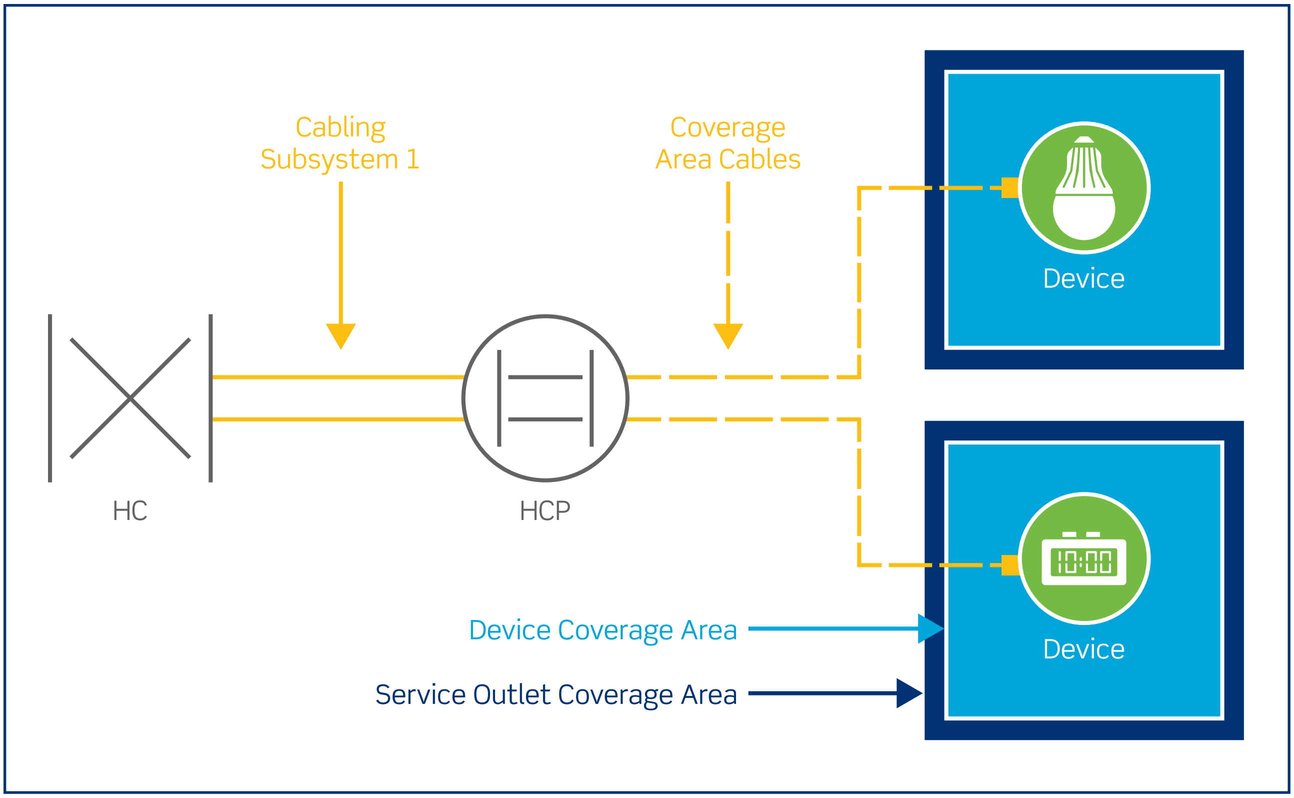


In addition, TIA standard 862-B recommends a minimum of one dedicated link per intelligent building system device be provided to each service outlet. However, often the network designers will not know how many devices or systems will be connected in a given area. To resolve this, BICSI 007 assumes that the average intelligent building device (sensor, meter, detector, controller etc.) will cover an area of about 25 square meters (270 square feet).

TIA 862-B assumes a service outlet coverage area of 3,600 square feet. Using this coverage area and anticipating the number of potential smart devices that could be needed, the recommendation is to plan for a minimum of 14 ports per service outlet coverage area, but optimally to install 18 ports per service outlet coverage area to allow for future growth.



When designing cabling infrastructure for smart buildings, cabling should be installed using a typical star wiring architecture. Devices can be connected using either a direct attach method — also known as a modular plug terminated link (MPTL) — or through installation of an outlet with a patch cord.



The best practice is to deploy horizontal cabling using a zone architecture where a Horizontal Connection Point (HCP) — essentially a consolidation point — services four to five Service Outlet coverage areas. Any HCP should be mounted permanently in an easily accessible area to allow for future moves, adds and changes.

An HCP can support approximately 15,000 square feet. Since each service outlet coverage area should be cabled to support 14 to 18 individual connections or ports, the HCP should be able to support a minimum of 56 ports. However, the standards recommend that the HCP be provisioned for future growth to anticipate the addition of more intelligent devices, and therefore should be **cabled to support 72 ports**.

Choosing the Right Cabling Systems

Power over Ethernet (PoE) is a core technology for implementing a smart building. PoE uses one Ethernet cable to deliver both data and power to an endpoint. Common endpoints that rely on PoE include WAPs, security cameras, lighting fixtures, and digital signage.

When Leviton advises customers on the types of cabling they need for connecting intelligent devices, we group applications into three areas that have their own distinct requirements:

1. High Bandwidth / High Power
2. Low Bandwidth / High Power
3. Low Bandwidth / Low Power

1. High Bandwidth / High Power

Typical applications requiring high bandwidth and high power include wireless access points and video conferencing systems. These applications will require upwards of 10 Gb/s of data and Power over Ethernet at 60 watts or higher. This makes Cat 6A cabling a must, with its ability to support 10GBASE-T. Also, Cat 6A cable and patch cords have larger conductors, which heat up less and perform better under power than small conductors.

2. Low Bandwidth / High Power

Devices requiring less bandwidth but high power include lighting and security cameras with advanced features, such as heaters, tilt, and zoom functionality. There are a couple of options for this category. The most cost effective would be to use newer Cat 5e cables on the market that have 22-gauge conductors (as opposed to the typical 24-gauge offering for Cat 5e). These are most efficient at delivering power and still support 1 Gb/s data transmission. By selecting Cat 5e cable, it also allows for selection of more cost-effective Cat 5e connectivity.

A Cat 6 system could also be used, as typical Cat 6 cable has 23 AWG conductors to handle higher power, while supporting 1 Gb/s. It is not quite as efficient for power delivery as using a larger 22-gauge conductor, and the system of cabling and connectivity will likely cost more than a Cat 5e solution.

3. Low Bandwidth / Low Power

Typical applications for this include building automation (e.g., thermostats) and security access controls. With low bandwidth and lower power requirements, a Cat 6 or Cat 5e system with 24-gauge or 23-gauge conductors are ideal.

Plan Ahead

As mentioned earlier, it's is smart to anticipate what the second and third generation of technology will be needed for your building or facility. Perhaps the applications you use today only require low bandwidth and low power, but will that continue to be the case?

PoE Optimized Cabling Systems

High-quality cabling and connectivity is essential for attaining the performance and reliability needed in current and future PoE network operations. System components should be designed to minimize temperature increases and meet industry standards for performance and construction. This ensures system longevity and prepares networks for future upgrades and growth.

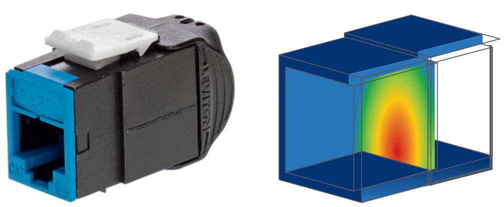
If you are unsure about which cabling system to choose, the TIA and ISO standards for new infrastructure installations is to install Cat 6A systems, as this will ensure that your cabling plant will support whatever the future holds.

If you require a cabling system for high power today or in the future, there are solutions that are optimized for high PoE. Leviton jacks include patented Retention Force Technology™, which maintains constant contact force at the connector and plug interface, preventing inadvertent intermittent disconnects caused by vibration or operational movement of the plug in the critical connector and plug mating region. The result prevents tine damage, saves on costly repairs and increases overall system longevity.

The Atlas-X1 jack ensures greater performance due to its unique all-metal-body construction. Leviton testing found that a metal connector body dissipates heat 53 percent more efficiently than conventional plastic bodies.

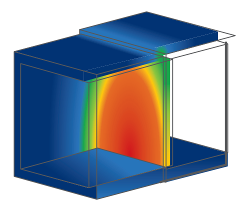
Heat Dissipation

Atlas-X1 UTP Jack with Metal Body



53% improvement
over plastic jacks

Typical Plastic Jack



Plastic runs hotter

Leviton also tested Atlas-X1 Patch Cords for compliance with the TIA TSB-184 temperature rise limit of 15 °C above ambient at 500 mA, and found its Cat 6 and Cat 6A cords maintained a temperature rise of less than 10 °C in bundled configurations.

To learn more about Leviton solutions for smart buildings, go to Leviton.com/SmartBuildings.

Today's networks must be fast and reliable, with the flexibility to handle ever-increasing data demands. Leviton can help expand your network possibilities and prepare you for the future. Our end-to-end cabling systems feature robust construction that reduces downtime, and performance that exceeds standards. We offer quick-ship make-to-order solutions from our US and UK factories. We even invent new products for customers when the product they need is not available. All of this adds up to the **highest return** on **infrastructure investment**.

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