THE TRUE IMPACT OF HIGH-POWER APPLICATIONS ON YOUR NETWORK

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Network power distribution and its efficiency has been a topic of discussion for many years. The increased capability of Power over Ethernet (PoE) and the introduction of fault managed power (FMP) have raised the bar even higher. Sustainability initiatives and complex networks play key roles in smarter applications and buildings to aid in the achievement of world impact goals and to make safer and healthier environments for occupants. These strategies require a building network that transmits increasing amounts of data and power at the same time. It is critical to understand the impacts these power levels and distribution strategies have on traditional networks and implement best practices to ensure future networks are fully capable of supporting smart applications for years to come.

REVIEW OF SMART BUILDING HIGH-POWER APPLICATIONS

Power distribution strategies and efficiencies are key focus areas because global electrical demand is increasing at high rates with no end in sight. An illustration from the International Energy Agency (IEA) highlights this upward trend of demand (Figure 1).

Figure 2 breaks down ICT power loads and the various applications that are responsible for the ever-increasing power demands.

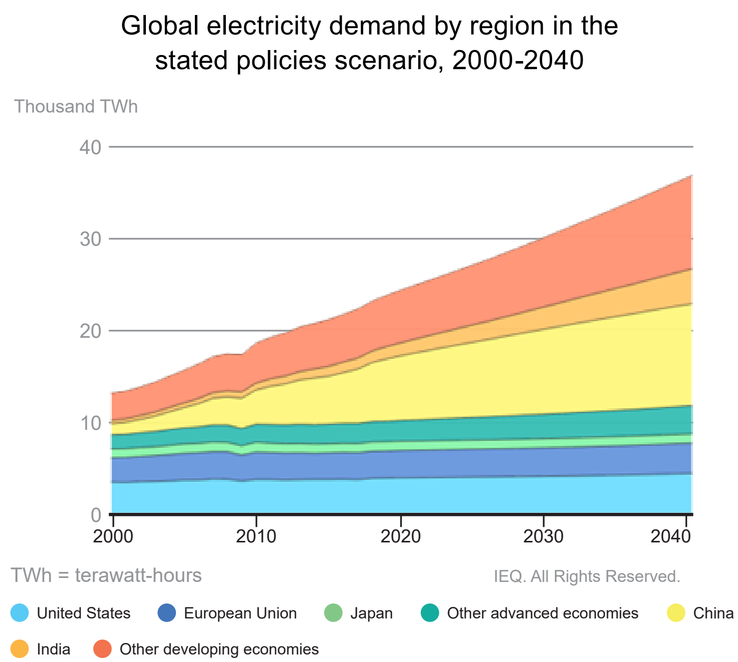

FIGURE 1: Global electricity demand. Source: IEA. All Rights Reserved. https://www.iea.org/reports/world-energy-outlook-2019

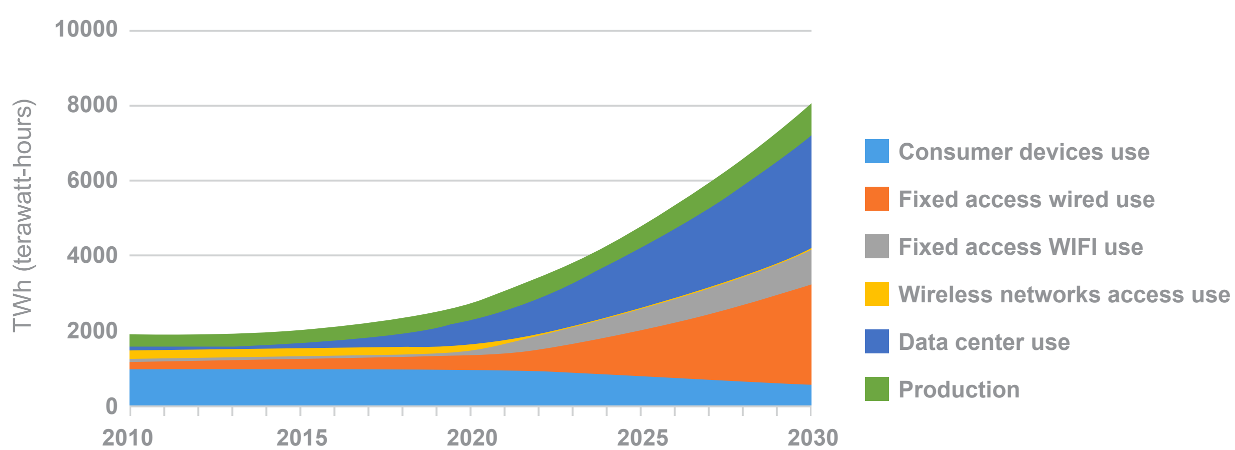

FIGURE 2: ICT power loads. Courtesy of Enerdata.

DEFINITION OF A SMART BUILDING

A smart building is one with integrated technologies that are networked instead of separate, providing data to allow system adjustments based on the rules set in an automated environment or even an environment that is learning from the data (Figure 3).

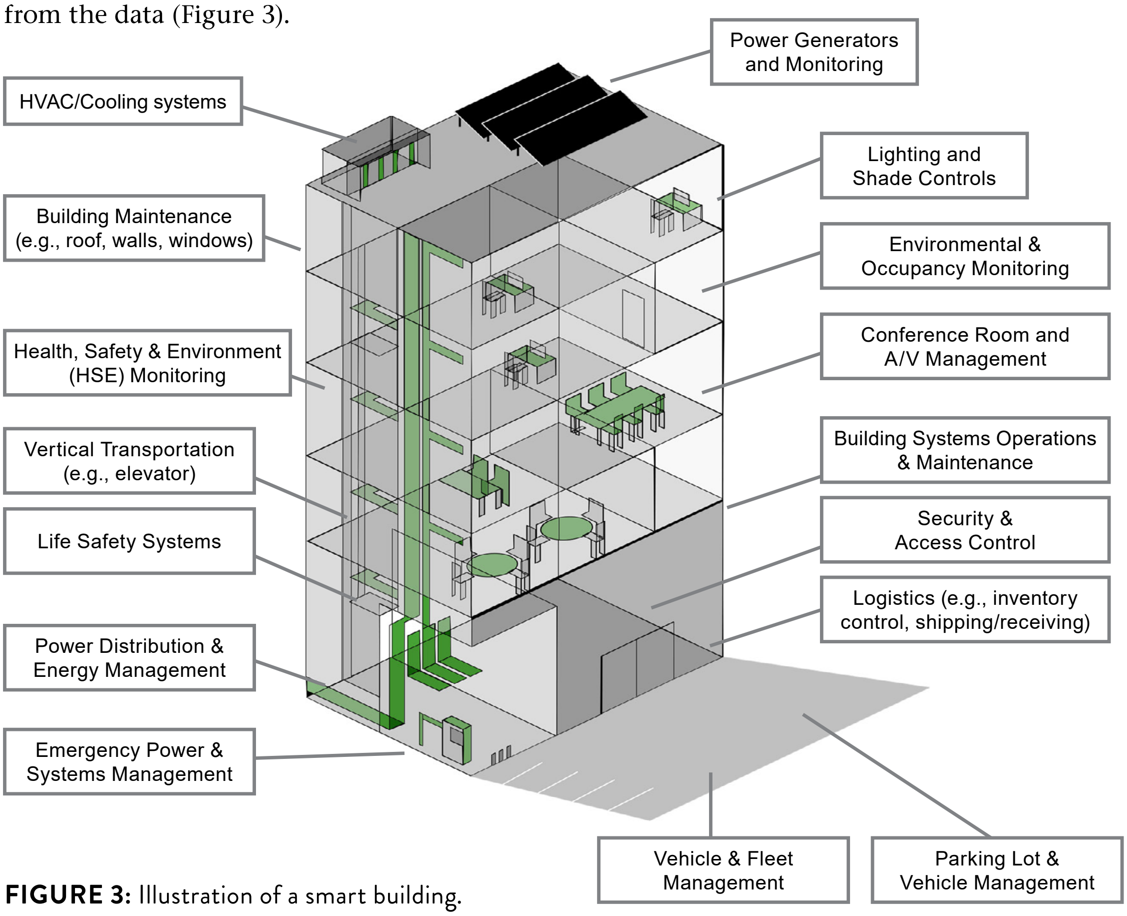

FIGURE 3: Illustration of a smart building.

The term "smart building" is becoming commonplace as the use of smart applications and the number of smart building projects both increase. With this uptick comes the need for a robust power delivery system that is efficient and offers flexibility to power and connect various applications and devices.

INDUSTRY DRIVERS

Beyond having cutting edge technology, PoE and FMP power distribution strategies help companies to achieve their own goals that may include the following:

Enhanced Occupant Satisfaction

Moving into a "back to the office" phase of the COVID-19 pandemic, the topic of satisfaction in the workplace is increasing and gaining more importance. Using a 40-hour work week as the reference, occupants will spend 24 percent of the week each year in that space. The percentage gets higher (34 percent) when factoring for awake time (an average of seven hours of sleep per day). Occupants need to feel safe and comfortable in these spaces, which smart building technology with PoE and FMP can help to support and make a reality. An example would be an office space where the position of the window blinds can be automatically controlled throughout the day as the intensity of sunlight changes.

Capital Expenditure (Capex) and Operational Expenditure (Opex) Cost Savings

Implementing PoE and FMP in new buildings or renovation projects, in most cases, will be lower than today's design. This is dependent on the global location as rates and labor change, but in most cases, the Capex and Opex for the project will be lower.

Reduced Environmental Impacts

Sustainable and green practices are prevalent today; many want to leave this planet a better place. Deploying sustainable intelligent building and 90W PoE strategies will aid in these efforts by deploying efficient power distribution and intelligent applications.

More Usable Space

The impact on the structuring of the usable space within a building can be controlled via smart building and PoE applications, such as assignment of spaces for permanent in-office occupants versus those that occasionally work in these spaces. Electrical closets could also be reduced in size along with the reduction of integrated development framework (IDF) spaces with a decentralized deployment model.

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COMPARISON OF CURRENT IN-BUILDING POWER DELIVERY STRATEGIES TO THAT OF SMART BUILDINGS

Alternating current (AC) power remains the most deployed power distribution strategy, which in many applications is converted to direct current (DC) to run most devices and applications. Figure 4 illustrates that a certain amount of power, as much as 20 percent, is lost due to the DC conversion. In cases where solar or other renewable energy is being harvested, this begins as DC power and is converted to AC for transmission and then back to DC for applications and possible storage, which can account for up to 16 percent power loss. This can be reduced with PoE and FMP strategies.

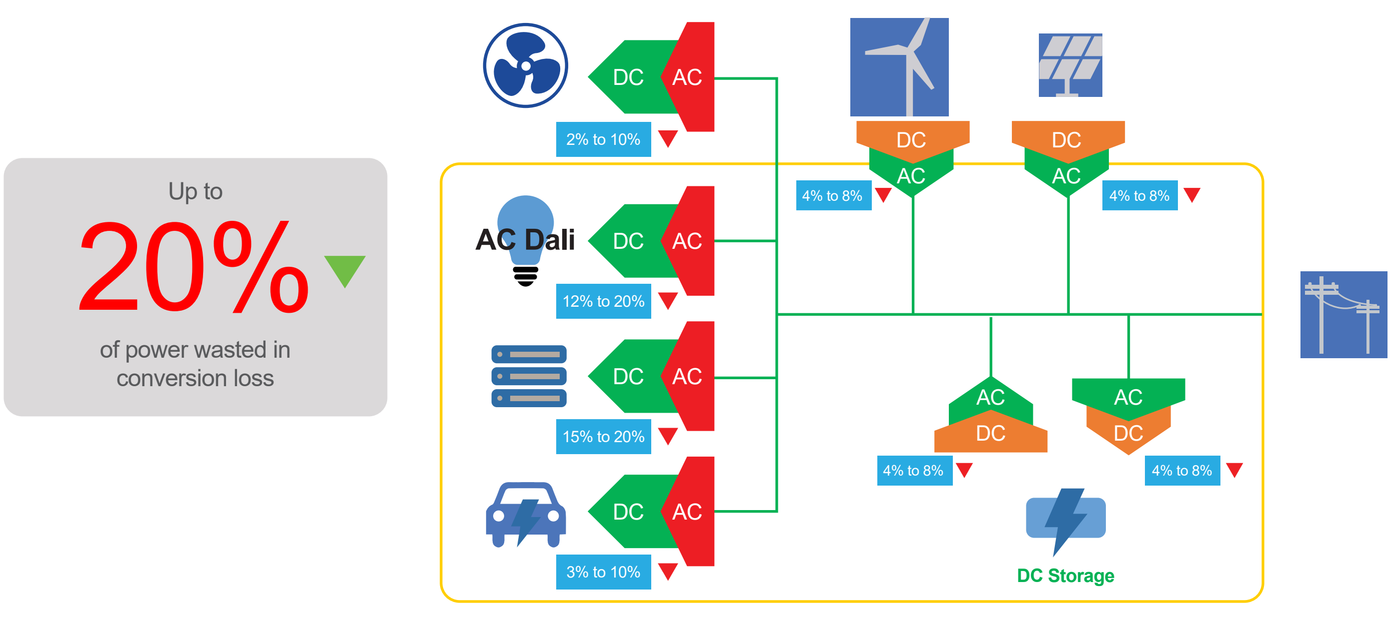

FIGURE 4: Power wasted in conversion loss. Source: CSA Group.

Looking at a DC distributed power strategy, which applies to both PoE and FMP, a realization up to a 45 percent reduction in energy waste with the elimination of the power losses due to the conversion of DC to AC and then back to DC for the transmission (Figure 5).

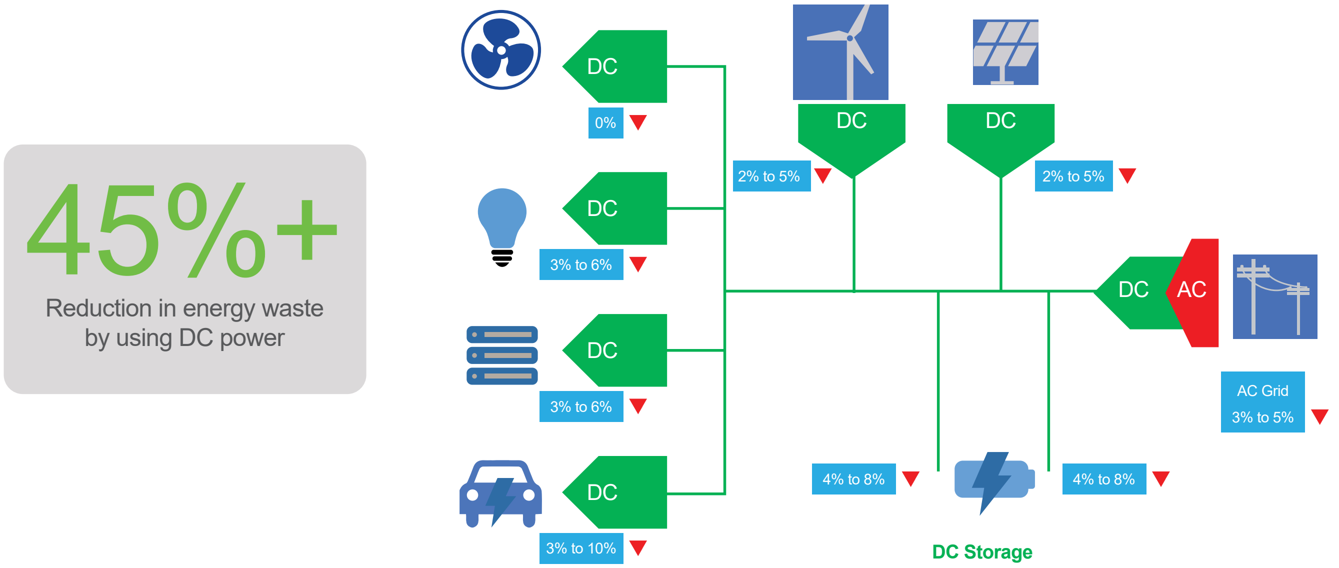

FIGURE 5: Reduction in energy waste by using DC power. Source: CSA Group.

Review of the Power Distribution Strategies (AC, PoE, Fault Managed Power)

The AC and DC electricity have been part of our lives since 1886. Since then, AC has been the dominant power source for transmission and consumer use. Furthermore, DC has remained dominant in providing the last "foot" of power to consumer devices because most modern devices immediately convert AC to DC internally to achieve operational and efficiency goals.

In 2015 Digital Electricity™ (DE) was introduced by VoltServer™. Digital Electricity is the delivery of high-voltage DC power via packet energy transfer format between a transmitter and a receiver (Figure 6).

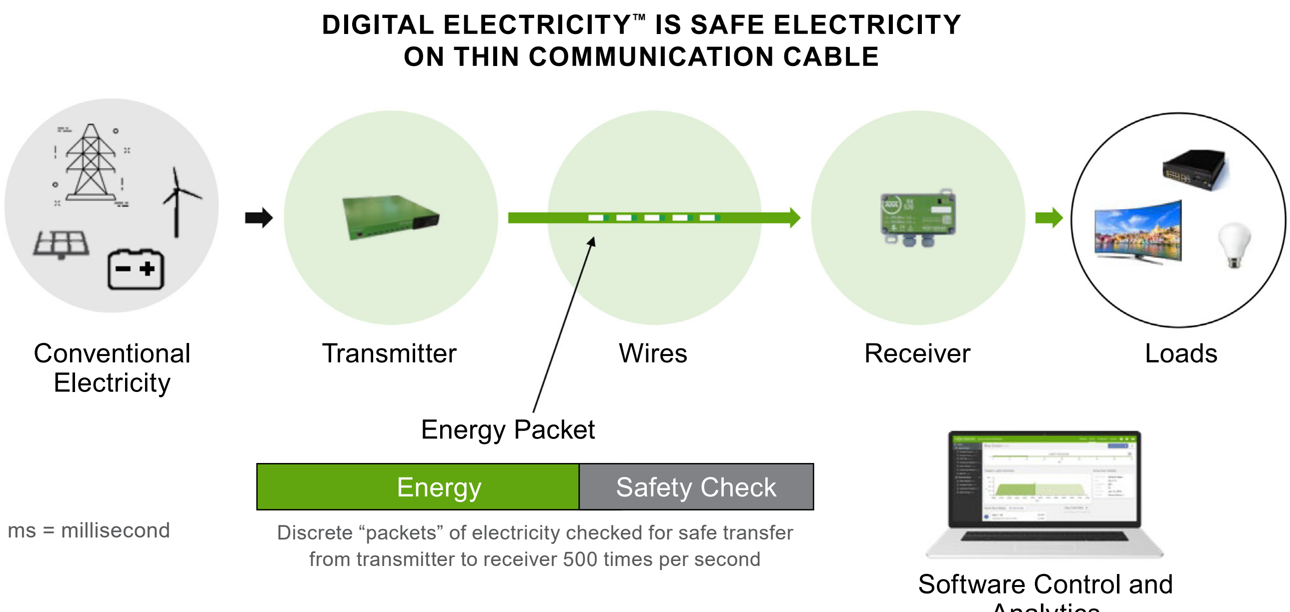

FIGURE 6: Digital Electricity™ VoltServer, Inc. Source: VoltServer, Inc.

There are various configurations of the receiver to allow for AC or DC power to be delivered to the loads. It can be deployed in many environments with benefits including:

- Power levels up to 600W per pair of conductors
- Distance up to 2 km (≈1.2 mi)
- Structured cabling of 16-18 AWG conductors
- Class 2 wiring practices (same as Ethernet or PoE)
- System monitoring and control that is remotely managed
- Scalable for future additions and upgrades
- Deployment is faster due to shared pathways for power and data
- Sustainable with more efficient power distribution, less materials, and the ability to directly use DC renewable energy sources

Looking forward, DE will be included within the *National Electrical Code® (NEC)* 2023 edition under Article 726, and will be referenced as Class 4.

STRUCTURED CABLING CONSIDERATIONS TO SUPPORT POE AND FMP

Think of the structured cabling in a building as the nervous systems in our bodies: a network of connections that supply the pathways for power, data, control, and communications. Smart building technologies, PoE, and FMP all require a robust network that will support reliable and efficient operation for the lifetime of that network.

Some considerations are required and continue to evolve to successfully design, install, and maintain a structured cabling system that will operate safely, efficiently, and reliably.

PoE is not new, having been deployed since the early days of the convergence of IT and voice and data systems, powering voice over Internet protocol (VoIP) phone sets and wireless access points (WAPs). With the Internet of Things (IoT), convergence continues with OT and building systems with traditionally separate and different cabling systems. IoT and the proliferation of connected devices, estimated to be 75 billion by 2025, and the vast amounts of data they generate continue to grow exponentially. This growth is due, in part, to the immense value that is derived from intelligently using the data from these connected devices to improve energy management and safety practices, all while lowering operating costs.

The number of applications utilizing PoE continue to grow with 4-pair cabling increasingly being used to transmit both data and power. A structured cabling system, largely non-application specific, must consider the likelihood of the specific application of PoE. Cabling and connectivity component specification and selection, along with codes and standard-based design and installation practices with respect to current-carrying capacity, become paramount with the transmission of power and data. Amperes, resistance, and heat dissipation are now a requirement along with the performance parameters that define bandwidth and transmission.

The 2017 and 2020 editions of the *NEC* added Table 725.144 for the ampacity of each conductor of 4-pair cables in a bundle. Additionally, the *NEC* added the limited power (LP) designation, providing an alternative to cable selection and deployment methods.

The use of 22 AWG conductors in communications cables is becoming a common practice to decrease the voltage drop or power loss over the length of the cable to ensure the maximum amount of power is delivered to the devices and applications that need the power. Over 100 m (≈328 ft) of cable and up to 88 percent of the power will be delivered over 22 AWG conductors versus 82 percent for 23 AWG. The power loss is converted to heat. Smaller cable gauges dissipate more heat which limits the maximum size of the cable bundles.

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The debate on whether to bundle or not continues. “Bundled” is defined by the *NEC* as *“Cables or conductors that are tied, wrapped, taped, or otherwise periodically bound together.”* Current flow in bundled cables may increase temperature in the conductors or cable that can degrade the insulation. Prior to current flow, alien crosstalk was a potential concern.

Individuality remains and workmanship is undefined, yet good workmanship shows when it is seen. In the case of attention to detail, examples include cable routing, cable dressing, and uniformity, particularly inside the telecommunications room (TR) where a technician can leave their “signatures.”

Laying cables loose in the corridors, whether in a tray or within open top supports, has been a sound approach given the frequency of moves, adds and changes (MACs), allowing easy identification of cables for removal and reinstallation. Whereas bundled cables in this scenario require more time to identify in a tray or open top supports and to remove the hook and loop fasteners placed at various intervals.

Detailed attention to cable routing and bundling in the TR (and elsewhere) will need continued research and guidance and individual solutions. It is not a “bundle or not to bundle” discussion; it is a “when and how to bundle” discussion industry leaders need to address. How does one ensure safety and performance, yet ensure safety and performance while recognizing the importance of these criteria from a visually stunning installation?

Power over Ethernet and FMP will be a part of an organization’s sustainability initiatives with reduced installation costs and energy savings from reduced energy consumption over the life of the system. Fault managed power compliments PoE; both are viable solutions in enterprise networks. The FMP provides a solution for powering the devices beyond the reach of PoE and traditional category type cabling and the channel limitation of 100 m (≈328 ft).

The FMP offers the convenience and safety of low voltage, like PoE, with the power and distance capabilities of AC. When paired with optical fiber cable, FMP conveniently powers and connects devices at locations up to 2 km (≈1.2 mi) away. Deploying FMP equipment and uninterruptible power supply (UPS) with a centralized approach in one or fewer locations provides a scalable and cost-effective solution for the initial installation and over the life of the system.

Furthermore, PoE continues to advance in the levels of power delivered and the types of devices this technology powers. Together, PoE and FMP, which is already being deployed, will radically change the electrical industry, how the work is performed, and possibly who can perform it.

Stephen Eaves, CEO, VoltServer, contributed to this article.

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