COMMSCOPE®

White Paper

Flexible Smart Buildings

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redwood®

Contents

1.0 Introduction

Today's buildings and workplaces are major generators and receivers of data. By capturing and analyzing this data, organizations can gain a better understanding of their operational efficiency, improve their ability to react to change, and increase returns from real estate-related decisions. Improved insight and control can create positive impacts on all aspects of real estate performance—from lease accounting and capital projects to facility maintenance, space utilization and energy consumption. In addition, it is challenging to manage facilities efficiently when the workplace is ever-changing, with a workforce growing increasingly flexible, mobile and home-based. This is compounded by an increasing variety of connected devices, including desktop personal computers (PCs), laptops, smartphones, tablets and Internet Protocol (IP) cameras. Add to this the connectivity of digital signage controls, light-emitting diode (LED) lighting, temperature and motion sensors, wireless access points to distributed antenna systems, and switches to physical/virtual servers and storage. This list continues to grow—ultimately leading to the "Internet of Things."

The proliferation of tablets and other smart devices has increased dramatically in the past several years. Employees have fallen in love with their mobile devices and now commonly carry them to work or when travelling, extending the boundaries of where work can be accomplished. With tighter corporate budgets, Chief Financial Officers (CFOs) are looking to leverage the cost benefits of personally owned devices, permitting some level of personally owned technology to be used on site, a phenomenon known as bring your own device (BYOD). Information technology (IT) and facility management (FM) managers are not only required to support higher speed wireless and cellular networks but also to balance security and accessibility in a BYOD environment.

2.0 Smarter integrated digital infrastructure and real estate management

CFOs use real estate to improve their top-line financial performance by opening new locations, as a source of capital to fund revenue growth, and to consolidate or dispose of under-performing locations to reduce expenses. In addition, pending changes to lease accounting rules—that will place operating leases on the balance sheets of public companies in the United States, Europe and many other countries—will increase the impact of real estate on financial performance.

In today's increasingly interconnected world, the distinction between FM systems and the IT systems that organizations depend upon is increasingly blurred. Indeed, they are now converging into a smarter, integrated digital infrastructure. The real estate and facility managers will find themselves in a position to deliver more business value to their organizations through increased operational effectiveness and improved financial and environmental performance.

Interconnected sensors and integrated systems, combined with advanced analytics, can convert unprecedented volumes of data into insights and actions that make the systems, processes and infrastructures more efficient, productive and responsive. Only through integration of real estate/workplace management processes with other enterprise systems and processes can result in authentic business intelligence. Such integration should cover at least the following key areas:

- Real estate portfolio and lease management
- Workspace management
- Environmental and energy management

In addition, any solution should deliver increased visibility (preferably using dashboards and digital signage), control and automation. Visualization using dashboards and digital signage can help influence occupant behavior.

3.0 Real estate portfolio and lease management

This function addresses:

- Strategic planning (such as site identification, selection and development)
- Capital planning
- Requests for proposal (RFPs) and lease analysis
- Real estate portfolio
- Financial management and analytics
- Tax management
- Lease administration (such as accounts receivable and payable)
- Transaction management
- Maintenance management
- Support for the new 2014 Financial Accounting Standards Board (FASB)/International Accounting Standards Board (IASB) standard, which eliminates off-balance sheet accounting and brings all leased assets onto the balance sheet

Maintenance management consists of preventative and unscheduled maintenance management, warranty management (compliance and administration), work order administration, parts and inventory management, vendor management and building assessment.

In addition, the growing trend toward globalization is also accelerating the need for a worldwide portfolio view of enterprise workplace assets.

4.0 Workspace management

Workspace management is among the hottest subjects for facility managers, as growing cost pressures drive organizations to uncover under-utilized facilities and dramatically reduce occupancy costs by rationalizing and consolidating real estate portfolios. A key driver of this trend to optimize facility utilization and efficiency is the rapidly evolving trend toward an increasingly mobile workforce. Accommodating both existing work styles and the more mobile and virtual workplace modes will require flexible planning capabilities. In addition, the IT and FM managers will have to plan for a BYOD environment.

Workspace management covers functions related to the operations and optimization of facilities, and includes facilities planning, space management, site and employee services management, office "hoteling" and reservation scheduling, physical security administration, remote workforce support, environmental, health and safety, and moves, adds and changes, "what if" utilization scenarios, facilities and space management analytics.

Studies reveal that the average office uses between 30 and 45 percent of its space on a daily basis[1]. The hot-desking concept provides an opportunity to reduce this significantly by eliminating the concept of fixed workspaces. Desks can now be assigned on an as-needed basis.

Workspace management will definitely include Geographic Information Systems-based (GIS-based) location management, Indoor Positioning Systems (IPS), or Automated Infrastructure Management (AIM) systems, which can be integrated with access control systems. Locating assets and people within buildings has value for potentially improving the performance of buildings, businesses and life safety. Indoor location technology is already being developed by some of the world's largest companies, such as Google, Microsoft, Apple, Nokia, Samsung and Sony.

[1] http://www.globalpost.com/dispatch/news/regions/europe/120420/hotdesking-office-space-the-latest-growing office-trend-workplace-culture

5.0 Environmental and energy management

With buildings responsible for about half of all energy consumption and greenhouse gas emissions, establishing, managing, optimizing, and maintaining sustainability objectives is becoming a core driver. Sustainability optimization and compliance is a relatively new but fast-growing function that is focused on the optimization of energy use. It addresses energy management and reporting, waste management, recycling, carbon credit calculation, certification and compliance, such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and renewable energy and water supplies.

Effective sustainability systems must include a comprehensive collection of accurate energy consumption and emissions data and the efficient analysis and evaluation of that data to facilitate informed decisions that optimize long-term sustainability goals.

Integrating HVAC systems with workspace management systems will evolve HVAC from the traditional schedule/set point policy to an occupancy-based policy, thereby optimizing energy usage.

Commercial lighting is the largest usage of energy in buildings. The LED lighting revolution has reached a tipping point in that this technology can now be used for general lighting in almost all applications. The energy-saving potential of LED lighting is a key driver for its increased popularity. LED lighting also has several additional advantages:

- Very long life (50,000 hours)
- Lower maintenance costs
- Small heat footprint
- LED efficacy improves dramatically when dimmed and no dimming ballast is required
- Contains no mercury, in contrast to fluorescent lighting

Another important aspect of LED lighting is that, with appropriate design, it permits the incorporation of various sensor technologies. Sensors for motion, occupancy, light level (daylight harvesting), temperature, and so forth can provide a high-density sensor network that collects data and provides fine-grain control of the environment.

Sensor networks are becoming a key ingredient of smart buildings. They provide insight into systems operation, building usage and location of occupants. When combined with advanced analytics, the data can be converted into business intelligence and facilitate informed decisions on energy optimization, operational efficiency and space utilization.

Further integration between smart meters, automated demand response systems, building automation systems and a smart grid will provide more efficient control between demand and supply of energy.

6.0 Building automation systems

Every building has to meet several basic requirements, such as security, fire and life safety, ventilation, lighting, health and comfort. The systems providing these services are collectively known as building automation systems (BAS). The biggest challenge facing the BAS industry is the myriad protocols, meaning that systems that perform similar functions cannot communicate with each other. It is likely that, over time, as the BAS industry converges to a common IP platform, the integration task will become easier. Combined with building analytics, this converged system will make buildings smarter and more energy efficient. This has already happened in the security and access control industry, where IP closed-circuit television (IP CCTV) cameras and access controls have enjoyed rapid market adoption over the past few years. In addition, the publications of standards for the Institute of Electrical and Electronics Engineers (IEEE) (802.3af Power over Ethernet [PoE] supporting a maximum of 13 watts, and 802.3at Power over Ethernet-Plus [PoEP], supporting an average of 25.5 watts) have helped accelerate the adoption.

The convergence of BAS to an IP platform will be greatly enhanced by the development of a higher wattage PoE (up to 60 watts) under 802.3bt.

7.0 Wireless technologies

Wireless technology is required to support a BYOD environment. This technology can be classified into two broad categories: one operating in the unlicensed industrial, scientific and medical (ISM) frequency bands and the other operating in the licensed bands. The former is for wireless local area network (LAN) applications, based on the IEEE 802.11 standards, and is often referred to as Wi-Fi technology. The latter is for cellular/mobile applications such as Global System for Mobile Communications (GSM, or 2G); Code Division Multiple Access (CDMA, or 3G); and LTE, or 4G.

Wi-Fi technology is now widely deployed in the enterprise space and has provided the primary support for wireless growth in commercial buildings. As with wired LAN, Wi-Fi technology has continued to evolve to higher data rates, with the latest generation under IEEE 802.11ac, which will eventually support aggregate data rates up to 6.9 gigabits per second (Gbps).

When installing a Wi-Fi network, the focus should be on optimizing coverage and ensuring the greatest flexibility for future growth and change. For these reasons, the grid design and telecommunication outlet (TO) placement guidelines provided in Telecommunications Industry Association (TIA) Technical Service Bulletin TSB-162-A and ISO/IEC Technical Report TR 24704 should be followed. TR-24704 recommends that the coverage area of each cell be limited to a 12-meter radius; and TSB-162-A suggests a square grid of cabling areas, each 18 meters wide.

As smartphones become the preferred mode of communications for enterprise users and consumers alike, network managers will find an increasing need to boost cellular coverage in office buildings. The problem is compounded by the use of new building materials to improve energy efficiency, such as low-emissivity glass and the continued evolution of cellular applications to higher frequency and data rates. In addition, emergency services personnel, such as police and fire-fighters, are demanding reliable and ubiquitous radio coverage to ensure public safety as well as their own. Improving cellular/mobile coverage and capacity will require the installation of an in-building wireless (IBW) system, sometimes referred to as distributed antenna systems (DAS). Over time, some of the Wi-Fi and cellular applications will converge into one unified infrastructure platform.

Contrary to popular belief, cabling and wireless technology are actually complementary; wireless technology requires cabling to provide PoE/PoEP to the access points.

8.0 Physical infrastructure

The integration of voice, data, video, wireless and BAS under one uniform structured cabling infrastructure will bring the "fourth utility" concept closer to reality. When constructing a building, the three utilities that are normally planned for are water, power and HVAC. Network cabling infrastructure will be the fourth utility, since it is the superhighway for many business applications and building services.

The publication of TIA-862-A (Building Automation Cabling Standard) and EN 50173-6 (European Norm for Generic Cabling Systems for Distributed Building Services) standards will help accelerate the acceptance of supporting BAS with structured cabling. These standards specify a generic cabling system for BAS used in commercial buildings that will support a multivendor environment. The purpose of these standards is to enable the planning and installation of a structured cabling system for BAS applications used in new or renovated commercial premises. It establishes performance, topology and technical criteria for various cabling system configurations for connecting BAS equipment and devices. It also provides information that may be used for the design of commercial BAS products.

The structured infrastructure approach provides many benefits, resulting in minimizing the total cost of ownership (TCO) and maximizing the return on investment (ROI) of a building property. It also gives the building an inherent ability to quickly and cost-effectively respond to the changing needs of its occupants, which affects the cost to occupy the space. Whatever the initial cost at inception, the lifetime cost of managing the building is potentially lower with this concept due to the flexibility of use of building space, more productive occupants and higher rental revenues.

The integration of voice, data, video and BAS under one uniform structured cabling infrastructure, possibly with separate but interconnected cabling for fire alarms (for circuit integrity connections such as to sounders/bells/sirens circuits, strobe lights and fire-fighters' telephones) is inevitable. However, one golden rule must always be followed for the concept to be successful: The planning and design stage must occur at the very beginning and not as an afterthought.

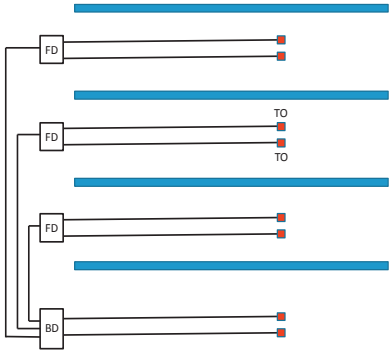

Figure 1: This illustrates a traditional network cabling topology.

9.0 Infrastructure topology

In a traditional network cabling topology, each floor distributor (FD) is star-wired to a building distributor (BD) and each TO is directly connected with a horizontal cable to the patch panel in the FD, as shown in Figure 1. In order to provide greater flexibility, one FD per floor is recommended and an inter-FD cabling link should be installed and a zone distribution system design implemented as shown in Figure 2. This alternative design can provide easier installation, greater flexibility and potentially lower operational expense (OpEx).

The zone distribution model uses cable runs from the FD to specific "building zones." A consolidation point (CP) within each zone allows fixed cabling to be installed up to the CP; drop cabling then runs from the CP to the TO for each required service/application. This approach also provides spare capacity for additional TOs as needed. This strategy is helpful during retrofit installations, where well-placed consolidation points allow long runs of cabling bundles from the telecommunications room to be fixed into difficult pathways. Once the fixed cabling is in place, installers have more flexibility in running and changing extension cable from the CP to the TO serving the required service/application.

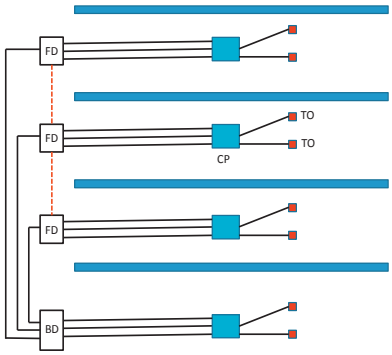

Figure 2: This illustrates an alternative network cabling topology

TIA-862-A defines coverage area as the space served by one BAS device. Typically, a coverage area will have one outlet for each building control application (e.g., HVAC, security, FLS, lighting control, etc.). Table 1 provides the typical coverage area for each BAS link as defined in TIA-862-A. The cell coverage area recommended in ISO/IEC TR-24704 and TIA TSB-162-A should also be taken into consideration together with Table 1.

TABLE 1: THIS TABLE SHOWS A TYPICAL COVERAGE AREA FOR EACH BAS LINK (SOURCE: TIA-862-A).

USAGE OF FLOOR SPACE	COVERAGE AREA (m^2)	ADDITIONAL CONSIDERATIONS
Office	25	In an open office environment, coverage area sizes will typically be greater than in a dedicated office space.
Indoor parking	50	Identify fire, security, carbon monoxide and HVAC requirements. NOTE—may also require voice connections for security.
Retail	25	Security requirements may increase the coverage area density (e.g., CCTV, alarm and access).
Factory	50	Coverage area size may vary according to manufacturing processes, environment and building design.
Hotel	25	Coverage area requirements may vary if BAS services have centralized control (e.g., HVAC, fire alarm safety system and access).
Classroom	25	Coverage area requirements may be centralized for security and access controls. Plan for the unique BAS requirements for each area type (e.g., fire alarm safety system, access control and HVAC).
Hospital	25	Coverage area density is averaged to compensate for a variety of environments (e.g., patient rooms, labs, emergency room and operating room). Plan for the unique BAS requirements for each area type.
Mechanical room	5	Determine location of air handlers, chillers, boilers, pumps, fans, compressors, etc. Air handlers will typically have a higher concentration of BAS devices.

NOTE—coverage area size depends on the BAS application and device. These coverage areas are based on average values from a study of FLS, security and HVAC/EMS applications.

Another design consideration is the number of outlets to be allocated for the CP. Table 2 provides the typical building services and IT applications that should be considered.

TABLE 2: THIS TABLE LISTS TYPICAL BUILDING SERVICES AND IT APPLICATIONS.

BUILDING SERVICES	BUILDING SERVICES	BUILDING SERVICES	IT APPLICATIONS
HVAC/EMS	SAC	Lighting	Voice/VoIP
Chiller	Card readers	LED light fixture	LAN
VAV (variable air volume)	Biometric readers	Motion sensor	Video conferencing
FCU (fan coil unit)	Time/attendance	Daylight sensor	Digital signage
AHU (air handling unit)	Guard tour	Window control	WAP
Actuator	Door lock		DAS
Plenum downflow unit	Emergency door release		Trader voice service (trading turret or dealerboard)
Temperature sensor	Mantraps		Squawk box
	Fixed CCTV camera		Market data service
	PTZ CCTV camera		

If one or more floors have to be sublet, the additional inter-FD cabling links provide the necessary connectivity between the required floors and the star-wired cabling to the BD can be disconnected. However, care should be taken at the design stage to ensure that the total number of connections in a channel do not exceed four.

In addition, preterminated copper and fiber solutions are preferred, as these solutions will not only permit an installation to be completed quickly but also allow most of the constituent products to be reused when a major refurbishment occurs.

10.0 Conclusion

As corporate budgets tighten, organizations are looking at various avenues for cost reduction. In addition, organizations are under pressure to be "environmentally friendly" and are required to meet certain sustainability objectives. By using a smart, integrated digital infrastructure and applying building analytics, organizations can gain better insight and control, improve operational efficiency and reduce OpEx. Underutilized facilities can be rationalized and consolidated through better workspace utilization—which can be achieved by using IPS and/or AIM systems that are integrated with access control systems and intelligent LED lighting incorporated with sensor technologies. The same intelligent LED lighting, incorporated with sensor technologies, can optimize building energy use as well.

Appendix A provides a case study for a commercial office building using CommScope's Redwood solution. This intelligent lighting network solution yields average energy savings of 75 percent—and often more than that—through better insight and control of the lighting energy consumption, occupancy levels and temperature throughout the building.

Organizations can also leverage the evolving trend toward an increasingly mobile workforce and the potential cost benefits of the BYOD concept. However, this requires careful planning to cater for wireless/cellular connectivity and to balance "security" and "accessibility" in a BYOD environment.

Appendix A: Customer success story

SAP, the largest global business software provider, is a recognized corporate leader in energy conservation and environmental sustainability.

"This intelligent lighting network solution is essential to helping us execute on our energy-efficiency efforts, while contributing to a state-of-the-art work environment at SAP Palo Alto."
Peter Graf,
Chief Sustainability Officer, SAP

As part of a comprehensive energy retrofit, they replaced fluorescent lights with LED fixtures powered and controlled by an innovative solution from CommScope's Redwood portfolio. SAP saw instant and ongoing energy savings, reduced operational costs, and an improved workplace environment that they use as a showcase to highlight energy efficiency measures with their customers.

SAP is the highest ranked software company in the Dow Jones Sustainability Index. The company's overall energy strategy includes the adoption of solar power, electric cars, videoconferencing, and DC data centers. SAP is using the California site as a model for energy initiatives they will introduce at their other locations in more than 50 countries worldwide. They called on CommScope's Redwood solution to provide ongoing energy savings from lighting and improvements in workspace and employee productivity through its intelligent lighting network solution.

SUMMARY OF BENEFITS

- *Lighting energy savings of 50 to 75 percent.*
- *HVAC energy savings via occupancy-based HVAC with Trane® VAV system.*
- *Comprehensive data on lighting related energy use, space utilization, and temperature available via the web.*
- *A warm, well-lit workplace that fosters productivity and comfort.*

Variable light levels, significant energy reduction

With the Redwood intelligent lighting network solution from CommScope, SAP can program its LED lights to operate according to specific schedules, to dim according to individual preference, or at certain times of high natural daylight, as well as to switch on and off in response to motion and occupancy. Redwood sensors attached to each fixture allow for flexibility in light levels depending on the amount of light needed for the task at hand. The smooth dimming capabilities also help SAP preserve and extend lifetimes for the LED fixtures by reducing their operating temperatures.

Easy access to energy usage, occupancy and temperature reports

SAP's facility management team used the Redwood solution's web-based reports to better understand lighting energy consumption, occupancy levels and temperature throughout the building. By examining the relationship between occupancy and lighting energy consumption, SAP discovered that occupancy-based time-outs for lighting were set far too long during evening hours. Lights would stay on for up to 25 minutes after janitorial or security staff left a room. This insight enabled SAP to reduce the time-outs to a more aggressive setting, thereby saving additional energy and money.

"This solution provides us data around space utilization and temperature mapping that gives us the insight we need to intelligently operate our facilities off of one platform. Partnering with CommScope has empowered us to carry out strategic facilities planning and pioneer new best practices. I highly recommend them."
Larry Morgan,
SAP Head of Operations,
Palo Alto and Vancouver Regions

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