EXTREME NETWORKS EBOOK

Smart Building Infrastructure:

The Benefits of Connecting People, Processes, Data, and Things with Integrated Network Technology Solutions

This eBook will cover:

- What is a Smart Building?
- Opportunities, Demands, and Requirements
- Smart Buildings and the Internet of Things
- Market-Specific Benefits

Given that the information network is today the circulatory system of any organization anywhere, regardless of size, geography, and mission, organizations continue to do whatever is necessary to assure that their networks are available, reliable, cost-effective, and otherwise suited to their mission-critical role, it's essential to ask what additional elements of organizational operations might benefit from a network-centric strategy. And one obvious direction here, already seeing broad adoption across essentially every market and application, is the rise of the smart building

While the precise definition can vary, the basic attributes for smart buildings of any form are as follows:

ENERGY AND ENVIRONMENTAL

First and foremost, a smart building optimizes energy use. While almost all new construction today is designed around the concept of a "green" building, minimizing energy consumption and optimizing energy efficiency via inherent architectural design, construction materials, layout, and operation, adding intelligence can have a dramatic impact on energy use, as people move throughout the facility and as localized demands for energy use change both instantaneously and in patterns over time. HVAC, lighting, and many more elements of facilities management are amenable to the automation and optimization techniques integral to smart buildings.

INTEGRITY, SAFETY, AND SECURITY

Smart buildings can take advantage of advanced security mechanisms, from physical access control, to video surveillance, fire alarm, fire-suppression and other emergency, health, and safety situations, and more, even across multi-building campus settings. As security requirements vary with the specific nature of a given organization's operations and the specifics of an organizational security policy, flexibility in the techniques and degree of automation applied here are essential. And, as this element cannot tolerate failures, integrity is also essential in this aspect of any smart building.

PRODUCTIVITY AND SOCIAL RESPONSIBILITY

And, finally, smart buildings ultimately optimize for the productivity of the staff occupying them. Providing worker comfort, minimizing unnecessary motion, and otherwise assuring a productive environment are essential, with the added bonus of being able to advertise a high degree of social responsibility along with all of those productivity gains.

Perhaps most interesting of all, the smart building fundamentally leverages the exact same network that is already at work optimizing productivity, supporting all required applications, maintaining information security, and minimizing costs.

Think of the smart building as another app on the network, enabling and optimizing the flow of a new type of traffic.

In so doing, though, it's fair to ask what new requirements will be placed on the network. While many think of smart-building operations as presenting only minimal traffic and duty-cycle demands, the opposite can in fact be the case – video surveillance comes to mind here, of course, but the myriad of sensors along with new applications and their servers, many just emerging today, will likely necessitate an audit of current network resources and operations. This drives new planning activities, network enhancements and upgrades, and even modifications to operational strategies, policies, and procedures as appropriate.

Properly-functioning smart buildings are not a slam dunk. Smart-building networks manage and optimize the flow of not just information, but also people and, as required, material as well. And smart-building implementations must, of course, be as cost-effective, cost-efficient, and synchronized with overall strategies and objectives, just as is the case with any other major organizational initiative. Let's take a look at the requirements involved here and see how these objectives can be achieved.

Opportunities, Demands, and Requirements

Given that smart buildings are becoming another app on the network, and given that networks today are evolving towards having the capacity sufficient to handle even very heavy, prioritized traffic flows, one might be tempted to think that the traditional overprovisioning of network resources would be all that's required to implement and optimize a smart-building implementation. Tempting as that thought might be, though, such simplicity can present a challenge.

While smart buildings can indeed be viewed as another app on the network, they will likely present a number of very demanding requirements, depending upon venue and specific functions. These demands can include:

COVERAGE

Coverage used to mean having an Ethernet port within reach, but today it more often refers to the reach of an organization's Wi-Fi network. More specifically, the key metric here is rate-vs.-range, or how much throughput is realized at a given distance between the endpoints of any given wireless connection. Smart buildings usually demand adequate service all the way to the exterior walls of the structure, and often with universal coverage between those walls – and, sometimes, beyond, as in the case of campus-area deployments where outdoor service is often required.

CAPACITY

But, as throughput requirements vary with application, even more important is overall solution capacity – the ability to handle all required traffic with the throughput required by each application, and with minimal connection latency. Products based on Wave 2 of the IEEE 802.11ac standard have the performance required here, with support for older 802.11 technologies as required, and with price/performance characteristics that make any upgrades and replacements, or simple infrastructure evolution over time, easy to justify and very cost-effective. Assuming, then, the installation of contemporary Wi-Fi technology, capacity is consequently a relatively minor concern in most smart-building projects.

ExtremeWireless AP3921i Wall Plate AP

COST CONTROL

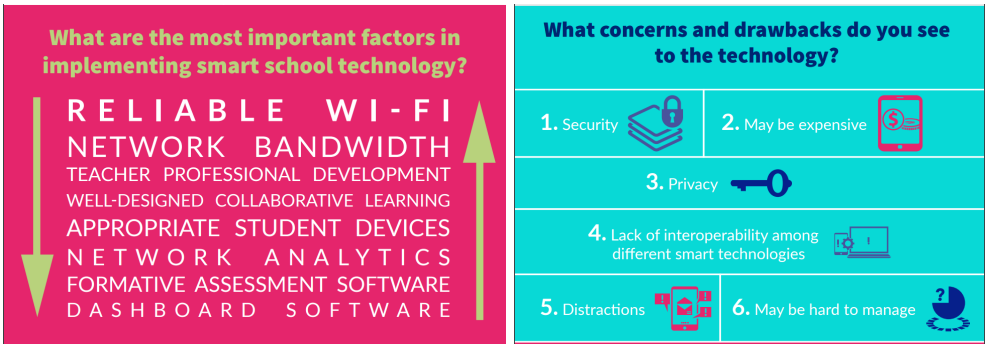
A real advantage to the smart-building strategy is the leveraging of existing network infrastructure to meet smart-building objectives. As we noted above, some network upgrades are to be expected as a matter of course, benefitting all applications beyond smart building functions alone. But any additions required just for smart-building operations are likely to be few in number, enabling the cost of any smart-building operations to be amortized as easily any other network application.

OTHER UPGRADES

Finally, some additions to wired infrastructure, typically in the form of additional switch ports provisioning connectivity and power for additional access points, along with enhancements to management systems, may be required as well. Switch ports, however, continue to exhibit remarkable price/performance with each new generation of Ethernet-switch products, and management software is best evaluated in terms of the enhanced productivity realized by operations staffs and the end users they support. A cost/benefit analysis is of course required in each individual case, but any upgrades required here to support smart buildings will typically be few in number, very cost-effective, likely required regardless of the deployment of smart building services – and will otherwise literally pay for themselves in a relatively short period of time.

The bottom line here is that smart building deployments will have a minimal impact on IT capital and operating budgets, with the benefits leveraging the existing network.

The rise of the smart building presents yet another opportunity to look into Cloud-based services, both private, and, increasingly, public (i.e., those provisioned by a managed service provider), a direction that will clearly benefit many IT activities from app deployment to network management and beyond.

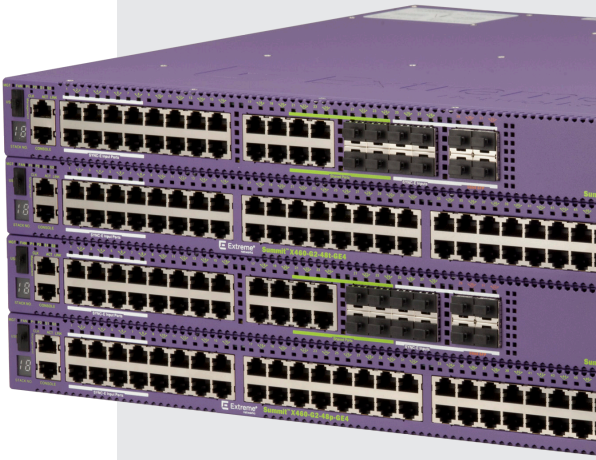


Mobility Is Driving the Internet of Things Smart School [Infographic] – Read More

Drilling down, specific smart building network requirements to meet the demands discussed above include the following:

WIRED NETWORK

Apart from the additional network traffic, the volume of which will be a function of specific services at work in a given venue, smart building applications run transparently across existing Ethernet infrastructure. This is a key point – while a good number of smart-building solutions today are still for historical reasons based on proprietary networks, wireless technologies other than Wi-Fi, and unusual system architectures, such should be avoided. The potential pitfalls here can include complex and difficult installations and deployments, limited functionality, limited support, rapid obsolescence, and increased capital and operating expenses. Again, **leveraging the existing network is key.**



X460-G2 Series Switches

We also expect that the software-defined network (SDN) will play an increasingly-important role in organizational networks going forward, and that smart-building applications will be among the first to benefit from this evolution.

WIRELESS NETWORK

Similarly, the standard access points already in place to provide IP services to end-users can easily handle smart-building operations with no changes, modifications, or re-thinking of operational strategies, although a few more APs may be required to assure coverage within and across the entirety of a given facility. Wave 2-based APs will have more than sufficient capacity, so the work involved here will be limited to examining traffic flows over time, tuning system settings using analytics tools (more on these below), and perhaps minor changes to operational policies.

We expect the majority of commercial-grade smart-building devices to use Wi-Fi in order to leverage the network already in place. While proprietary, limited, and ad-hoc building-automation solutions have traditionally been deployed, they are best viewed simply as closed implementations and thus no longer a cost-effective option. And, given that the performance differential between wire and wireless at the edge of the network (often called the access layer) is now as minimal as it's ever been, the only real challenge here will be, as we noted above, related to coverage, and not throughput or capacity.

IT AND NETWORK MANAGEMENT AND OPERATIONS

The deployment of smart-building services presents an excellent opportunity to reconsider current network operations solutions – not because smart buildings necessarily represent a massive increase in workload for operations staffs (they don't), but rather because the addition of new mission-critical applications should, we suggest, always motivate such. Contemporary management systems, which have yet to be put in place at many sites, can include Cloud-based deployments for access-anywhere convenience and productivity; centralized and uniform access control; policy-based strategies that minimize configuration efforts (and with new APs being self-configuring regardless); APIs for extensibility, customization, and future-proofing; monitoring and enforcement of appropriate regulatory policies; and unified operating and control software implementations across all functional units.

The primary goals remain high visibility, rapid resolution of issues as they occur, maintaining security per policy, maximizing staff productivity, and minimizing costs across the board.

SECURITY

And, finally, the importance of physical and information security demands a careful consideration of all aspects of this element. Some have minimized security requirements for smart-building elements, with such cavalier statements as "it's only a light bulb; what kind of security challenge could that be?" The answer here is, however – a big one. Very smart hackers with a strong desire to cause mischief and much worse are hard at work every day, demanding that all networks and the systems and solutions that depend on them be hardened against attacks, single points of failure, and even the unforeseen and unknown threat.

The key starting point here, of course, is an organizational security policy, and extending the provisions of this document for smart buildings is straightforward in most cases. The security capabilities of the network itself are also key here, including access control, authentication, identity management, and traffic encryption.

*But equally important are the security **benefits** that smart buildings bring to organizations everywhere.*

Analytics Tools are Essential in Smart Buildings

A key recent addition to the management and operations arsenal that will become essential in smart buildings is analytics tools.

In addition to obvious benefits in terms of productivity, cost control, and the other objectives we noted above, analytics provides a simple way to monitor for quality of experience (QoE) across the entire user base – including any functions related to smart building services.

These solutions take large amounts of uncorrelated, disparate, and often multi-variate and multidimensional operational data, and look for patterns that can indicate, just for example, congestion, security issues, problems just emerging, and much more; and present this information in an easily-understandable. format to operations staff members.

For example, wireless motion detectors, security cameras, and badge or other ID readers can be used to continuously and cost-effectively monitor any part of a structure (see below for more on location and tracking). Ditto for environmental monitoring (for example thermal anomalies, fire, water metering or flooding conditions, and more), emergency services (panic button, directing medical staff, etc.), and beyond. The integrity and overall availability of these capabilities are just as important as any other element of overall security, which, after all, they fundamentally and essentially enhance.

Smart Buildings and the Internet of Things (IoT)

The *Internet of Things (IoT)* is rapidly becoming at the very least the conceptual basis for the smart building. IoT is a relatively new term, but this concept builds on a rich history of monitoring, telemetry, sensor-based computing, and automation that has been a part of many industries for decades. IoT also builds upon another relatively new term for an established capability, *machine-to-machine or M2M*, but adds the fundamental element of IP-based communications, making IoT instantly compatible with organizational networks and the Internet overall. This advance is thus relatively minor in terms of complexity, but absolutely *enormous* in terms of long-term benefits.

> *Operations, applications development, scalability, security, and integrity are all enhanced via the IoT strategy.*

It is now clear that IoT will benefit essentially *every* telemetry and M2M application, dominating, as a consequence, the smart building opportunity – which, by the way, is *enormous*, involving perhaps *billions* of new endpoint devices deployed globally over the next decade.

Note, however, that not all of these devices will be of the low-demand/low-duty-cycle nature that is often associated with remote sensing and control applications. Many will involve, for example, high-resolution and high-frame-rate video surveillance, in addition to the continuous monitoring of environmental and security conditions. And, regardless of application, adequate bandwidth for low-latency operations is essential in meeting both user expectations and application performance constraints.

In addition, of increasing interest is the use of wireless networking technologies for in-building (and, again, even campus) location and tracking of people and objects as they move throughout a facility. Both Wi-Fi and Bluetooth Low Energy (BLE) beacons are already at work here, with asset tracking a very straightforward addition to any network. In addition to assisting in tracking key staff, patients and vital equipment is hospitals or assisted living facilities, and the flow of materials in a manufacturing or distribution setting; smart buildings can take advantage of location and tracking information adjust HVAC, lighting, and other environmental factors automatically, minimizing energy consumption and reducing operating expense while not interfering with staff productivity in any way.

ExtremeWireless AP3916i Surveillance AP

> *In short, IoT enables enhanced data collection for better business decisions, ease-of use for customers and employees, the use of real-time data to increase productivity, and, when based on Wi-Fi (which, by the way will be by far the most popular IoT radio technology), further leveraging existing infrastructure, and again minimizing costs.*

Add in the benefits of the advanced network management capabilities and Cloud services that we noted above, and operations staffs can easily manage even large, multi-site facilities and their related smart-building capabilities with minimal additional effort and cost.

Smart Buildings: Market-Specific Benefits

It's easy to see how the market drivers and technological requisites for smart buildings are already present. Let's look next at key market and application domains to see how each benefits from the smart-building strategy.

> *Our goal, regardless of mission, industry, or scale of a given deployment, remains optimal business outcomes as evaluated in terms of productivity, cost control, reliability, and seamless scalability.*

And keep in mind that while the cost models of IoT and smart buildings are new and still evolving, telemetry, control, and automation have a long history of making very positive contributions to cost control. We expect, then, that the relatively minor shift in thinking involved in moving to IoT-based smart buildings will shortly demonstrate enormous benefits in terms of end-user quality of experience, comfort, productivity, and even overall competitive advantage. It is, however, also important to note that user privacy remains a concern, and is unfortunately often a moving target. This factor is today best addressed via common-sense local policies and staff agreements, along with appropriate legal advice.

With that out of the way, let's look at how smart buildings can provision a broad range of benefits in a wide variety of markets and applications:

PRIMARY/SECONDARY AND HIGHER EDUCATION

The enhanced mobility enabled by smart building technologies increase student engagement, facilitate educational personalization, and enhance creativity while also lowering costs, improving security, and overall increasing student success. Such capabilities as network-based video surveillance cameras, online help, tutoring and testing, wearables for athletics and attendance tracking, environmental control and monitoring, and even assuring that a given student gets on the correct bus can all be part of a smart-schools strategy.

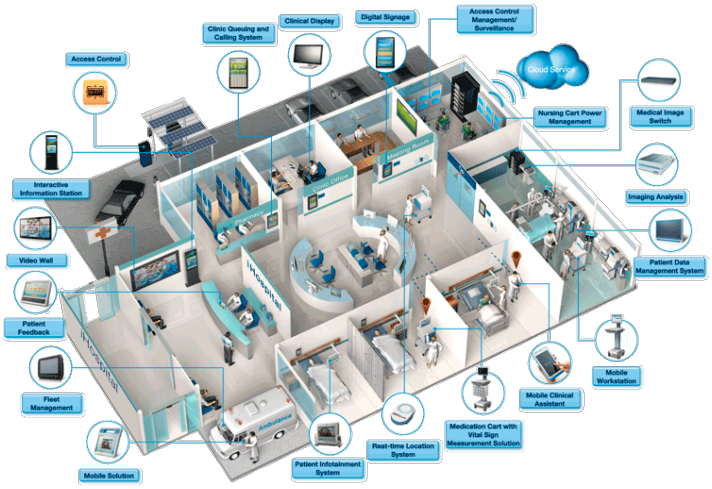
HEALTHCARE

No market is more mission-critical than healthcare, with the primary overall goals of improving outcomes, enhancing cost efficiencies, and dealing with specialized environmental requirements. Smart buildings here can locate critical equipment, automatically direct and track patients as they move from department to department, integrate clinician communications with location services, monitor for environmental issues, optimize for cost-effective operations, and provide valuable data to aide in facility planning going forward.

RETAIL

Retail today isn't just about having the right products available; rather, perhaps even more important are the optimal customer service and satisfaction that differentiate one retailer from another. Providing enhanced physical security, loss prevention, stock management, environmental cost management, and even in-store directions and self-checkout are all enabled via smart-building technologies.

Solutions for your Industry, Results for your Organization



MANUFACTURING, TRANSPORTATION, AND DISTRIBUTION

Optimal material flow depends upon location tracking, an inherent capability of the Wi-Fi network at the edge of the smart-building network. Managing and minimizing the costs related to harsh or complex environments will also be important here.

TRAVEL AND HOSPITALITY

Facilities designed for large, transient groups will benefit enormously from the smart building strategy. Hotels can improve guest service, the efficiency of meeting and conference facilities, and manage environmental costs more effectively. Location-based services (including directions and wayfinding) are also vital in airports and other transportation hubs, and many aspects of the security so essential to modern travel are also enhanced.

SPORTS AND ENTERTAINMENT

Wi-Fi is rapidly becoming essential in sporting venues, including stadiums. Large venues benefit from the obvious, as where the nearest food vendor or restroom might be, but also to enhance the game experience with custom content such as replays, statistics, and even augmented reality. Smart-building strategies also fit quite nicely in smaller settings, including auditoriums, and theaters.

ENTERPRISE

There is really no enterprise or commercial organization that cannot profit from the benefits that accrue from the smart-building approach, as we've discussed in this document. Extensibility and enabling seamless growth over time are key.

PUBLIC SECTOR

Most of the benefits above also apply to government, and enable the concept of smart cities. Smart cities can apply a wide variety of network-based techniques to parking management, traffic control, lighting, utilities, environmental monitoring, surveillance, and, yes, even smart municipal buildings, again with improved cost-effectiveness and overall quality of life.

And, finally, many of the above application areas will in addition require support for outdoor operations and services in some cases. These can include patios, parking areas, campuses, so equipment capable of performing in harsh weather conditions may be required.

It would be difficult to imagine any organization that won't be taking advantage of the smart building over the next few years.

Conclusions

The trend here is clear – every building is going to be a smart building. And the key to smart-building success is in leveraging network infrastructure with the coverage and management to make this outcome a reality.

Smart buildings, again, can indeed be viewed as just another application on the organizational network, and properly implemented, smart buildings simply represent new traffic that can be accommodated via additions (primarily access points and Ethernet switch ports) to current networks, along with the appropriate upgrades and improvements always in the plans at any given facility. When properly implemented, the benefits inherent in smart buildings will pay for themselves in a relatively short period of time, with the bonus of obtaining additional operating information that will aid in making better overall organizational decisions in the future.

Completing the opportunities we've explored in this document, let's also extend the smart-building model we've outlined here for organizations of all forms and smart cities to smart homes. "Home automation" has been around for decades, but only as point-product, limited-function solutions often missing key capabilities, weak on interoperability, and with little-to-no extensibility. Successful residential solutions must also clearly be network-based, and we even expect to see many home offices literally connected to organizational or service-provider facilities via the private or public Cloud model.

In summary, given that all the benefits of smart buildings will be applicable to all of the organizations, markets, and applications that we've discussed in this document, ultimately only one simple rule applies – smart-building (and beyond) success depends upon planning, configuring, installing, operating, and leveraging the network infrastructure that's already hard at work.

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Data Sheet

[eBook] The 5 Essential Elements in the 802.11ac Wave 2 Business Case

[Case Study] How East Grand Rapids Used Analytics to Transform Into a Smart School

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