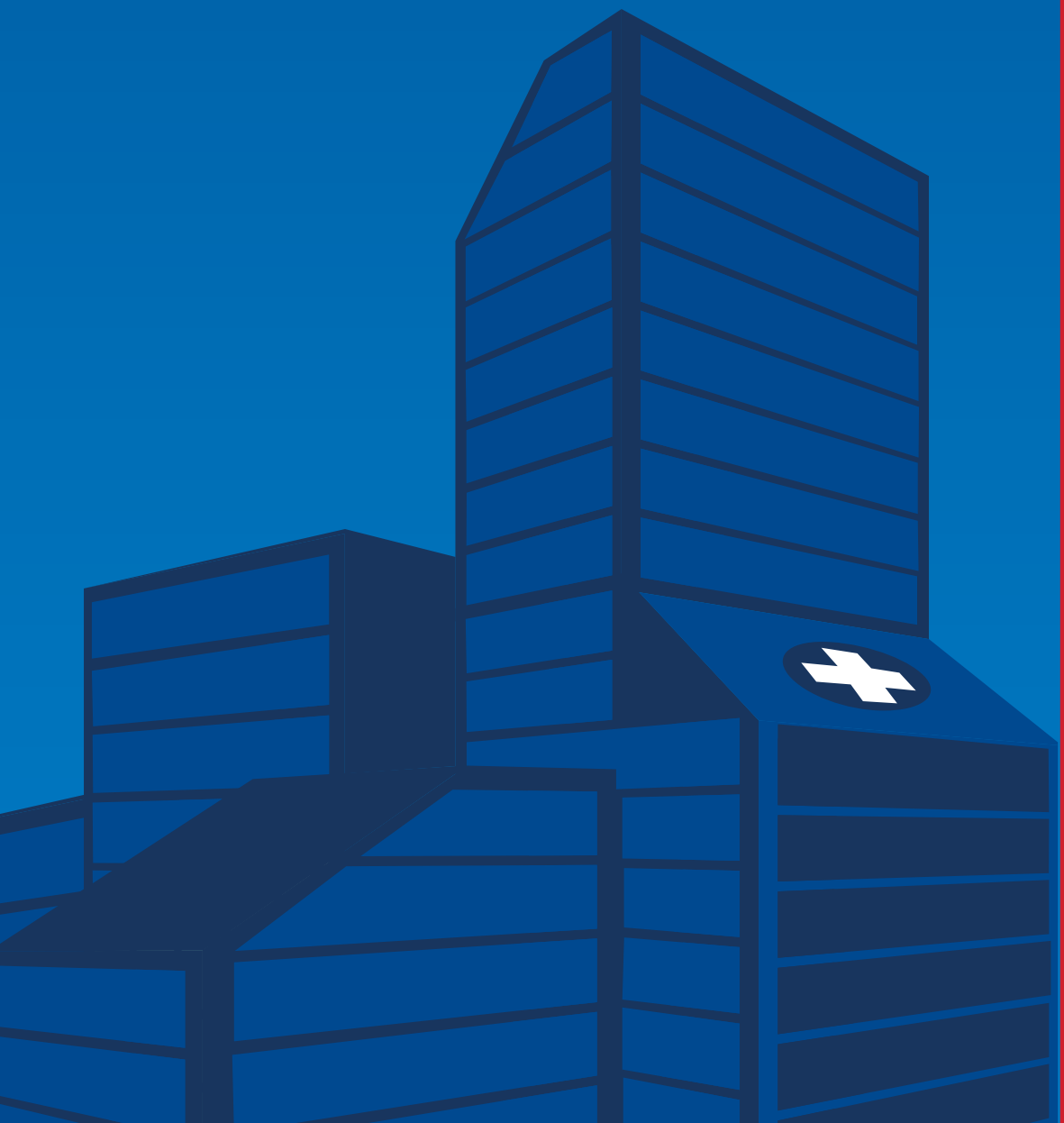
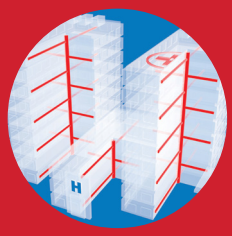
ANIXTER

GLOBAL TECHNOLOGY BRIEFING

SMART HOSPITAL INFRASTRUCTURE BEST PRACTICES



RISK MANAGEMENT



NETWORK PERFORMANCE

POWER OPTIMIZATION

COMMUNICATION EFFICIENCY

IoMT ENABLEMENT

Infrastructure as a Platform
by Anixter

How do you define best practices in your healthcare facility?

Introducing Infrastructure as a Platform by Anixter for an agile, flexible and scalable solution.

Healthcare environments are continually evolving to meet the needs of patients. New technologies provide administrators the opportunity to improve patient satisfaction and outcomes through connectivity and access to information, while also achieving regulatory compliance and optimal building efficiency. An agile healthcare facility allows you to plan and build with interoperable technologies that fulfill current demands, as well as scale as needed to meet future requirements.

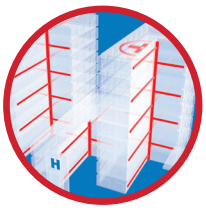
Infrastructure as a Platform addresses the foundations of patient-centered interoperability that can provide agility for budgets, scalability for demand and flexibility for technology choices.

This approach not only addresses the five key technology areas, but it also integrates innovative solutions to meet your assessment and deployment needs.

Anixter's site-specific deployment solutions allow you to more accurately plan projects and improve scheduling, reducing non-productive labor and on-site assembly challenges.

Healthcare Infrastructure Solutions

RISK MANAGEMENT: Anixter has defined a **six layered physical security approach** that provides you with the ability to deter, detect, delay, defend and deny at every layer of your healthcare facility. This approach reduces the risk of a breach and increases your peace of mind.



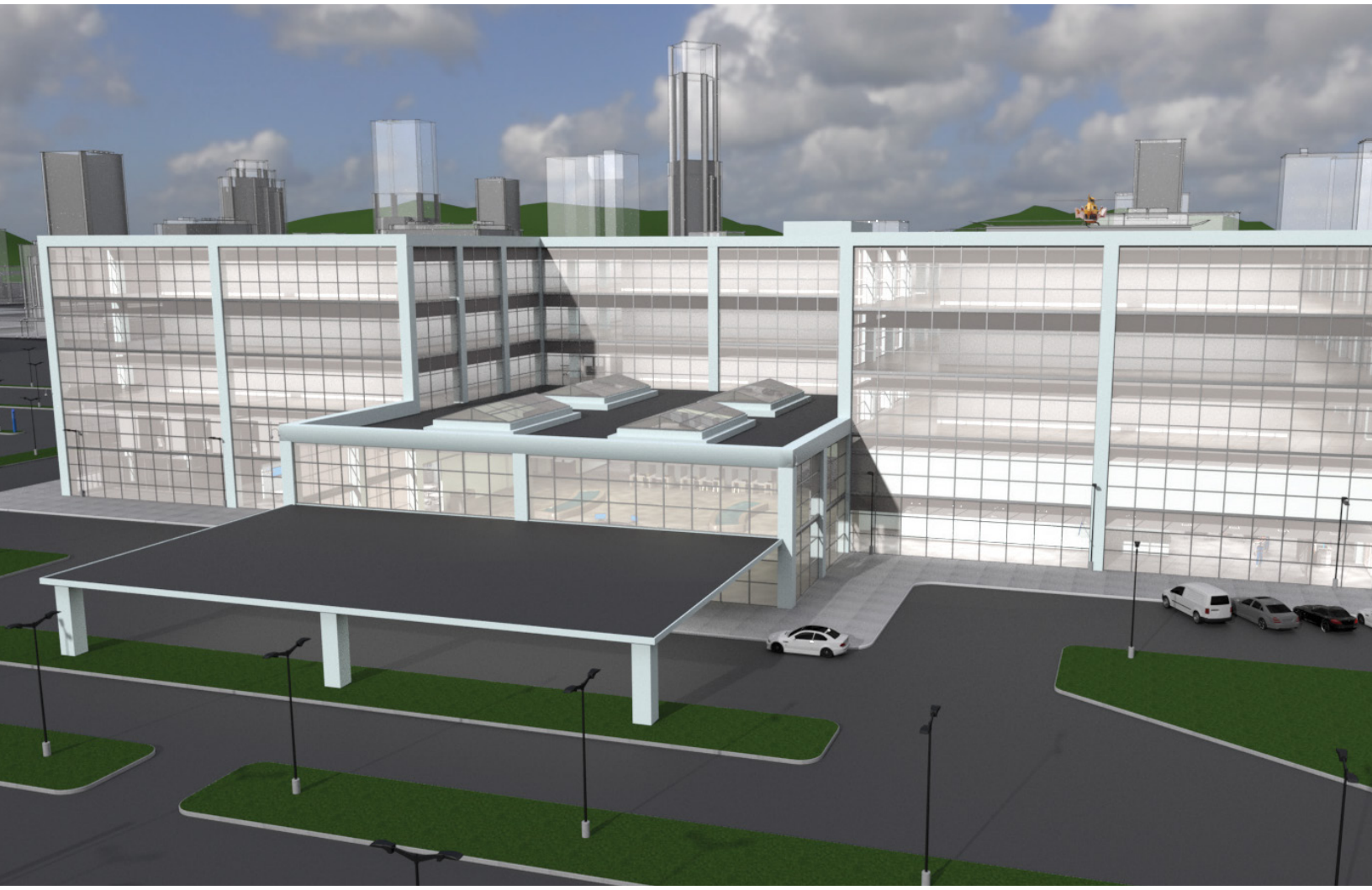
NETWORK PERFORMANCE: More than ever before, a high-performance structured cabling system plays an essential role in operating a modern healthcare facility. Without it, you cannot achieve the best practices of **versatile physical layer connectivity**, which is required to support multiple applications, cope with increased bandwidth and eliminate network downtime.

POWER OPTIMIZATION: When evaluating critical power in a healthcare environment, multiple factors such as facility, backup, conditioned, efficient and monitored power must be considered. Developing a **critical power chain** that starts at the grid and flows through healthcare equipment and devices will make sure those considerations are met.

COMMUNICATION EFFICIENCY: Communication is the driving force behind patient care. Improving responsiveness, providing seamless wireless availability, and reducing noise pollution require **targeted healthcare engagement,** where new technologies can simplify the flow of information between healthcare staff, patients and administrators.

IoMT ENABLEMENT: Enabling the Internet of Medical Things (IoMT) in your healthcare facility allows you to analyze your environment, and make real-time adjustments to improve efficiency and productivity. The **five senses of an intelligent hospital** address the challenges of open-architecture design, supplier integration and migrating to an IP platform.

To learn more about Anixter's approach to helping you solve these challenges, visit **anixter.com/healthcare.**



CONTENTS

INTRODUCTION

What Is a Smart Hospital?

The overarching goal of a healthcare facility remains the same. Facility operators seek to provide an ideal environment that promotes the best possible care for patients. They need to do so efficiently in order to control costs and improve the speed of delivery.

Innovations in technology and care methods as well as changing patient expectations have created an opportunity for healthcare facilities to utilize the resources of big data, building automation and the Internet of Things to advance patient care and increase productivity of clinicians and staff, as well as the building itself.

Smart hospital design is not a set standard that defines a facility as intelligent or not. Rather it is an approach that encourages facility managers to look at each division of their operation through the lens of smart technology and find real solutions to real challenges to achieve improved patient outcomes and operational productivity. If executed properly, with specialized attention to open architecture interoperability, building operators will be prepared to apply new technologies to the challenges of today and tomorrow.

Understanding This Resource

This report provides insight into various industry trends and explores the particular environments of healthcare facilities, ultimately addressing the fundamental elements required to migrate to a smart hospital platform. It will be helpful for anyone tasked with providing safe and secure environments, enhanced network connectivity, critical power, efficient communications and a more automated environment for building efficiency and patient care.

In each section, you will uncover key trends in the industry, explore the top challenges faced by building managers and gain insight into clear solutions that can solve the most difficult of challenges.

THE EVOLUTION OF HEALTHCARE FACILITIES

In recent decades, medical delivery has undergone a dramatic transformation from facility or clinician-centered care towards patient-centered care. Physicians and administrators are now taught to see people using health and social services as equal partners in planning, developing and monitoring care to make sure it meets their needs.

This shift has been in response to soaring costs of care and a preference for personalized attention, which is having an effect on all industries and has been shown to deliver improvements of health outcomes.

This patient-centered approach now goes beyond doctor-patient interaction to include the healthcare facilities crucial to treatment and recovery. From accessible digital records and 24/7 patient monitoring to visual engagement and wireless connectivity throughout a facility, the technologies that improve patient care and the patient experience are essential to operating a modern healthcare facility.

Technological Innovation

Technology is a main driver for change, no matter the industry. In healthcare facilities specifically, major technological innovations have occurred both in infrastructure and in the tools utilized by staff to administer care.

Beyond the innovations in medicine itself, breakthroughs occur every day with new medical equipment and care methods. More and more, this equipment utilizes connected technology and data to better analyze and deliver care.

Advancements in Patient Care

Patient Data

Gone are the days of endless file cabinets with stacks of patient records. The move towards Electronic Health Records, or EHRs, was at first simply about efficiency, manageability and reducing human error. It is more efficient for a provider to access a file than to constantly dig up and re-organize a paper record. At this point, market adoption of EHRs approaches 90 percent.

Now, the opportunity with patient data goes far beyond the individual. Care providers want to be able to share more medical data with more stakeholders for more purposes, some of which include research and diagnosis across patients and populations.

Wearables and Biotelemetry

Innovations in biotelemetry have become almost commonplace with consumer products like the Apple Watch and Fit Bit. Modern healthcare is defined by the ability to constantly monitor patients, whether or not they are actively in a facility. Sensor technology, including things like activity trackers, automated insulin machines and connected ingestible tablets, allow providers to be more predictive and proactive in treatment.

Virtual Care

The digitization of medicine has opened opportunities to access expert insight and treatment across an unlimited amount of miles. Whether someone inside a facility is seeking an opinion from an expert in a different facility, or patients at home are looking for a quick checkup or diagnosis, virtual care is aiding in the efficiency and quality of care.

Sources: Health Innovation Network.
Gartner, Market Trends: Four Major Opportunities in the U.S. Healthcare Provider Market.

INTERNET OF THINGS

The Internet of Things refers to the interconnectivity of physical "connected" or "smart" devices, buildings and other electronics or software, which enables them to send and receive data across the network.

The trend toward the Internet of Things (IoT), and more recently the Internet of Medical Things (IoMT), which addresses the unique demands of a healthcare environment, allows building managers to analyze their facility and make real-time adjustments to improve operational efficiency and productivity.

Just as smart people require information to make good decisions, smart buildings require data to operate intelligently. The challenge lies in enabling the building to capture, analyze and act upon data across what can often be a series of disparate systems.

Gartner, Ibid.

More than $100 billion is spent globally every year by healthcare providers on IT, on top of the $33 billion spent by health insurers. There is a tremendous amount of investment right now looking to capture the potential of digital innovation in healthcare.

Green Impact

Present in many discussions surrounding smart innovations is the collective desire to counteract the negative effects healthcare facilities can have on the environment. Case in point, hospitals have more than 2.5 times the energy intensity and carbon dioxide emissions of similar-sized commercial office buildings.

IBM estimates that around 50 percent of all energy in commercial buildings is wasted. Industry leaders are taking advantage of smart technologies to not only reduce their negative impact on the environment but also to generate enormous cost savings.

Addressing the critical power chain, including facility, conditioned, backup, efficient and monitored power, can help an organization achieve sustainability and cost savings goals.

Sources: U.S. Department of Energy.
IBM, Energy and Environment. https://www.ibm.com/ibm/green/smarter_buildings.

REALITIES OF THE HEALTHCARE MARKET

Lack of Adoption

Despite the vast potential for efficiency and improvements to patient care within a smart hospital, the reality is that many healthcare facilities have not taken the steps required for migration to an intelligent platform.

This is likely due to the prevalent lack of understanding throughout the industry on what constitutes an IP-enabled open-architecture environment, as well as what the key elements of its functionality are.

Interruption of Service

Even more so than in a standard commercial environment, interruptions in service to an existing healthcare facility are complicated and undesirable, given the consistent levels of care required. Any upgrades to connected technology require precise planning and deployment.

Cost a Top Barrier to Adoption

Prominent surveys have found time after time that cost is a chief barrier to migrating to a smart building platform. Although there is a wide variance in the cost of open-architecture solutions, many budgets don't account for this expense.

Another barrier as it relates to cost is implementation. This differs from the cost of the product, yet is as much of an obstacle for deployment as any initial product investment. Facility managers need to consider the costs beyond deployment, such as:

- Time
- Dedicated internal resources
- Education
- Installation
- Integration

IT and facility team collaboration (or lack thereof) can have an impact on moving forward with healthcare facility interoperability. This is because getting the budget finalized for such a large purchase could be hindered by competing interests and priorities. Although interoperability bridges the gap between these traditionally soloed groups—IT and facilities—sourcing funding from them can be problematic.

Proving Return on Investment

Proving return on investment (ROI) is essential to smart hospital design because this is not a one-time-fix-all solution.

A smart hospital platform can support technological innovation and serve the needs of a healthcare environment well into the future. Energy savings and improved patient care are the two key elements to consider in terms of ROI, and each present their own unique challenge in analyzing outcomes. If executed properly and aligned with hospital goals, a smart building approach can save money or be cost neutral in the short term.

When businesses try to bring everything under one centralized solution and take on all issues at once, it makes proving ROI even more difficult. Sometimes the best approach is to find small wins or to solve one particular challenge first. Once the challenge is identified along with an estimate of how much it costs the business, building managers can estimate how an intelligent solution would help the business fix the problem. Those can be hard numbers (e.g., inefficient cooling systems tied to electricity costs), or they can be softer numbers (e.g., productivity gains from better business processes).

ROI and Getting Approval from Finance

There are some key lessons that can help justify funding for smart building solutions.

- Understand common, costly healthcare facility challenges that can be fixed with intelligent solutions.
- Identify the high-value problems inside a healthcare facility.
- Measure what these problems actually cost
- Learn to align the smart building project with corporate objectives.
- Build, identify and sell an ROI model to the decision makers.
- Identify the challenges with traditional systems, such as cybersecurity, access to data and supplier lock-in for maintenance.

In order to develop a road map that will propel your premises toward a smart hospital platform, it's important to identify the key challenges and considerations within healthcare spaces, which can be broken down further, depending on your unique situation.

Based on trends, industry leaders are looking for ways to make progress in the following areas:

SMART HOSPITAL CHALLENGES

Managing Risk

Healthcare facilities contain a number of complex areas that require a balance of specialized attention and integration into an overall risk management strategy. Securing patient-centered, pharmaceutical and biomedical zones are essential to improving patient satisfaction and achieving regulatory compliance.

Enhancing Network Performance

More than ever before, a high-performance structured cabling system plays an essential role in enhancing network performance and improving patient care in a healthcare facility. Versatile physical layer connectivity guides the creation of an open-system platform, where the right media selection, cabling topology and density of interfaces will increase the scalability of the network.

Optimizing Power

Quality patient care requires uninterrupted power throughout a facility. Building a critical power chain can help you achieve an always-on environment, while also reducing costs through energy-efficient solutions.

Improving Communication

Research shows that good communication is the driving force behind quality care. Improving responsiveness, providing seamless wireless availability and reducing noise pollution require targeted healthcare engagement, where new technologies can simplify the flow of information between healthcare staff, patients and administrators.

Enabling a IoMT Environment

The Internet of Medical Things (IoMT) brings into focus all the components in a healthcare facility that could be connected to the network (the Internet) for the purpose of creating operational efficiencies, reducing energy consumption, improving occupant experiences, achieving sustainability goals and effectively optimizing financial performance. Enabling the Internet of Medical Things allows you to analyze your environment and make real-time adjustments to improve operational efficiency and productivity.

PREPARING FOR A SMART HOSPTIAL

A Uniter, Not a Divider

A smart solution should give all teams the opportunity to collaborate and work toward a common goal of optimum building productivity and efficiency.

Open Lines of Communication

Smart hospital design holds the promise to open the lines of communication between IT and facilities groups. However, IT will need to take certain steps in order for a holistic approach to be implemented throughout the building.

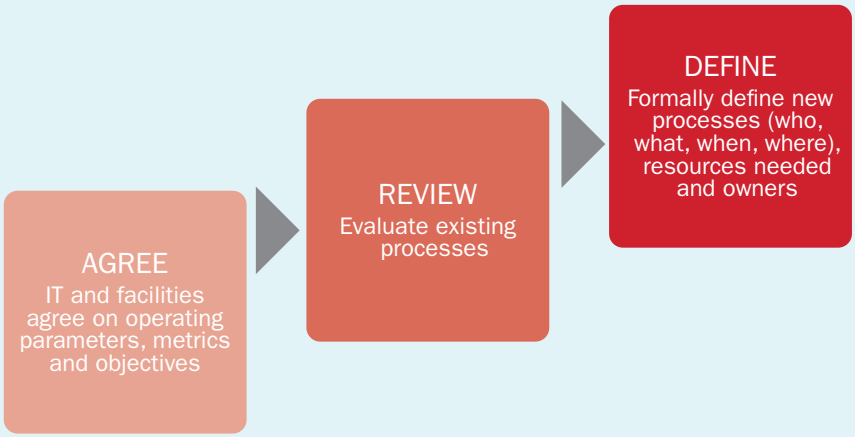
IT and facilities teams don't always make talking and working from common sources a priority. When interoperability is determined to be the way forward, it should be implemented in existing systems so duplication of functionality doesn't occur, which could potentially create a whole new set of operational silos.

Deploy Intelligent Hardware

In order for most interoperable tools to work properly and at their maximum potential, the building must feature at least a baseline of intelligent hardware that will collect data at the level of granularity required to solve the business's specific challenges.

Healthcare facility operators must invest in physical infrastructure devices and intelligent hardware that can feed the intelligent solution what it needs. The most effective smart buildings work off the continuous input of live data from the physical infrastructure devices and other management systems. These may include intelligent hardware pieces that could communicate on an ongoing basis in order to effectively monitor and plan.

Turning Information into Action



Determine and Distribute Staff Levels

All stakeholders, including management, must agree upon and commit the necessary resources to implement and operate the various solutions. All of this upfront discussion and buy-in allows for ongoing cooperation and participation well beyond the implementation phase.

Also, owners of the tools and their associated processes should be explicitly named before solutions are implemented. This may be tricky because facilities personnel may be unfamiliar with IT systems, while IT personnel may have little knowledge of the various elements of facilities. For this reason among others, it is recommended that evaluation and operation teams include people from both sides to help close any knowledge gaps.

Working closely with manufacturers to understand staffing and workforce requirements will help to make the solutions work effectively. Another consideration is who will use the solution if crucial users leave their role. This information will help the evaluation team decide what level of manufacturer-provided (or consultant-provided) training and support might be needed.

Define Actionable Business Processes

Having business processes in place to take action on gathered intelligence is important. Without established processes and a plan to act on the information, all that is left is data—good data, but no clear path or resources in place to use that data to increase productivity and efficiency.

A business process that responds to smart hospital design should be addressed in a manageable way, perhaps starting with core functions and features that are most important, as opposed to attempting to address all processes at once.

Planning Real-Time Healthcare

Gartner defines the future of healthcare as the "real-time health system," or the transformation of the healthcare delivery organization into one that is more aware, collaborative and patient-centric.

Real-time healthcare will give rise to a new, more-agile ecosystem that makes better use of:

- Alarms and notifications
- Analytics and algorithms
- Business continuity management
- Consent management
- Digital signage
- End-to-end user monitoring
- Enterprise mobility services
- Experiential wayfinding
- Health information exchange
- Integrated building system controls
- Interoperability, IoT and API management

These are the types of technologies that a smart hospital's infrastructure should support.

Sources: Carol Roswell and Aching Agawam, Attention to Eight Building Blocks Ensures Successful Digital Workplace Initiatives. 2015.
Gartner, Hype Cycle for Real-Time Health System Technologies, 2017.

CONSIDERATIONS FOR SELECTION

Develop Individual Goals

When developing goals, diving deeper and addressing specific questions should naturally lead to a list of product objectives and requirements.

A building manager should consider the following before looking at specific solutions:

- What problems need to be solved?
- Of these problems, which are particularly pressing?
- Why are the current methodologies not working?
- What is the desired end state?

As these questions are answered, the scope of requirements will be defined. Use these requirements and goals as a starting point to evaluate smart building solutions.

Consider Other Stakeholders' Goals

Facilities, IT and other management teams should work together early on and come to an agreement on the adoption and use of various tools.

Conversely, management should not move forward with intelligent solutions without the buy-in from those who will be required to implement and operate it. All sides should be involved in the early evaluation phase to make certain everyone's needs and expectations are met. Not only will this secure the right selection for the entire building, but it's also a positive step in nurturing collaboration with other stakeholders and teams, including:

- Infrastructure and operations
- Facilities
- IT architecture
- Business and technology analysts
- CSR
- Finance

Establish Baseline Criteria

No matter what solution is selected for individual environments, these tools should have certain essential attributes in order to be effective today and in the future:

- Scalable, modular, flexible system
- Open communication architecture
- Standardized, pre-engineered design
- Active manufacturer support structure

Using these four characteristics as a high-level baseline for evaluating tools can help verify that the business's processes, data and methods will be in line with expectations moving forward.

Start with the Basics, Then Move Forward

When selecting a smart hospital solution, consider how the integration will be achieved and how it will be supplied. It is important to highlight that the more systems that need to be integrated, the more expensive and complex the project becomes and the longer it will take to implement.

A lot of smart hospital implementations become stalled because businesses try to take on too much at once. They attempt to pull everything together under one platform in a short time but find the difficulties of such an endeavor overwhelming. This can lead to frustration and a lack of clear wins along the way, causing the deployment to stall or stop entirely.

As the solution is evaluated, consider the most important dashboards that are a priority for the different stakeholders that were involved in the selection process. Taking a more simplified, realistic and pragmatic approach will help to avoid overwhelming an organization—both in terms of costs and workforce hours—as well as prevent information overkill and project fatigue.

FOUNDATIONS OF HEALTHCARE INTEROPERABILITY

As you have seen, healthcare environments are continually evolving to meet the needs of patients. New technologies provide administrators the opportunity to improve patient satisfaction and outcomes through connectivity and access to information, while also achieving regulatory compliance and optimal building efficiency. An agile healthcare facility allows you to plan and build with interoperable technologies that fulfill current demands, as well as scale to meet future requirements.

Our approach addresses the key building blocks for smart hospitals that can provide agility for budgets, scalability for demand and flexibility for technology choices.

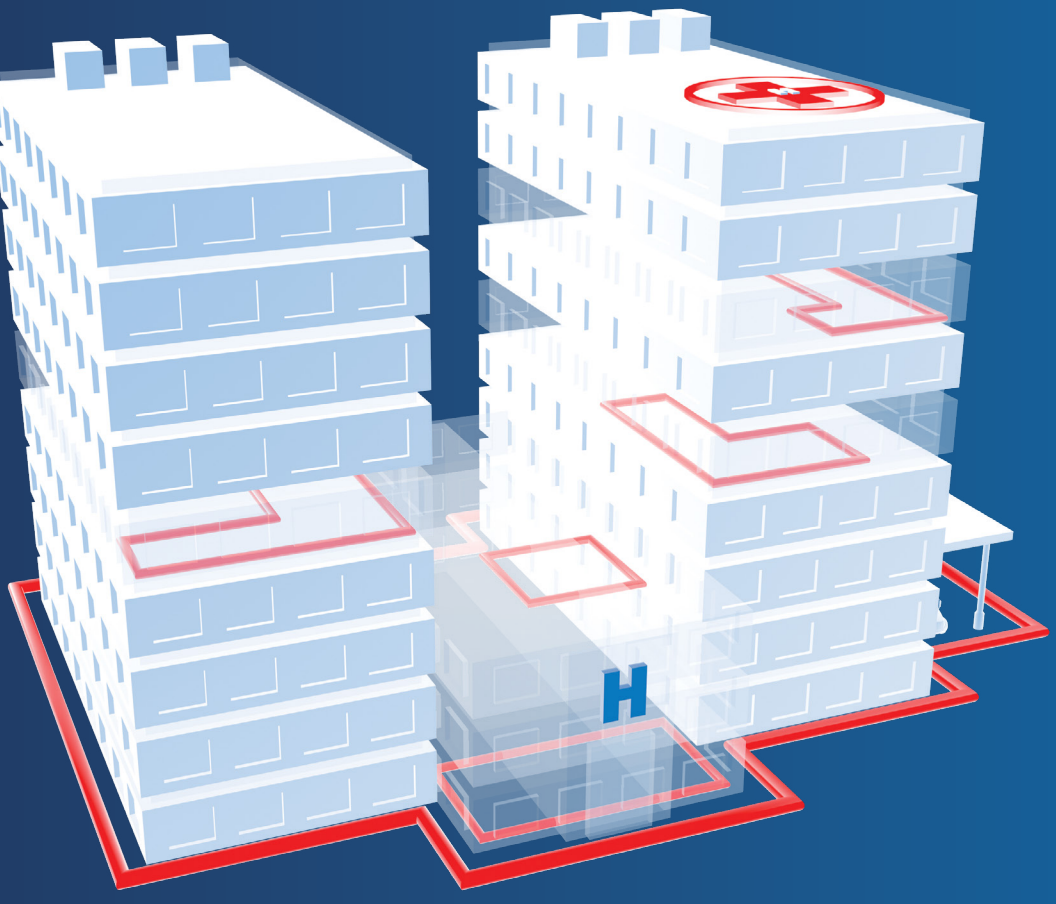
This approach not only addresses the five key technology areas, but it also integrates innovative solutions to meet your assessment and deployment needs.

ANIXTER

GLOBAL TECHNOLOGY BRIEFING

RISK MANAGEMENT BEST PRACTICES

SIX LAYERS OF PHYSICAL SAFETY AND SECURITY



INTRODUCTION

As healthcare facilities strive to create an ideal environment for patient care, maintaining a safe and secure setting for patients, visitors and staff is essential. But this is no simple task. The sheer complexity of areas within a healthcare facility can be challenging—from patient rooms and hi-tech specialty wards to administrative offices and public waiting areas. Patients may already feel a sense of anxiety when undergoing certain procedures or treatments, and the goal of a facility is to allow clinicians and staff to be entirely focused on providing the best patient experience and outcomes.

With the emergence of electronic health records, automated building systems and connected medical devices, cybersecurity measures are critical to maintaining peace of mind, patient confidentiality and a high standard of patient care. The right approach can holistically address physical and cyber challenges, reducing the risk of breach in your facility.

Healthcare facilities exist for a particular purpose. Safe and secure environments enable administrators to focus and ultimately achieve that purpose.

Proactive vs. Reactive Security

The future of security will see a split between practicing reactive security and proactive security. Proactive security anticipates risk and finds solutions while the threat is still manageable. Reactive security is costly, both in terms of the potential for tragedy and the potential for debilitating financial costs. One of the leading candidates to address with a proactive approach is disorderly conduct, which is by far the most common crime within a healthcare facility, with nearly 34.1 incidents a year per 100 beds, according to the International Association for Healthcare Security and Safety Crime Survey.

The National Crime Prevention Institute identifies three steps to move towards a proactive security approach:

1. A vulnerability assessment to identify the deficiencies and excesses in the security process.
2. A cost-benefit analysis to determine if recommendations are affordable, feasible and practical.
3. A test of the system to confirm that everything is working properly and determine if changes need to be made to achieve the desired level of security.

Sources: 2017 International Association for Healthcare Security and Safety (IAHSS) Crime Survey.
Marianna Perry, National Crime Prevention Institute (NCPI), “Proactive vs. Reactive Security” in Buildings. 2010.

CONSIDERATIONS

The Joint Commission

A sensitive healthcare environment requires risk management steps that go beyond mere suggestions. A number of organizations with a goal of improving patient safety serve as accrediting bodies. These include OSHA, FEMA, NFPA and, most notably, the Joint Commission.

"To continuously improve health care for the public, in collaboration with other stakeholders, by evaluating health care organizations and inspiring them to excel in providing safe and effective care of the highest quality and value."—The Joint Commission Mission Statement

Accreditation is required for various forms of funding, including state and federal healthcare programs as well private insurance providers. For this reason, compliance with industry standards and regulations is a leading driver for security enhancement in healthcare facilities.

The Joint Commission is the largest U.S. healthcare accreditor, providing guidelines and direction for 21,000 organizations once every three years. It is recognized by 47 of the 50 U.S. states. Joint Commission guidelines are used as the benchmark for organizations around the world that provide accreditation to healthcare facilities.

Understanding the Joint Commission process and requirements will help in the consideration of relevant technology that can help meet Joint Commission standards.

Joint Commission Action Steps

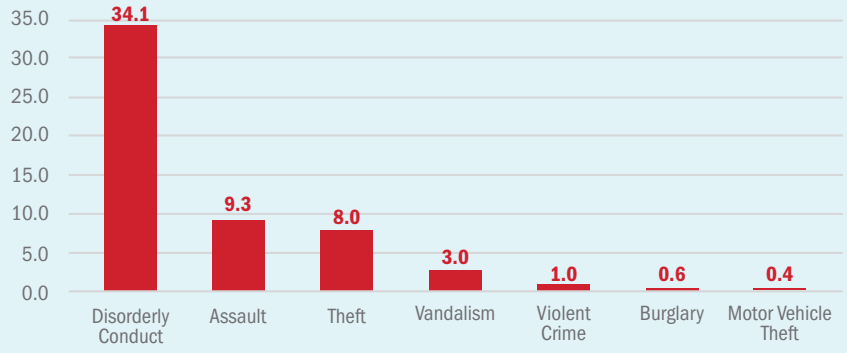
There are several standards within the Joint Commission requirements related to risk management.

EC.0.01.0—Create a plan
The hospital has a written plan for managing the security of everyone who enters the hospital's facilities.

EC 04.01.01—Report on the plan
The hospital establishes a process for continually monitoring, reporting and investigating security incidents involving patients, staff or visitors.

EC 04.01.01, 15—Evaluate the plan
Every 12 months, the hospital evaluates each environment of care management plan.

2016 Crime Rates per 100 Beds by Type of Crime



Source: 2017 International Association for Healthcare Security and Safety (IAHSS) Crime Survey

HIPAA and Patient Records

Every day, 17,000 patient records are breached. That is the average according to NetIQs Cyberthreat Defense Report. In addition, 12 percent of healthcare practices reported at least one known case of medical identity theft. That is an enormous amount of compromised data, affecting a large number of patients who could lose confidence in their healthcare providers.

HIPAA, or the Health Insurance Portability and Accountability Act of 1996, is U.S. legislation that outlines data privacy and security provisions for safeguarding medical information.

According to HIPAA, a covered healthcare entity must:

- Limit physical access to its facilities while ensuring that authorized access is allowed.
- Implement policies and procedures to specify proper use of and access to workstations and electronic media.

Relevant HIPAA Standards

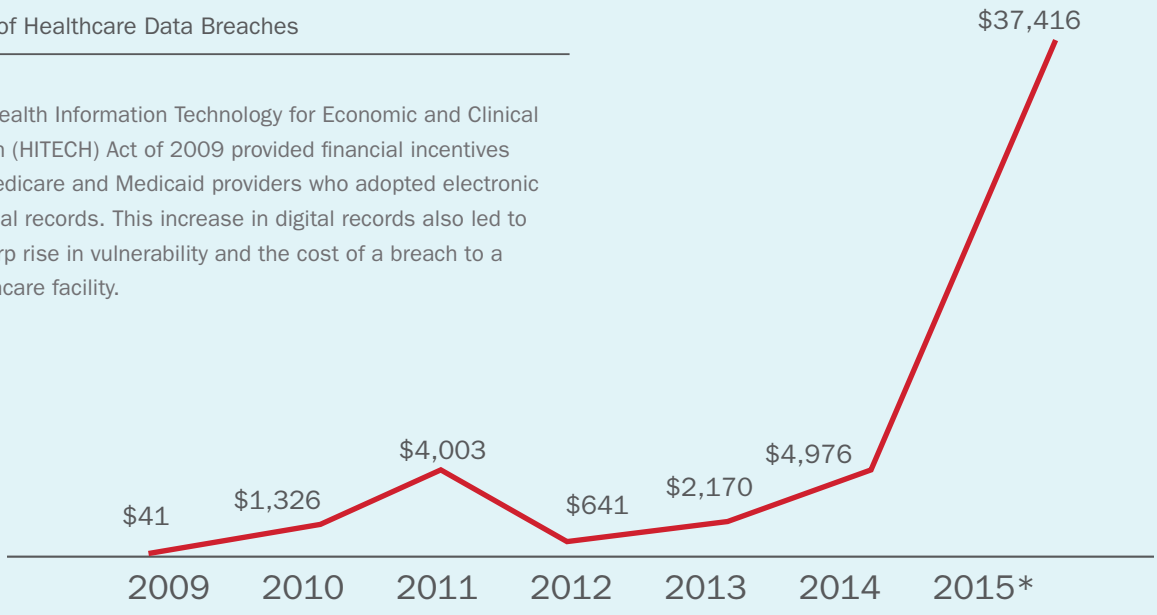
HIPAA Standard 164.310(a)(1)
Facility access controls

HIPAA Standard 164.310(b) and (c)
Workstation use and security

HIPAA Standard 164.310(d)(1)
Device and media controls

Cost of Healthcare Data Breaches

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 provided financial incentives for Medicare and Medicaid providers who adopted electronic medical records. This increase in digital records also led to a sharp rise in vulnerability and the cost of a breach to a healthcare facility.



*2015 Data through June 26, 2015; Source: HHS Office for Civil Rights

Investment vs. Risk: Striking a Balance

Physical security deployments are significant investments with the majority of costs incurred upfront. Once installed, these security systems are often considered adequate, receiving little to no maintenance post installation. However, security systems and processes become outdated, while threats become more sophisticated. A scalable, interoperable security solution can make proactive updates and upgrades simpler, quicker and more cost-effective than a complete system overhaul. This can help you effectively balance the costs of maintaining a robust physical security system with managing the risk of attack and breach.

Steps You Must Take

1. Create a Battle Plan

What are the plans and procedures to defend against threats that are increasing in sophistication and complexity?

2. Invest the Time to Stay Informed

Being properly plugged into the healthcare facility security world should be a priority for an organization. Join some of the active, vibrant communities of security professionals, who share updates on the latest threats and ways to overcome them. Attend industry conferences and join, participate, listen, learn and share.

3. Commit to Security as an Organization—Including the Budget

From the boardroom to the front lines, an organization must have complete buy-in and commitment to the level of security it requires. To stay ahead of risks, the strategy must be to exceed minimum requirements, not to meet them.

Maintaining Sound Policies and Procedures

Healthcare facilities must maintain and follow sound policies and procedures. This is part of an overall security plan that balances best practices with a willingness to evolve to properly defend against new threats.

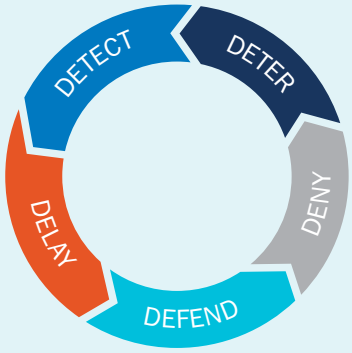
- A policy document is a living, breathing thing. Policies are not static. Policies should be frequently reviewed and updated.
- Security protocols should be understood by all and followed closely.
- Complacency must be avoided throughout the organization.
- Logical security and physical security policies are interrelated and support one another. The logical security strategy should have a physical component to it.

Prevention, Detection, Response

While it may not be possible to ensure complete protection at all times, employing an approach that responds to each stage of a threat is crucial in mitigating serious harm. It is important to consider your approach to the "Five Ds" of protection in a commercial setting:

- Deter: to turn aside, discourage or prevent from acting.
- Detect: to discover or determine the existence, presence or fact of danger.
- Delay: to postpone, hinder or cause something to occur more slowly than normal.
- Defend: to take action against an attack or challenge.
- Deny: to refuse admittance or entry.

Defense in Depth: "Five Ds" of Protection



A layered approach to security for critical infrastructures

Source: Earl Perkins, Gartner. The Marriage of Cybersecurity and Safety for Organizations.

The Necessity of Interoperability

The entire ecosystem that serves the healthcare security market is continuing to evolve to provide more interoperable solutions that will eventually support standards-based open architectures. However, today there are still disparate systems that do not integrate with one another. This creates security gaps that are an impediment to the mission of keeping people and facilities safe.

Security has made great interoperability progress by developing network-based solutions that have the same communication protocols.

Formerly, manufacturers built proprietary systems without regard to integration with other systems or manufacturers. Today they are opening up their application programming interfaces (API) to allow integration with many other security subsystems. There is still one host system, usually the access control system, which releases their API so the other subsystems can integrate with it. This requires the manufacturers to work together to keep everyone updated on new software and firmware upgrades and hardware enhancements.

Clearly, the future of healthcare security will include smart security systems that have standards-based open architecture environments with a multifaceted, layered approach, allowing components from multiple manufacturers to work as one seamless interoperable system. This will enable a scalable, flexible, long-term security solution and put the end user in control.

Safety-Critical Is Security-Critical

According to Gartner, there are three core lessons for organizations seeking to create a safe and secure experience for their customers—in this case, patients, as well as healthcare providers, staff and visitors.

1. Safety and security planning and governance must be aligned to account for security's impact on safety technologies and services.
2. Cyber-physical security practices can be enhanced by embracing some safety cultural principles, behaviors and attitudes.
3. Focus on the cyber-physical security lessons being learned today in the convergence of information technology, operational technology and the deployment of security for the Internet of Things.

Source: Earl Perkins, Gartner. The Marriage of Cybersecurity and Safety for Organizations.

Cybersecurity and Automation

With the massive benefits for patient care with digital records and other connected medical technologies, as well as efficiency advantages with building systems, it is important to consider potential threats and develop a proactive strategy to address patient records, building automation systems, safety systems and critical environmental technology from a security perspective.

Data breaches are the most common and publicized cyber threats, but medical devices, including X-ray equipment, communications systems, diagnostic equipment and life support equipment have also been vulnerable to attack.

In addition, the physical building itself has become a target.

Potential dangers include the following:

1. Shutting down heating or cooling for sensitive locations such as pharmaceutical or food processing plants
2. Manipulating cooling settings on an HVAC system, creating significant business disruption, lost productivity for employees and a negative experience for patients and visitors
3. Shutting down cooling or power management functions for a data center, destroying IT equipment and taking business critical applications offline
4. Disruption to hospital refrigeration, which can affect blood or drug storage

Cyber-related threats impose an increased economic burden on healthcare facilities, if not handled proactively.

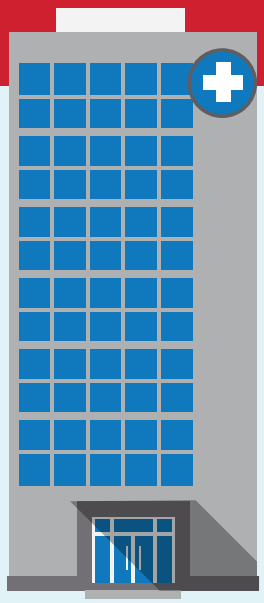
The United States Department of Defense recently developed the Unified Facilities Criteria, which states:

"While the inclusion of cybersecurity during the design and construction of control systems will increase the cost of both design and construction, it is more cost-effective to implement these security controls starting at design than to implement them on a designed and installed system. Historically, control systems have not included these cybersecurity requirements, so the addition of these cybersecurity requirements will increase both cost and security. The increase in cost will be lower than the increase in cost of applying these requirements after design."

Sources: Luis Ayala, Cybersecurity for Hospital and Healthcare Facilities. 2016.
Johnson Controls and Booz Allen Hamilton Inc., Cyber Smart Buildings: Securing Your Investments in Connectivity and Automation. February 2017.

876,000
number of IP-enabled management-level HVAC controllers in **2015**

1,100,000
number of IP-enabled management-level HVAC controllers in **2018**



- **95%** of building systems that are connected to the Internet have insecure connections
- **65%** of vendors have remote access to building systems
- **85%** have no vendor access policy
- **92%** of building system computers are running outdated, insecure, unpatched software
- **40%** of building control and monitoring systems have a potential backdoor to the Corporate Network

695,000
the number of attacks on SCADA systems doubled from 2013 to 2014

69,666
known vulnerabilities reported by NIST in the National Vulnerability Database

9,400
new vulnerabilities found in 2014 alone, 2/3 were related to network attacks

Note: Statistics represent U.S. only.

Source: Intelligent Buildings, CyberSafe. 2016.

CHALLENGES

Challenge I: Creating Safe Environments for Patients and Staff

A safe and secure environment is critical for a healthcare organization to achieve its goal of improving the patient experience and outcomes.

The challenge for healthcare facilities is to leverage technology and policies to protect against internal and external threats.

Additional trends include the following:

- Disorderly conduct remains the highest form of crime in a healthcare facility, nearly doubling from 2014 to 2016.
- Approximately 75 percent of all workplace assaults occur in healthcare settings.
- Theft can be prevalent in a healthcare environment, both in terms of identity and patient records, as well as motor vehicle and pharmaceutical theft.

Key Commercial Building Risk Trends

WORKPLACE ASSUALT

Approximately 75% of ALL workplace assaults occur in healthcare settings

DISORDERLY CONDUCT

The reported disorderly crime rate in hospitals has nearly doubled from 2015 to 2016.

THEFT

Theft occurs in many forms at a hospital, from identity and patient record, to motor vehicle and pharmaceutical

VANDALISM

Annually, there are 3 reports of vandalism for every 100 beds at the average hospital.

Sources: New England Journal of Medicine, Workplace Violence against Health Care Workers in the United States. 2016.
2017 International Association for Healthcare Security and Safety (IAHSS)

Challenge II: Preventing Theft of Medicine and Radiological Materials

Healthcare facilities contain a number of restricted materials, including pharmaceuticals, high-value equipment and potentially hazardous waste.

Controlling these substances, especially from internal and external theft, is important in maintaining industry compliance and protecting patients, visitors and staff.

Pharmaceuticals must be under constant surveillance to help ensure patient safety.

Likewise, radiological materials could have serious public safety consequences if compromised and in the hands of the wrong people.

Challenge III: Achieving Regulatory Compliance

Compliance is meant to prevent or mitigate risk. A proactive approach to compliance could prevent unauthorized access to and use of controlled substances, as well as allow you to follow the right steps in response to such a situation.

Regulatory compliance can be complex in a healthcare facility, involving patient safety, staff safety, accessibility, energy use, patient confidentiality, data management and physical design.

Organizations must consider how to meet audit requirements to comply with various regulations, often tied to funding sources from state, federal and private insurance programs. This may include the Joint Commission, HIPAA, SOX, PCI-DSS, OSHA and ADA, among others.

Source; IBM, Cost of Data Breach Study. 2015.

Challenge IV: Preventing Cyber Threats to Patient Records

When a single data breach can cost a hospital millions of dollars, preventing cyber threats in an IoT environment is crucial to managing risk, reputation and the well-being of patients.

Cybersecurity may be the biggest challenge for healthcare organizations today due to the vulnerability of the increasing number of networked devices and sensors, as well as patient records.

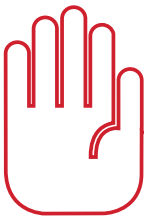
Building systems present an additional concern, particularly if they have been put in by a system supplier to provide remote monitoring to reduce the cost of an operations service contract, or if they require connectivity to a cloud service.

There are many opportunities to use the experience of the IT world to mitigate the risk of these connected systems, using best practices for policies, monitoring and hardware. For example, follow best practices to prevent hacking of IP devices that reside on your network. Cameras and similar devices typically hold predefined security measures that always should be changed. A best practice would be to customize the settings to match the requirements for the rest of the IT infrastructure.

The reality of BYOD (bring your own device) environments creates additional challenges, as a person bringing multiple devices into a building is essentially bringing multiple new doors that could be opened for a costly breach.

In the future, smart hospitals will provide an open architecture where sophisticated security technologies and protocols will combat new and evolving threats.

Challenge V: Limiting Physical Building and Network Accessibility



With a number of sensitive areas around a hospital, directing the flow of traffic among patients, visitors and staff is essential to providing a safe environment. This is made all the more challenging with the goal to provide seamless and secure network access.

This comes down to an ability to authenticate the identity of who is accessing the building and the network.

Advancing technologies and security threats pose another question—how do you ensure the person using the credential is actually the person assigned to that credential?

The Key Is Biometrics

Traditional access control credentials only authenticate the credential, not the person who is holding it. Biometrics positively authenticate an individual by identifying their measurable physiological traits, such as fingerprints, iris patterns and facial or hand geometry, before granting access to a restricted area. Biometrics can be used for either verification or identification.

Verification

Verification uses a one-to-one comparison and requires a secondary credential. In this case, the biometric element simply confirms that the person using that credential is the individual to whom it was issued and they have the authority to enter. One-to-one verification can be achieved by storing biometric templates in the reader database or storing the biometric template on a credential. Storing the biometric template on a credential maintains privacy regulations that prevent storage of biometric data; it also serves as dual authentication. Triple authentication includes a pin code along with the credential and biometrics. The user enters their pin code to recall their template in the reader to be matched to their live biometrics. Storing a biometric template on a credential works well, but if the end user is seeking to eliminate credentials, then this method will not be ideal.

Identification

Identification is the process of determining that the person requesting access is who they say they are. This involves matching the biometric characteristic to a template called up from a central database. Biometric identification uses a one-to-many comparison in order to ascertain whether a given user is authorized for entry. The biometric characteristic alone is used and is compared to all templates in the database until a match is found or the data is rejected as unidentified. Since the stored template and the live biometric are converted to an encrypted algorithm, matching occurs instantaneously.

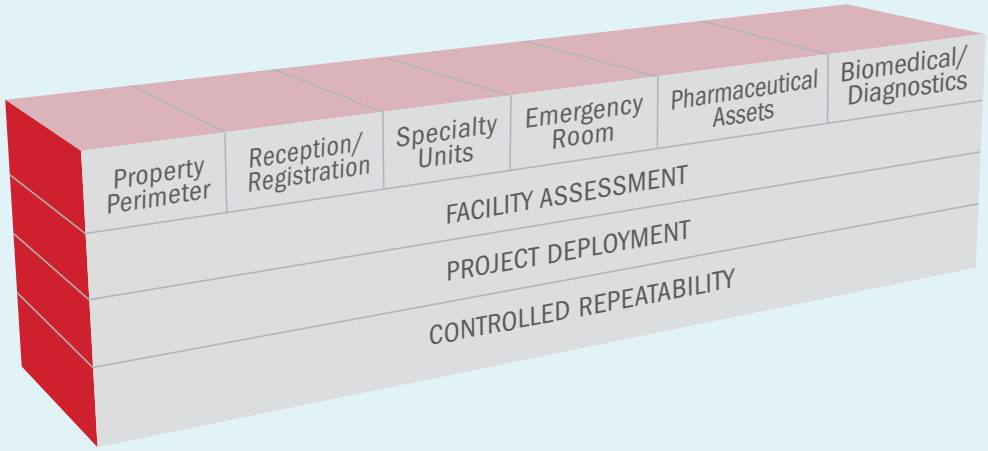
SOLUTIONS

The Anixter Approach

Six Layers of Physical Security

Healthcare facilities contain a number of complex areas that require a balance of specialized attention and integration into an overall risk management strategy. Securing patient-centered, pharmaceutical and biomedical zones are essential to improving patient satisfaction and achieving regulatory compliance. Deploying a layered security strategy can provide you with the ability to deter, detect, delay, defend and deny in every area of your healthcare facility.

In addition to micro-segmentation of logical security, our approach provides healthcare facility managers with a clear set of guidelines and best practices for macro-level security implementation.



Best Practice I:
Property Perimeter

Determine vulnerable areas around the property edge to deter external threats.

Considerations

When protecting the property perimeter, it is important to consider:

- ☐ How do you protect patients and staff in parking areas?
- ☐ How do you manage entrances and exits 24/7?
- ☐ How do you mitigate loitering and anti-social behavior?
- ☐ How do you provide for external emergency communication?

Recommended Solutions

Parking Lots and Parking Structures

Access to medium security healthcare facility parking areas can be managed with unattended drop-arm gates and UHF readers with window tags that allow for extended read ranges. Readers can be configured as standalone systems or connected into the building's access control system. Drop-arm gates with self-service ticket dispensers control access to visitor parking.

IP intercoms with or without video integration are used for authorization before entering the parking area.

High-security healthcare facilities typically have guard shacks and rolling gates to control traffic, while active vehicle barriers and ram-resistant cable barriers prevent vehicles from penetrating the property perimeter. This is in addition to perimeter LED lighting.

Parking Structure Emergency Communications Systems

Emergency call stations, identified by high-visibility colored lighting, allow for direct contact with emergency personnel. Integrated video enables security personnel to see what is happening. The stations are connected to the building's VoIP phone system and can even roll over to smartphones.

Building Perimeter

Fixed bollards or heavy cement planters prevent vehicles from breaching the building perimeter. Bollards can be manually retractable to allow for maintenance vehicles.

Loading Docks

Loading dock doors are vulnerable to unauthorized access and should be locked and monitored. Wide dynamic range (WDR) cameras are appropriate due to the fluctuation in light levels. Door prop alarms can prevent doors from being left unsecured, while intercoms with or without integrated video allow authorized couriers into the hospital for deliveries.

RISK MANAGEMENT BEST PRACTICES

Lobby Entry Doors
Depending on the function of certain areas of the hospital, you need to be able to support 24-hour access, limited access zones as well as potential lockdown situations. Often the same access control system manages both the building perimeter and the different zones, so tenants can use one credential for both.

Stairwells and Emergency Exits
To control pedestrian access, all secondary doors and stairwell exits should be exit only with night latch function hardware that is locked from the outside or with no exterior hardware at all. These doors should have exit devices on them for unimpeded egress and door closers to close and relock after exiting. They should also be monitored and/or alarmed to prevent them from being propped open.

Key Control
A patented restricted key system prevents unauthorized key duplication of the master keys and suite keys while providing building management, maintenance and cleaning crew access throughout the building. Doors with electronic access control should have a mechanical key bypass and lockdown capability for emergencies.

Handicap Access
The Americans with Disabilities Act (ADA) requires that all healthcare facilities provide unimpeded access for handicapped persons. Automatic door operators using a chain drive motor can open heavy lobby doors upon the push of a wired or wireless handicap button.

Video Surveillance
To monitor the exterior of the building with changing levels of light, wide dynamic range (WDR) cameras are effective. High-resolution, multi-sensor panoramic cameras can monitor critical areas and entranceways. Video surveillance can be sent to mobile devices, such as smartphones or tablets, to enable security personnel to monitor the video on the go. Video analytics enhance efficiency by creating automated parameters that filter out normal motion events and detect events that security should review. License plate recognition (LPR) software can be used to monitor traffic and access to specific parking areas on the property.

Best Practice II:
Reception and Registration

Control the flow of visitors and patients to the facility and validate various levels of staff authorization.

Considerations

When protecting the reception area, it is important to consider:

- ☐ What is your strategy for managing visitors?
- ☐ How do you manage patient registration?
- ☐ How do you monitor common spaces?
- ☐ How do you limit accessibility to clinical areas?

Recommended Solutions

Electronic Visitor Management
Electronic visitor management systems enable preregistration of patients, visitors and contractors. Visitors can use a kiosk to view appointments, accept company policies, NDAs or other criteria, and print temporary credentials. Coupled with an employee/tenant badging system, this creates an environment of alertness, as visitors are identified and deterred from entering restricted areas. Electronic records are kept to quickly reregister return visitors, flag barred visitors and account for visitors during emergencies.

Glass and Optical Turnstiles
Turnstiles restrict unauthorized personnel from going past the lobby. Glass turnstiles use a physical glass barrier that is waist-high or full height, while optical turnstiles may have only an arm to restrict access. Both use beam optics to verify that only one person is going through the turnstile with the card read.

Credentials
Depending on the hospital's security requirements, credentials to operate turnstiles and access clinical areas can range from low-security temporary barcodes to permanent card badges to advanced biometric readers. They help identify who each individual is, where they should be and what they should have access to.

Video Management System
Video surveillance in the reception area monitors and records during all operating hours. The video management system (VMS) can be integrated with the access control system to provide a visual record of activity. Choosing a VMS is critical, as all video surveillance footage is viewed and extracted through the VMS. VMS software must meet the facility's current and future needs, allowing for management of not just video surveillance but other linked operational technology systems.

Video Analytics
Analytics can monitor pedestrian traffic flow, detect people entering through an exit and identify parcels left in the reception area. The video monitoring station in the lobby should be optimized to support processing of the video footage.

Best Practice III:
Specialty Units

Protect patients and comply with privacy regulations with attention to complex specialty units.

Considerations

When protecting specialty and patient care units, it is important to consider:

- ☐ How do you limit access to nurse stations and patient areas?
- ☐ How do you protect medical equipment from theft?
- ☐ What is your strategy for medical record protection?
- ☐ How do you minimize hospital-acquired infections?
- ☐ How do you provide speech privacy in care environments?

Recommended Solutions

Visitor Management

Visitor management systems can be deployed at the specialty unit level with basic features. Requirements may only include on-site registration, visitor badge printing and electronic visitor records.

Mechanical Access Control

Occupants of various areas in a hospital in some cases only require mechanical keys to enter their area. Their keys do not operate in other spaces or utility and janitorial rooms. Master keys can gain access to tenant and utility spaces on all floors, or the key system can be designed with individual floor masters.

Noise Privacy Masking

Sound masking is the process of adding background sound to reduce noise distractions, protect privacy and increase patient comfort. This is essential to maintaining HIPAA standards. A variety of elements can address noise control and speech privacy that absorb, block or cover sound, often referred to as the ABCs of acoustic design.

Electronic Access Control

Building electronic access control systems can be partitioned so that the individual departments or authorized personnel can only view and manage their individual areas or suites. However, the property manager has the ability to manage the complete system. This allows the tenant to use the same credential to access the parking area, building entry and their own space.

RISK MANAGEMENT BEST PRACTICES

Stairwells
Stairwells need to be locked from the outside, but upon alarm activation, the doors must unlock on both sides on all floors to allow free ingress and egress for evacuation and for emergency personnel. Stairwell doors must also close and latch every time to prevent fire from spreading through the stairwells.

Elevator Video and Communications
Cameras in vandal-resistant enclosures monitor events in the individual elevator cabs. Video transmission can be done through the elevator cable bundle or wirelessly with a transmitter on the top of the cab and a receiver at the top of the elevator shaft. Emergency intercoms are required in all elevator cabs for two-way communication to emergency personnel.

Video Surveillance
Doors that access floors and suite entrances should deploy video surveillance to record all access and egress events. Set to record on motion, video surveillance can be standalone or integrated with an electronic access control system for video verification. Lower resolution (720p) can be used in small spaces.

Patient Protection Service
RFID-enabled bracelets or other wearables are used to track newborns, elderly and other at-risk patients. Medical staff can track the location of patients to prevent things like newborn abduction.

Best Practice IV:
Emergency Room

Improve staff safety and care through effective management of high-stress and high-traffic emergency settings.

Considerations

When protecting department zones, it is important to consider:

- ☐ How do you monitor ambulance bay traffic?
- ☐ How do you mitigate public area disturbance?
- ☐ What measures are in place to manage workplace violence?
- ☐ How do you manage safety between triage and treatment?

Recommended Solutions

Motion Sensors and Automatic Door Openers
Facilitate fast and efficient movement in high-traffic areas with motion sensors and automatic door openers. Motion sensors are needed to initiate the action, which also can turn on lights and cameras, and alert security personnel in the case of emergencies.

Electronic Access Control
Electronic access control can prevent unauthorized personnel from entering restricted areas within an emergency department. If a suite already has electronic access control integrated into the building, then adding access control to a department entrance is done through the existing system.

Video Surveillance
Individuals going in and out of emergency rooms and trauma departments are often in a highly anxious and emotional state of mind. These settings can be volatile due to carryover from the scenes of accidents, fights, crimes and other traumatic events. People under the influence of drugs or alcohol or suffering from mental health issues may also seek care in the ER. Video surveillance is necessary for monitoring traffic and activity near entrances, exits, hallways, lobbies, intake and waiting areas. However, patient confidentiality must still be upheld, and cameras should not be placed where they can see into patient rooms. A licensed security integrator will design the surveillance system to provide sufficient coverage of the ER without violating privacy laws.

Asset Management and Patient Protection Service
In higher security applications, passive RFID is used to ensure company assets remain in the building. High-value assets can be tagged with active RFID tags and tracked in real time. These tags can also be used to track pharmaceuticals or at-risk patients.

Best Practice V:
Pharmaceutical Assets

Achieve regulatory compliance and loss prevention by monitoring access and intrusion to pharmaceutical zones.

Considerations

When protecting technical spaces, it is important to consider:

- ☐ How do you comply with medication protection regulations?
- ☐ How do you audit and control access to medication?
- ☐ How do you secure pharmaceutical storage?
- ☐ What is your surveillance policy for dispensing?

Recommended Solutions

Intrusion Detection

An intrusion detection system (IDS) is a device or software application that monitors a network or systems for malicious activity or policy violations. Any detected activity or violation is typically reported either to an administrator or collected centrally using a security information and event management (SIEM) system. A SIEM system combines outputs from multiple sources and uses alarm filtering techniques to distinguish malicious activity from false alarms.

Electronic Access Control and Cabinet Locking

Electronic access control can prevent unauthorized personnel from entering restricted areas within a pharmaceutical department, as well as dispensing cabinets. If a suite already has electronic access control integrated into the building, then adding access control to a department entrance is done through the existing system. Otherwise, standalone battery-powered access control locks can be installed on the door.

Video Surveillance

Pharmaceuticals must be monitored at all times. Video surveillance provides a visual record of who has accessed the pharmaceutical cabinets. The switches, servers, and storage for video surveillance need to be optimized for that application, and the devices need to meet specific criteria to continuously perform their functions in a secure manner.

Biometrics and Sensors

Keeping records of who entered a pharmaceutical cabinet and when is critical to maintaining regulatory compliance. Electronic access control at the cabinet level captures all access records in addition to regulating who has access. It can even restrict access to specific days and times. In higher security applications, biometric readers at the cabinet can positively authenticate the individual before allowing access to the cabinet.

Best Practice VI:
Biomedical and Diagnostics

Protect valuable equipment and potentially harmful materials in biomedical and diagnostic areas.

Considerations

When protecting biomedical and diagnostics spaces, it is important to consider:

- ☐ What department is responsible for diagnostics protection?
- ☐ How do you comply with hazardous material requirements?
- ☐ How do you restrict access of unauthorized individuals?

Recommended Solutions

Intrusion Detection

An intrusion detection system (IDS) is a device or software application that monitors a network or systems for malicious activity or policy violations. Any detected activity or violation is typically reported either to an administrator or collected centrally using a security information and event management (SIEM) system. A SIEM system combines outputs from multiple sources, and uses alarm filtering techniques to distinguish malicious activity from false alarms.

Electronic Access Control and Cabinet Locking

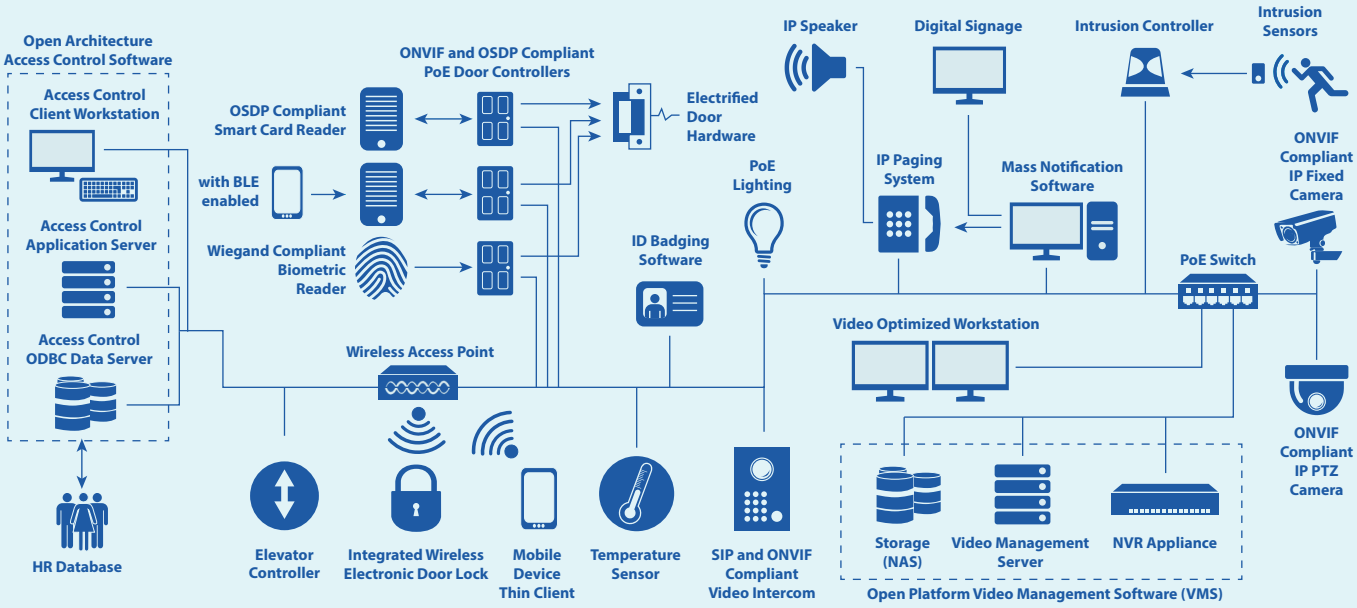
Electronic access control can prevent unauthorized personnel from entering restricted areas within a healthcare facility. If a suite already has electronic access control integrated into the building, then adding access control to a department entrance is done through the existing system. Otherwise, standalone battery-powered access control locks can be installed on the door.

Biometrics and Radiological Sensors

Keeping records of who entered biomedical and diagnostic areas is important to maintaining company and regulatory compliance. Electronic access control at the cabinet level captures all access records in addition to regulating who has access. It can even restrict access to specific days and times. In higher security applications, biometric readers can positively authenticate the individual before allowing access to hazardous areas. In some cases, radiological sensors are required, which can be connected to alarms in the access control or intrusion systems within the hospital. Integrating these monitored areas with video surveillance for verification is always a best practice.

Open Architecture Security Solution

The concept of open architecture security systems suggest flexibility with best-of-breed options and the latest technology. This view represents the challenge of these technologies working together.



TECHNOLOGY SUMMARY

Technology Solutions

The chart below details the technology solutions that can support a layered security approach in a healthcare facility.

TECHNOLOGY	Property Perimeter	Reception and Registration	Specialty Units	Emergency Room	Pharmaceutical Assets	Biomedical and Diagnostics
Emergency call boxes	✓			✓		
Access control	✓	✓	✓	✓	✓	✓
Intrusion detection		✓	✓	✓	✓	✓
Fire detection and suppression		✓	✓	✓	✓	✓
Visitor management software		✓		✓		
Mass notification	✓	✓	✓	✓	✓	✓
Surveillance solutions	✓	✓	✓	✓	✓	✓
Surveillance viewing and monitoring		✓	✓	✓	✓	

Anixter's Technology Support Services can offer further insight to your specific application. For more information, contact your local Anixter representative.

anixter.com/healthcare

SUPPLY CHAIN SOLUTIONS

As you develop a smart hospital roadmap, it's also important to consider the physical migration from the existing environment to the building's future state. This entails identifying the challenges and risks during the installation phases of technology deployment. Coordination between material deployment and installation schedules can have an impact on the productivity, efficiency and connectivity of the facility, as well as patient experience and outcomes during the deployment.

Properly coordinated deployments allow for tangible savings in time, reduced installation costs and increased efficiencies, all while reducing the risks of lost productivity associated with the physical migration of the building environment.

Challenge	Service	Save Time	Reduce Costs	Increase Efficiency	Mitigate Risk
Coordinating the deployment of the right system components that corresponds with the integrator installation schedule	Deployment and technical services	✓	✓	✓	✓
Confirming all system components work properly as an integrated solution	Interoperability testing		✓	✓	✓
Video camera deployment and on-going maintenance	IP addressing and serial number tracking	✓	✓	✓	
Coordinating installations by kitting similar solution components	Custom part number for each unique configuration	✓	✓	✓	✓
Managing integrator SLAs and maintenance agreements	Asset management and managing maintenance costs and upgrades		✓		✓

For more information, contact your local Anixter representative.

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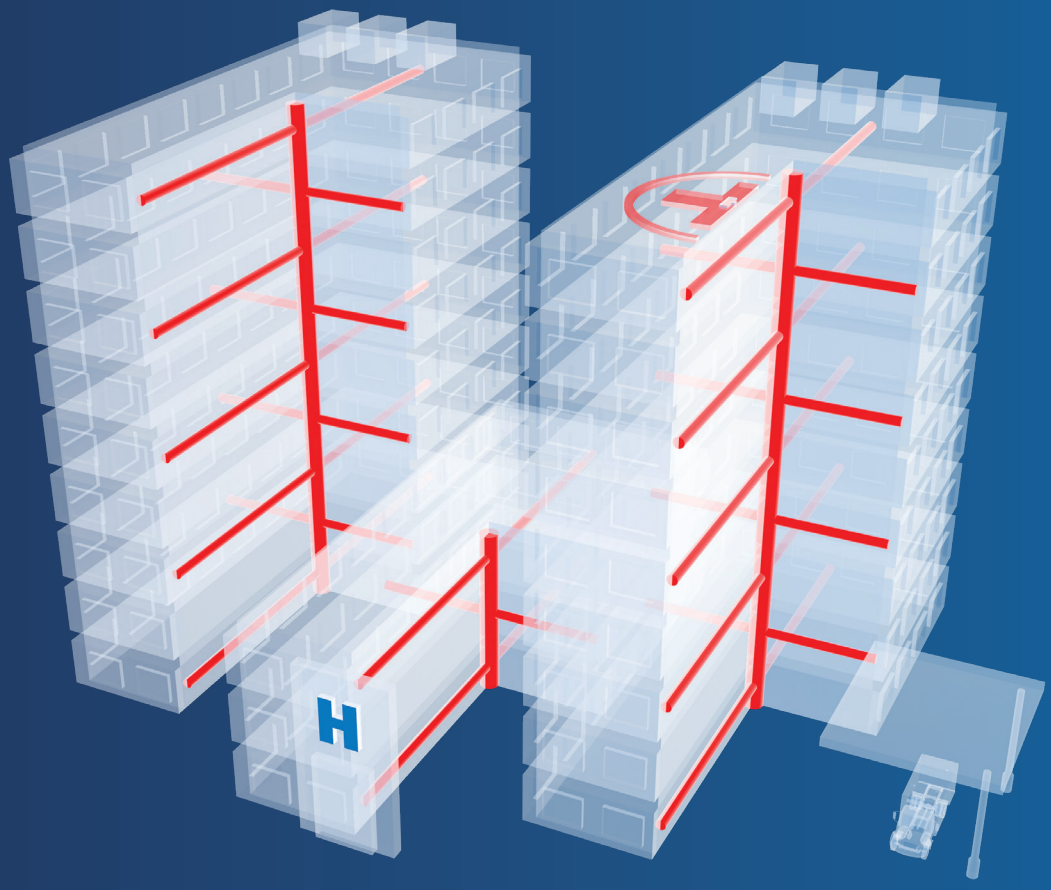
ANIXTER

GLOBAL TECHNOLOGY BRIEFING

NETWORK PERFORMANCE BEST PRACTICES

VERSATILE PHYSICAL LAYER CONNECTIVITY



INTRODUCTION

A recent report suggested that there are nearly 4.5 billion medical-oriented devices capable of connecting to a network. That accounts for nearly 30 percent of all IoT-capable devices. The growing number of connected medical devices is in addition to the massive increase of digital storage from patient records and advanced diagnostics, as well as everyday devices, such as phones and tablets. Healthcare facility operators need to determine what kind of foundational network will be required to support connectivity of these devices and automated building technologies. Furthermore, the sheer complexity of diverse areas in a healthcare facility, including patient care rooms, pharmaceuticals, diagnostics, administrative and technical spaces require careful attention and planning to ensure sufficient support.

Smart hospital design optimizes network performance, utilizing a broader set of elements that can empower today's transformations in technology and the delivery of care.

There are nearly 4.5 billion medical-oriented devices capable of connecting to a network.

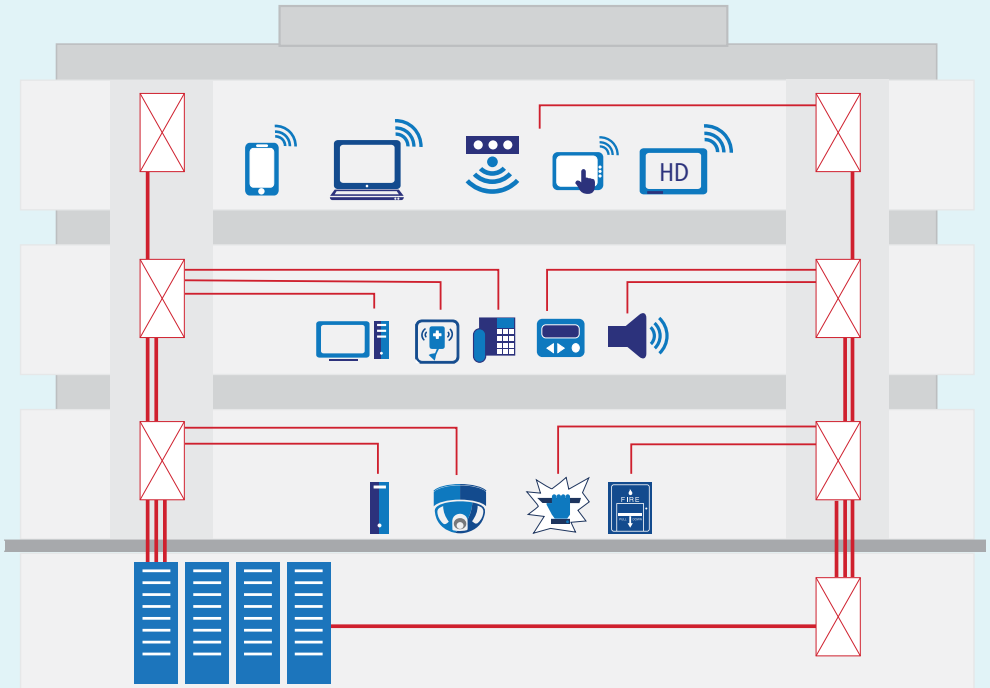
Source: Frost and Sullivan, Internet of Medical Things Forecast to 2021.

A Smart Hospital Approach

Adequate network performance occurs with a holistic approach, examining the foundations and backbone infrastructure that will support a variety of building operations, patient experience and care delivery tools, while allowing for additional capacity to provide flexibility and near-future scalability for tomorrow's technology.

Within a hospital, there are different ways to transport data—specifically a wireless or wired infrastructure. Innovations are happening on both sides, but particularly with wired infrastructure, the industry is experiencing innovations such as increased power and bandwidth delivered to different devices.

Today's Building Applications



- Distributed antenna systems
- Wi-Fi connectivity
- Digital signage
- Wayfinding
- Smart kiosks
- Sound and paging
- Mass notification
- Connected lighting
- HVAC
- Video surveillance
- Access control
- Intrusion detection
- Fire/life safety

CONSIDERATIONS

Data Storage and Bandwidth Demands

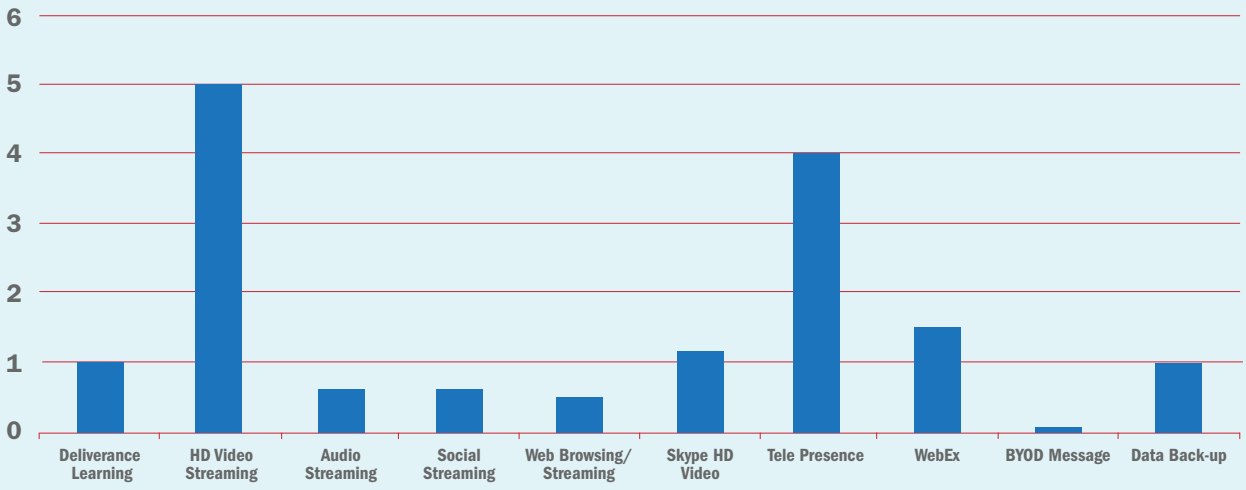
According to the Ponemon Institute, more than 30 percent of all of the electronic data storage in the world is occupied by the healthcare industry.

Video streaming, BYOD facilitation and other network applications are growing in use by medical and administrative staff, patients and visitors alike, increasing bandwidth requirements.

Additional network strains include the following:

- Electronic Patient Records (EHRs)
- Medical imaging, of which there are currently 400 million procedures annually in the U.S., which require large amounts bandwidth for data processing and storage
- Patient satisfaction demands, both in terms of care outcomes and the patient experience, which is directly tied to funding sources for healthcare facilities, and a robust network enables improvements to satisfaction
- Telemedicine, which 7 million patients will utilize by 2018, up from only 350,000 in 2013.

Network Application Bandwidth



Source: ACG Research

The Healthcare Facility Telecommunications Infrastructure Standard—ANSI/TIA 1179-A

Healthcare organizations have a diverse set of services available to them and are constantly adding new services. When applying specific applications to these cabling systems, consult application standards such as the healthcare-specific ANSI/TIA-1179-A, regulations, equipment manufacturers, system suppliers and service suppliers for applicability, limitations and ancillary requirements.

The ANSI/TIA-1179-A standard for healthcare telecommunications infrastructure is a useful resource for facilities wanting to enhance the quality of their care and safety through considered network and security systems that support their transformative technologies and approaches.

Work Area Outlet Density Guidelines

ANSI/TIA gives guidelines for media type and telecommunications outlet densities required to support specialty areas and key technologies around a hospital. Understanding high-density areas allows you to properly plan the space in order to accommodate the pieces and people that deliver modern care.

According to the standard, “After the initial installation, adding or changing cabling could result in a net decrease in the quality of care provided, infection control measures or compromising life safety measures.”

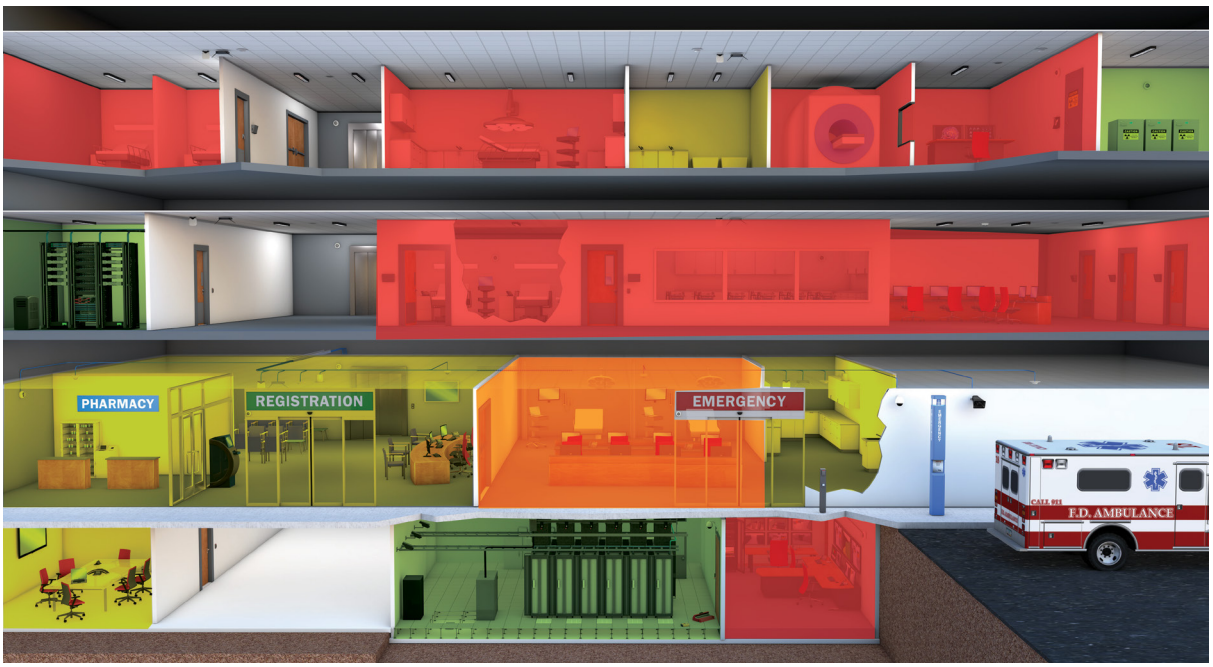
For IT professionals, providing technology services and integrating multiple departments’ clinical systems while maintaining compliance with hospital and government policies during implementation is essential to maintaining long-term patient care and satisfaction.

The ANSI/TIA-1179-A standard was developed due to the diversity of the application environments within healthcare facilities, and different design approaches need to be considered. Healthcare-specific considerations include:

- Wired and wireless infrastructure
- Properly delivering Power over Ethernet (PoE) in hospitals
- Providing enough bandwidth and density to specific clinical areas in the hospital
- Installation considerations (infection control and life safety)

Work Area Outlet Density—Technology Guide and Map

Specialty Areas	Key Corridor outlets	Work Area Outlet Density	Terminology
Radiology	**Imaging bandwidth demands:** Large data files associated with 3-D imaging applications, high-capacity transport and storage	HIGH	Cat 6A FTP or UTP - OM3, OM4 multimode fiber, 802.11ac wireless, distributed antenna systems
Pharmacy	**Security:** Loss prevention, protection of patient records, audit trail	MEDIUM	Paging, access control, locking hardware, video surveillance, self-service kiosk, POS
Critical care patient rooms	**Patient monitoring:** Patient communications systems, amenities, cleanliness and quietness, smart rooms, integrated systems	HIGH	Cat 6A FTP or UTP, multimode fiber, 802.11ac wireless, Zigbee-enabled sensors
Emergency rooms	**Safety and security:** Protecting patients and medical staff, communications with first responders, emergency preparedness	MEDIUM OR HIGH	Access control, specialty door-locking hardware, video surveillance, distributed antenna systems, public safety wireless
Infectious control areas	**Safety and health:** Reduction of infection risk due to airborne viruses and bacteria	LOW	Dust containment, anti-microbial door-locking hardware, RFID/RTLS, thermal cameras
Data center	**High-performance structured cabling:** 10G server connections, 40/100G data center backbone, high-density cable management	HIGH	Cat 6A FTP or UTP, multimode and single-mode fiber, direct-attached cabling

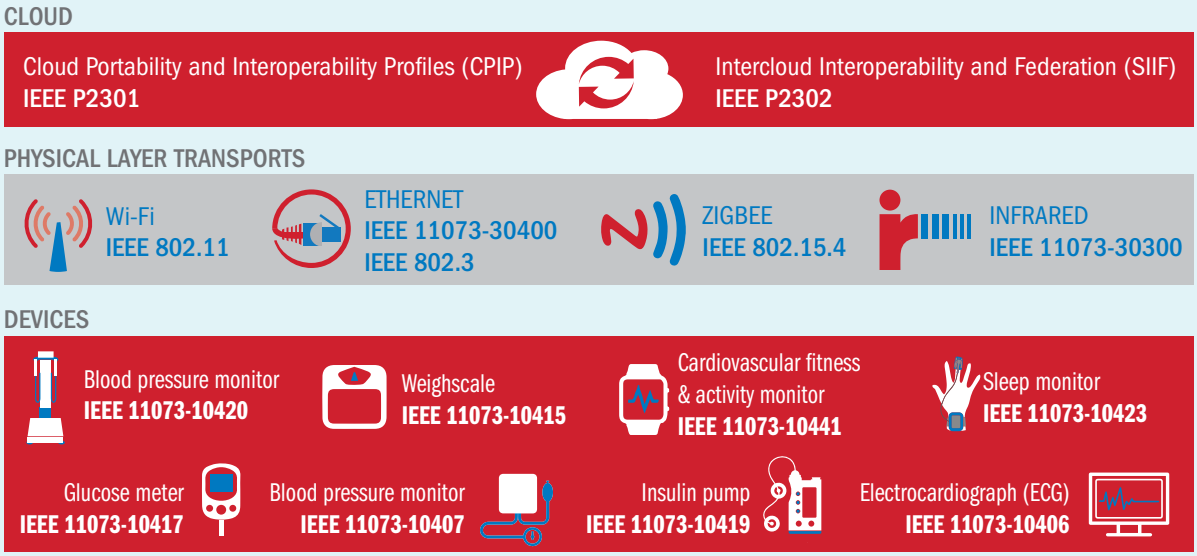


IEEE 11073 and Others

Another example of emerging standards in healthcare is IEEE 11073, which provides standards for medical health devices. This can be challenging to plan for, given the speed of innovation in medical devices, but a strategic approach to the cloud and physical layer transport can help with the goal of interoperability.

The standards are adapting based on the needs of the user, as key organizations try to keep up with the pace of innovation.

IEEE Standards for Healthcare Systems



Hardened Connectivity

Specialized areas and equipment in a hospital, such as operating theaters, triage, radiology and diagnostics, may be subject to wet or RF environments that can impact normal equipment operation. And therefore it is important to consider ruggedized solutions or products suited to the specific environment where they will be utilized.

MICE is a way to define the type of connectivity required, depending on the severity of the environment. MICE levels typically refer to industrial environments, but can be applied to non-industrial environments.

- WM1 I1 C1 E1
  Classifies the typical office environment, as is assumed in ISO/IEC 11801.
- M2 I2 C2 E2
  Classifies the industrial environment of an ordinary factory floor.
- M3 I3 C3 E3
  Classifies harsh environmental conditions, such as in heavy industries.

MICE Table for Hardened Connectivity Requirements

INCREASING SEVERITY			
Mechanical (Shock, vibration, impulse)	M_1	M_2	M_3
Ingress (Polishes and liquid)	I_1	I_2	I_3
Climatic (Tempature, humidity, containers, radiator)	C_1	C_2	C_3
Electromagnetic (ESO, SF1, transverts, magnetic fields)	E_1	E_2	E_3

Migration of Legacy Systems

Navigating through the myriad of network-infrastructure choices needed to support high-speed data rates can be challenging. For this and several other practical reasons, it's vital to have a well-planned network migration strategy that will enable a healthcare facility to support modern care methods now and in the future.

During the original Levels program in the 1990s, which led to the development of cabling performance standards such as current Category 5e and Category 6, Anixter recognized the challenges faced by designers of low-voltage communications cabling systems when choosing the type and grade of cabling that would best support the emerging Ethernet protocol being deployed across enterprise networks. Still, media selection, cabling architecture and cable management choices remain complex. Choosing the right high-density cabling architectures and equipment is mission-critical as healthcare facility managers try to control costs by maximizing floor space.

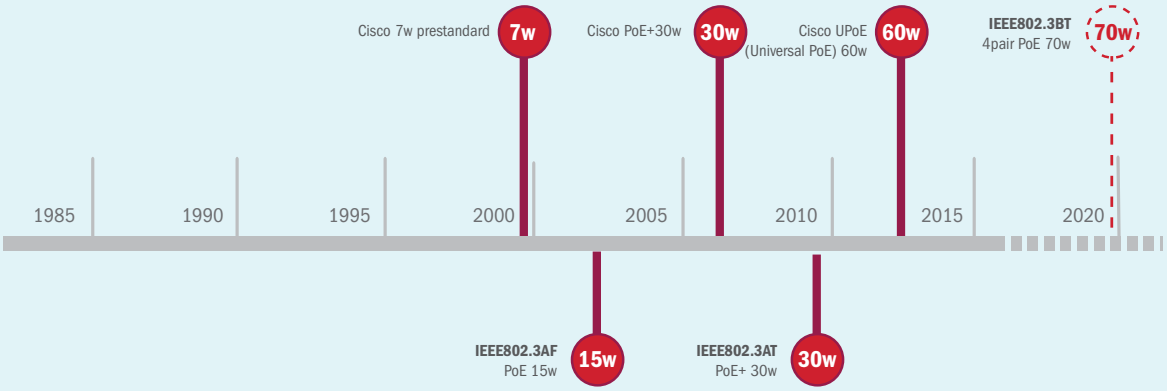
Faster, denser technology is driving costs, and the right high-performance cabling is needed to provide stability in the network. Unsuitable infrastructure can become an expensive problem, delaying necessary upgrades and creating other potential obstacles to staying competitive.

Evolution of Infrastructure Technologies

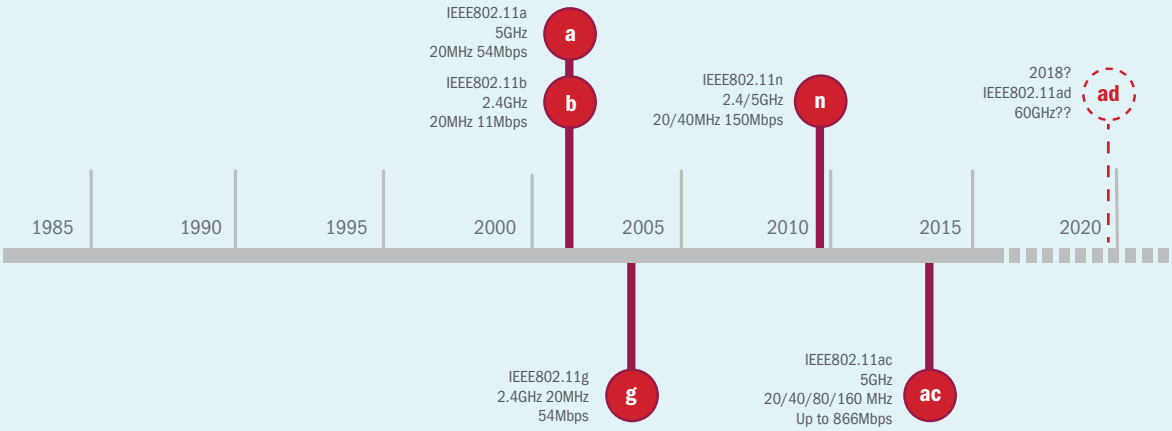
Evolution of Twisted Pair Cabling

Evolution of Infrastructure Technologies

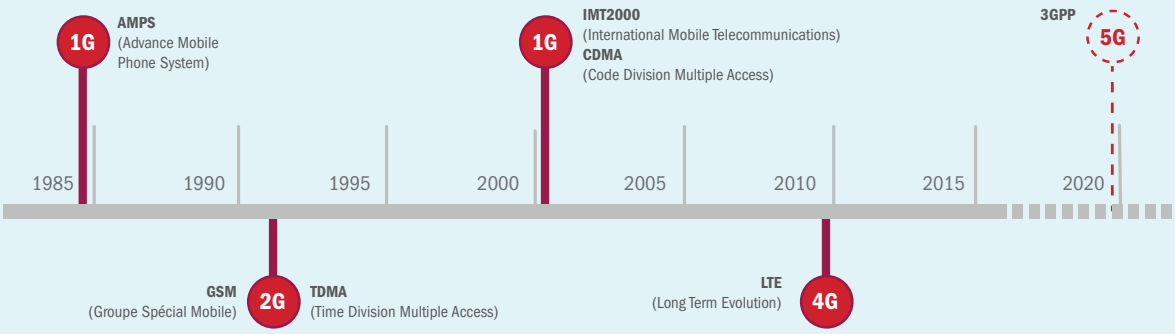
Evolution of PoE



Evolution of WiFi



Evolution of Cellular Networks



Monetizing Building Efficiencies

There is continuous pressure to reduce operational costs and deliver savings through the facility while remaining aware that savings cannot be gained at the expense of patient care. This usually means doing more with less—building a better space for less capital cost than previous iterations, allowing for more efficient use of the space, and using less energy and utilities, while also having a space that allows for innovation in treatment.

Driving cost out of a building is a well worn path to driving business outcomes, and it can be achieved either by investing in capital equipment (like LED lighting) or through operational improvements (like scheduling or maintenance procedure changes)—or better yet, a combination of both approaches. Regardless, data should determine the course of action.

Limiting Moves, Adds and Changes

Any infrastructure adjustments must be carefully planned to limit the potential for infectious disease. A number of organizations provide guidelines for this process.

"Use of dust-control procedures and barriers during construction, repair, renovation, or demolition…" **Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC)**

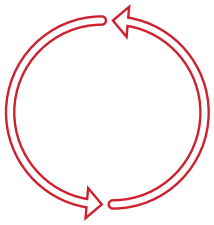
"After the initial installation, adding or changing horizontal cabling would result in a net decrease in the quality of care provided, jeopardizing infection control measures, or compromising life safety measures." **ANSI/TIA-1179-A**

Moves, Adds and Recommendations

- Maintain positive air pressure
- Build in cable redundancy
- Use retrofit mechanical fire stop methods

CHALLENGES

Challenge I: Keeping Up With Evolving Technologies



There is a continuous drive for rapid innovation throughout the industry, which affects not only the tools that drive patient care but also the infrastructure that supports those tools.

Migrating to an IP Platform

When migrating from traditional building management systems using serial or analog interfaces to an open IP platform, it can be challenging to respond to the variety of protocols and equipment interfaces.

It is important to aggregate new technologies with building intelligence in a useful and meaningful way, which can demonstrate efficiency and return on investment.

Considerations when Evaluating Technology

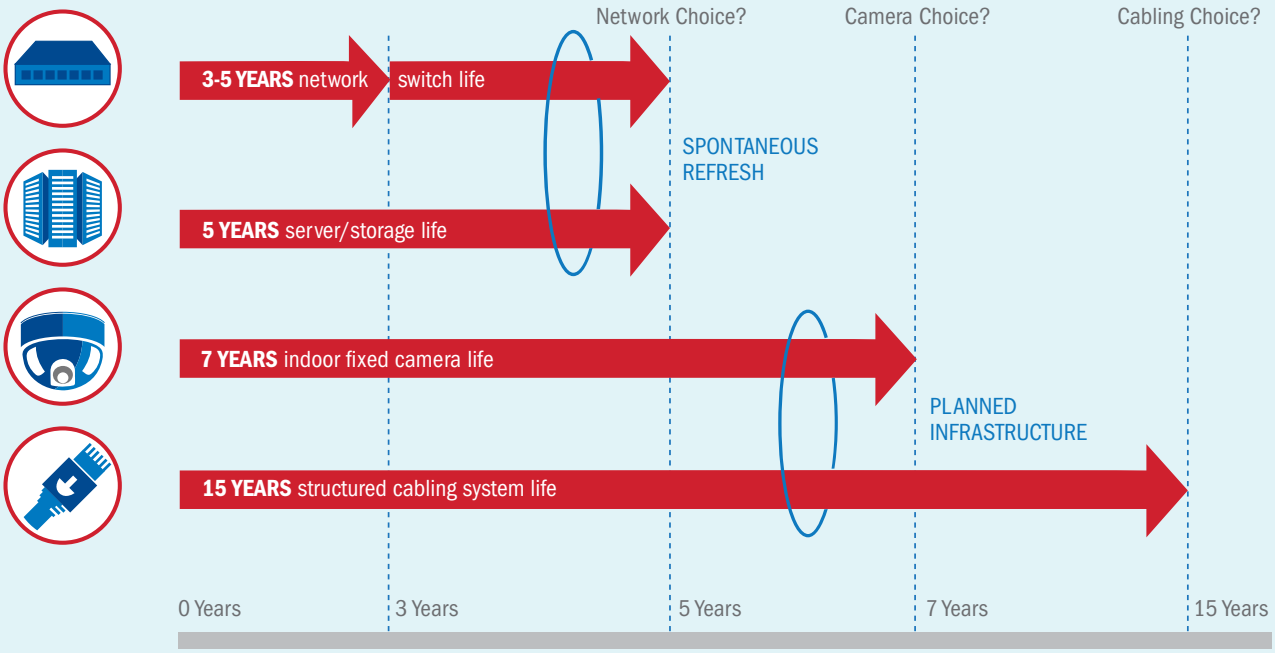
Replace vs. Retrofit

One decision building operators have to consider is whether to replace a piece of equipment or retrofit new technologies with existing equipment. Both options carry their own unique cost and integration challenges.

For example, using VFD (Variable Frequency Drives) instead of ON/OFF controllers to support fans in HVAC equipment may cause unwelcome noise that could disrupt other equipment, including monitor disturbance, sound and paging RF interference.

When it comes to mechanical plant and equipment technology, it's important to integrate new technology without impacting other infrastructures, in addition to managing separation between power systems and data systems.

Lifecycle of Key Technologies



An IP platform can be a key component to the life cycle of an existing asset. When existing systems are updated or retrofitted, the new or upgraded system should be specified to use the IP-based network in the building. This will reduce the capital cost of the system update, supporting the economics of the project. When necessary, the network can be scaled in an efficient manner to accommodate increased bandwidth or number of connected

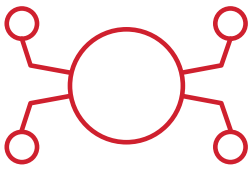
Challenge II: Amortization of Cabling Investment

Cabling is expected to outlive most network components, but it might be the most difficult and cost-intensive component of a network to replace.

Infrastructure amortization periods run for an average of 10 to 15 years. When looking at healthcare facility cabling costs, you should consider both initial and long-term costs.

You also should understand the full life cycle and industry trends of other technologies and note that cabling represents only two to three percent of the initial network hardware investment.

In many ways, the proper investment serves as a necessary insurance, providing protection for the innovations of the future.



Rip and Replace

In determining when to rip and replace cabling, you should also consider the timing of departmental refurbishment, building upgrades or relocation. This is in addition to the continuous emergence of new technologies.

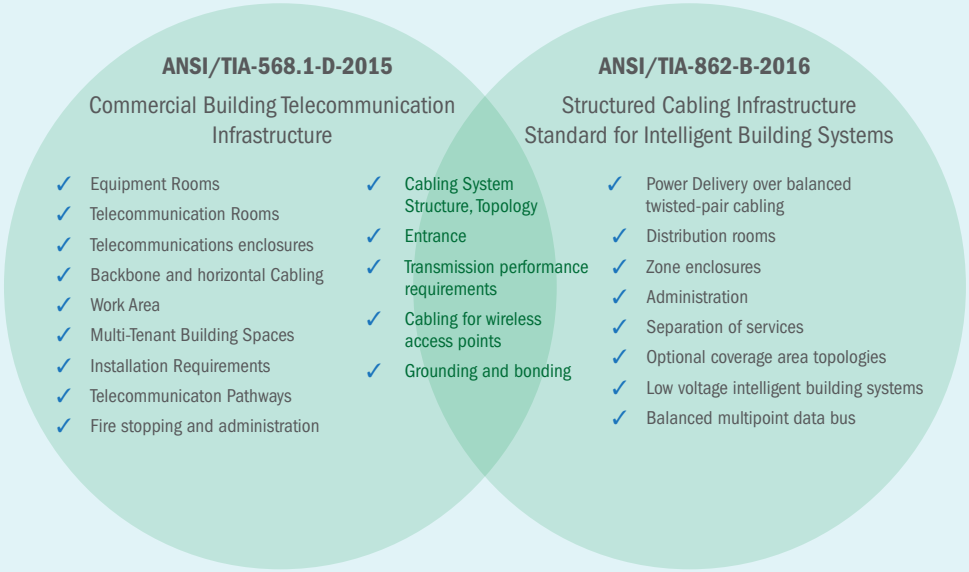
Your justification for an infrastructure upgrade can also take the following into account:

- Spreading the cost of facility upgrade versus CAPEX of IT hardware
- Sharing the efficiency of structured cabling to support non-traditional applications besides voice and data (i.e., lighting, HVAC, security and other building controls)

Cost of Not Acting

The ultimate question should not focus solely on the cost to upgrade; it should quickly turn to the cost of not upgrading your infrastructure. In other words, the opportunity cost.

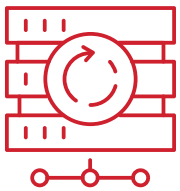
Relevant Standard References



Source: ANSI/TIA and ISO

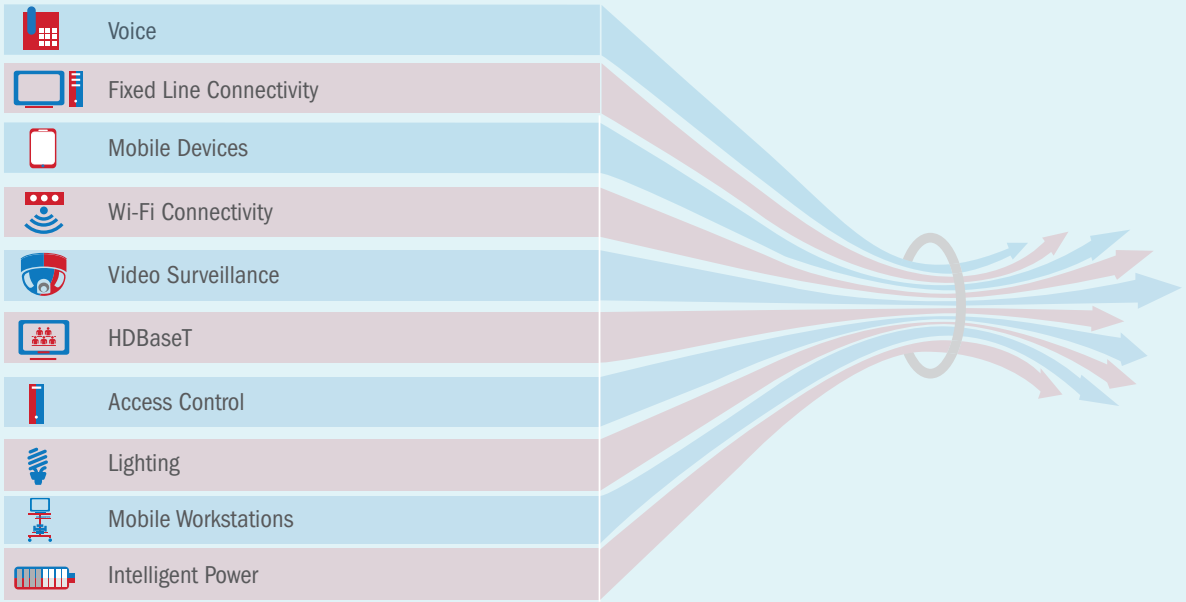
Those costs include the following:

- Slower adoption of digital technology
- Loss of competitive advantage
- Long-term risk and increased complexity
- Limited use of valuable information from sensors, monitors and logistics systems
- Higher costs without enterprise standards for hardware, software and communication protocols
- Limited innovation in traditional IT and operational systems by failing to share engineering knowledge
- Complicated compliance and security efforts by limiting transparency and “auditability” of OT information by managers dependent on IT business systems
- Conflicts of interest and unnecessary duplication of development and management costs between the two fields
- “Lock-in” for system life with older, proprietary systems that make access to data more expensive or difficult
- Decline in patient satisfaction scores, which can impact funding

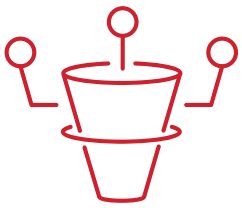


Challenge III: Supporting

Increased Application Traffic



Multiple Applications



Today's enterprise applications are increasingly a large collective of distributed software components that enable complex business services. With so many components, often monitored in different silos, it can be difficult to manage a business service or application as a whole.

An Interval Approach

The goal is to quickly migrate towards a unified open architecture. The reality is that this migration will most likely become an ongoing process that may include multiple stages and intervals.

During this process, it is important to consider who is responsible for managing the various applications and systems. Historically, IT, voice and facilities all had individual agendas and priorities. The challenge is to figure out how IT and OT align for better collaboration.

Challenge IV: Reducing Network Downtime

Digital Imaging File Sizes

MEDICAL IMAGING MODALITY	AVERAGE EXAM FILE SIZE (MB)
Radiology	38
Ultrasound	20
Echo	350
CT	35
MRI	23
Angiogram	225
Interventional Radiology	22
Nuclear Medicine	2
Fluoroscopy	20

There's little to no margin for error when it comes to network performance, especially considering how integral electronic health records and connected medical devices are now to routine care.

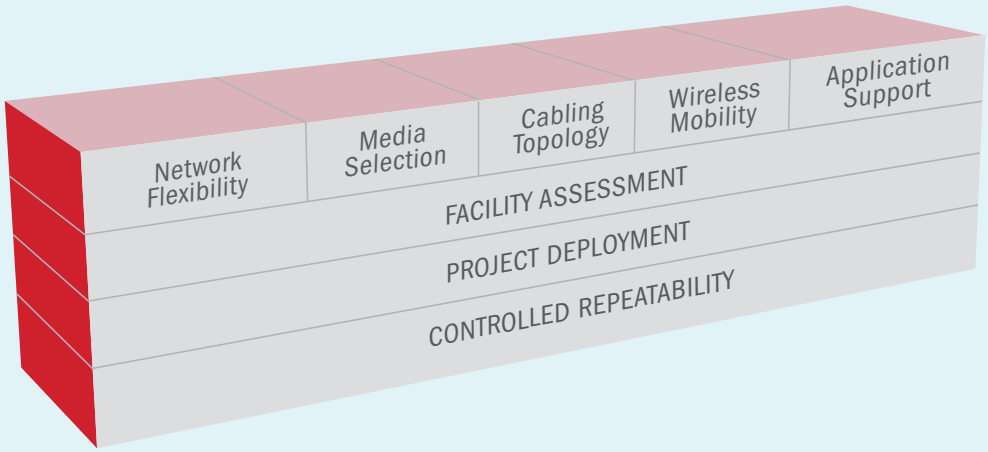
Identifying critical and non-critical assets is foundational, but organizations can make strategic decisions in the ranking of equipment to determine what takes priority.

Availability Levels

As more devices come on to the network, outages can cripple more than business operations. Maintaining availability becomes critical for patient care.

Through a better understanding of the causes for IT service downtime, many healthcare facilities have improved availability levels over the years. Still, the demand will only continue to increase, as complex systems are deployed and the cost of business downtime increases.

Challenge V: Coping With Increasing



Best Practice I:
Network Flexibility

Bandwidth Demands

The adoption of electronic patient records, advanced diagnostics, BYOD policies and network-enabled medical devices have triggered an enormous strain to the network.

Building operators are asking themselves:

- How can I cater to increased network traffic within the building caused by BYOD environments, telemedicine, media-rich applications and the integration of additional systems?
- How can I ensure connectivity while maintaining security?
- How can I create pathways and spaces to scale and upgrade the cabling infrastructure, while maintaining consistent levels of patient care?
- Do I have a plan in place to avoid bottleneck and network congestion, in particular during emergency situations?
- How can I support non-medical bandwidth demands, including the needs of patients, visitors, providers and non-staff-based users?

The Anixter Approach
Versatile Physical Layer Connectivity

More than ever before, a high-performance structured cabling system plays an essential role in operating a smart hospital. Versatile physical layer connectivity guides the creation of an open-system platform, where the right media selection, cabling topology and density of interfaces will increase the scalability of the network.

They key is to build a strong foundational layer, as it becomes integrated into the bricks and mortar and influences long-term functionality and usefulness of the space.

Apply open-architecture designs to accommodate your performance requirements for a highly scalable network.

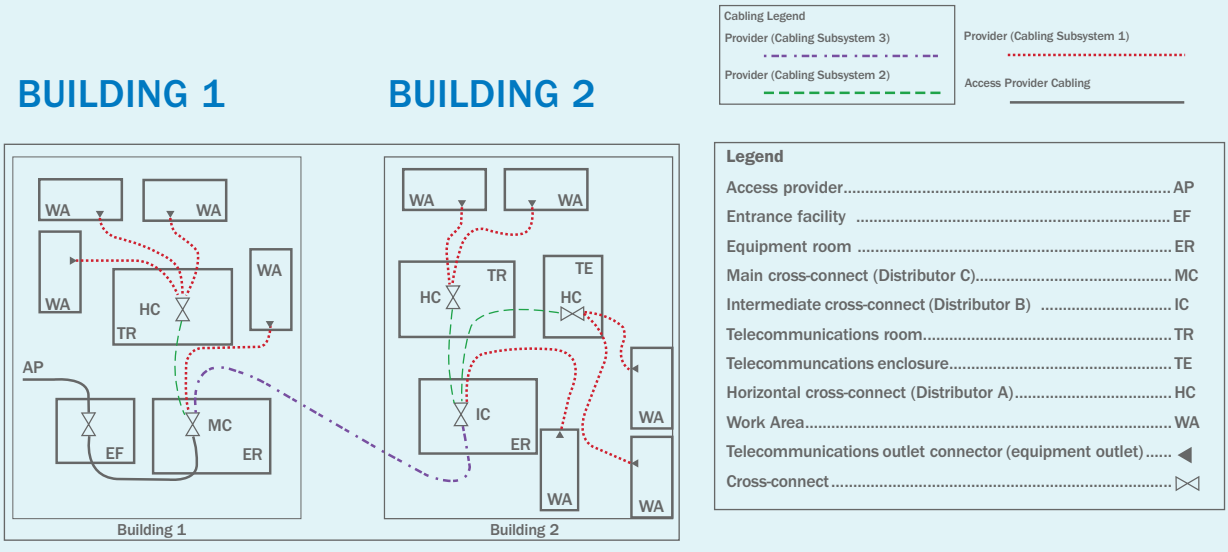
The flexibility of the foundational layer creates ripple effects throughout the network.

Considerations

When enabling network flexibility, it is important to consider:

- ☐ Can your cabling infrastructure support healthcare applications?
- ☐ How do you manage moves, adds and changes in your hospital?
- ☐ What is your device scalability expectation?
- ☐ How do you balance wired versus wireless connectivity?
- ☐ What are the work area outlet density requirements in your healthcare facility?

ANSI/TIA-1179-A Representative model for healthcare facility



Telecommunications Rooms

Best Practice II:
Media Selection

Recommended Solutions

Zone Wiring Techniques

Due to the 100 m (328 ft.) maximum length limitation for balanced twisted-pair copper cabling, it is not practical at times to construct multiple telecommunications rooms to service devices that require network connectivity. Zone cabling solutions provide flexibility where the physical constraints of the building dictate extended reach for the low-voltage cabling plant to support applications such as video surveillance and Wi-Fi.

Intelligent Patching Solutions

Adapting and managing the network infrastructure effectively can be a difficult task for modern healthcare facilities. Utilizing intelligent patching solutions to deliver detailed visibility of the physical layer can provide a dynamic platform that enables efficient moves, adds and changes to the network infrastructure while improving network resilience.

Migration from 802.11n to 802.11ac

As more mobile devices require network connectivity in healthcare environments, high-capacity wireless systems are needed in order to relieve the traffic bottlenecks that can occur when multiple users attempt to access the network simultaneously. Ensuring a seamless migration to high data rate Wi-Fi systems such as 802.11ac require a structured cabling design that can deliver upwards of 10 Gbps throughput to the wireless access points. Category 6A cabling solutions become the logical choice, as they are able to support 10GBase-T applications up to 100 m.

Cable Type and Main Features

Cable Type	Main Features
Category 5e/Class D Unshielded Shielded Twisted Pair TIA | ISO Designation: (UTP) | (U/UTP)	• Originally designed to support 100 MHz operation • This media is used the most for 100BASE-T and 1000BASE-T applications • Conductor gauge size is typically 24 AWG • Patch cords are available with solid or stranded conductors
Category 6/Class E Unshielded Shielded Twisted Pair TIA | ISO Designation: (UTP) | (U/UTP)	• Originally designed to support 250 MHz operation • This media is used the most for 100BASE-T and 1000BASE-T applications • Conductor gauge size is typically 23-24 AWG • Patch cords are available with solid or stranded conductors
Category 6A/Class E_A Unshielded Shielded Twisted Pair TIA | ISO Designation: (UTP) | (U/UTP)	• Originally designed to support 500 MHz operation • This media is used the most for 10GBASE-T applications • Conductor gauge size is typically 22-23 AWG • Patch cords are available with solid or stranded conductors

Best Practice III:
Universal Cabling Topology

Choose the appropriate physical media from twisted-pair, optical fiber and direct-attach cables to address high-speed bandwidth requirements.

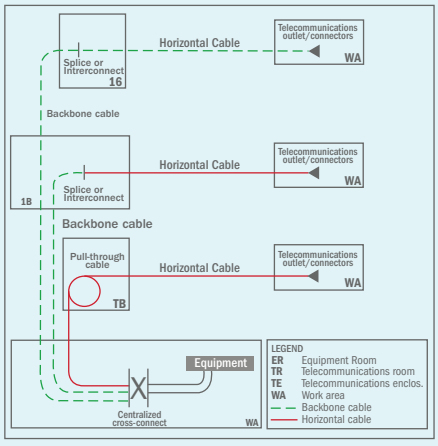
Considerations

When choosing the right cabling media, it is important to consider:

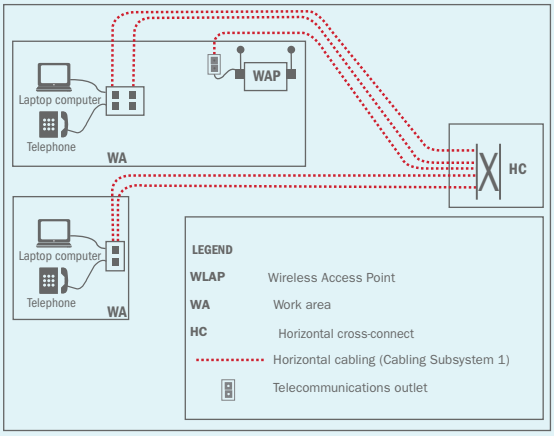
- ☐ What is your plan to migrate from 1 GbE to 10 GbE?
- ☐ How do you deploy PoE today?
- ☐ What is your current copper and fiber specification?
- ☐ How are you future-proofing with the right media?

ANSI/TIA-1179-A - Telecommunication Cabling System

Centralized fiber optic cabling



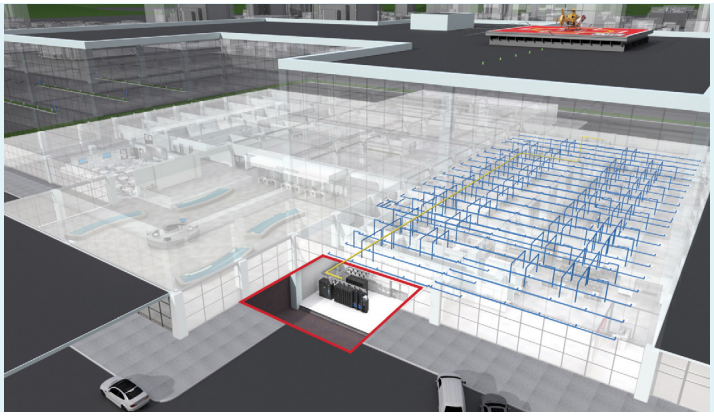
Typical star topology



Recommended Solutions

High-Performance Structured Cabling
Healthcare facility infrastructure is typically designed for a minimum 20-year useful lifespan. As seen over the last 20 years, technology evolves quickly, and facility owners and designers must have the foresight to avoid near-term obsolescence of the cabling infrastructure. Deploying high-performance structured cabling solutions such as Category 6A cabling in the horizontal and laser-optimized multimode fiber (OM3/OM4/OM5) in the backbone maximizes the utility of the network infrastructure.

802.3af (15W), 802.3at (30W), 802.3bt (100W)
Twisted-pair copper in the horizontal has the advantage over other media types such as fiber and wireless in its ability provide a physical transport for both data communications and low-watt power delivery. Since the advent of the first Power over Ethernet (PoE) Standard IEEE 802.3af in 2003, the ICT industry has seen a breathtaking array of PoE-enabled devices and applications, such as Wi-Fi, surveillance cameras, commercial lighting and sensors, proliferate healthcare facilities.



Best Practice IV:
Wireless Mobility

Determine the right choice for an open-architecture environment by adopting healthcare wiring and building automation standards.

Considerations

When planning for network performance, it is important to consider:

- ☐ What is your current network cabling infrastructure?
- ☐ How do you implement ANSI/TIA-1179-A standards?
- ☐ How do you ensure design will support growth?
- ☐ What level of cabling administration do you provide?

Recommended Solutions

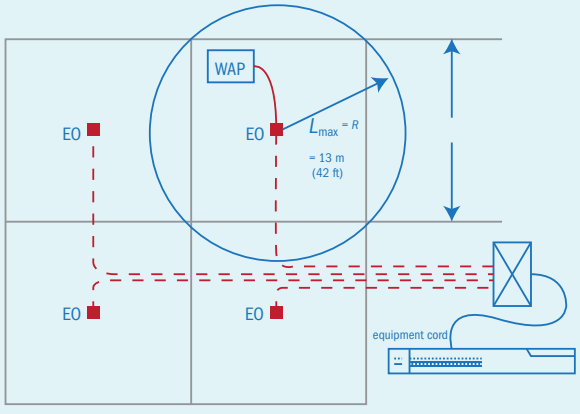
Star Topology

In this topology the telecommunications cables are distributed from a central point. An advantage of the star topology is the simplicity of adding additional nodes. The primary disadvantage of the star topology is that the centralized hub represents a single point of failure.

Horizontal Cabling (Cabling Subsystem 1)

The horizontal cabling system extends from the work area's telecommunications information outlet to the telecommunications room (TR) or telecommunications enclosure (TE). It includes horizontal cable, mechanical terminations, jumpers and patch cords located in the TR or TE and may incorporate multiuser telecommunications outlet assemblies (MUTOAs) and consolidation points (CPs). The maximum horizontal cable length is 90 m (295 ft.), independent of media type.

TSB-162-A - Wireless Connectivity



Best Practice V:
Application Support

Backbone Cabling (Cabling Subsystem 2 or 3)
Backbone cabling is the inter-building and intra-building cable connections in structured cabling between entrance facilities, equipment rooms and telecommunications rooms. Typical media type is multimode or single-mode fiber, but shorter backbone cabling distances can use multi-pair copper cabling.

Structured Cabling Expertise
Choose partners that are credentialed to the latest ICT industry certifications such as the Registered Communications Distribution Designer (RCDD®). This credential is awarded to individuals who have demonstrated knowledge in the design, integration and implementation of telecommunications and data communications transport systems and related infrastructure.

Pre-Labeled Hardware and Bundled Cable
Pulling cables individually is often impractical and inefficient. Bundling and binding together different types of color-coded or numbered copper, fiber and electronic conductors into one compact, flexible multiconductor cable can deliver cost savings of up to 30 percent.

NETWORK PERFORMANCE BEST PRACTICES

Determine your migration path for Wi-Fi and cellular connectivity to support a modern healthcare environment.

Considerations

When delivering wireless mobility, it is important to consider:

- ☐ How do your medical staff, patients and visitors use mobile devices on premise?
- ☐ Where are the wireless coverage gaps in your healthcare facility?
- ☐ What is your migration path to 802.11ac?
- ☐ How does PoE support your wireless infrastructure?

Recommended Solutions

Distributed Antenna Systems (DAS) and Small Cell

The growing reliance on mobile devices from patients and clinicians as well as visitors and first responders, requires consistent coverage throughout the interior and select outdoor spaces. DAS and small cell solutions have the principal function of ensuring adequate RF coverage for multiple cellular service providers.

Indoor Wi-Fi Systems

With the use of mobile devices by clinicians and the bring your own device (BYOD) trend changing the way care is delivered, the exponential growth of data usage in facilities requires a scalable network to meet the significant demand on Wi-Fi networks.

Applications for Power over Ethernet

ORGANIZATION/STANDARD	WATTS REQUIRED	APPLICATIONS
IEEE 802.3af 2-Pair PoE	Up to 15.4W	802.11n WAPs, access control, thin clients, IP phones, fixed IP cameras
IEEE 802.3af 2-Pair PoE+	Up to 30W	PTZ IP cameras, alarms, video IP phones, RFID readers
IEEE 802.3bt 4-Pair PoE	Up to 60W	Access control, PTZ IP cameras, 802.11 ac WAPs, point-of-sale readers
Cisco UPOE	Up to 60W	Access control, PTZ IP cameras, 802.11 ac WAPs, point-of-sale readers
IEEE 802.3bt 4-Pair PoE	Up to 100W	Televisions, desktop computers
Power over HDBaseT (PoH) Draft IEEE 1911 Standard**	Up to 100W	Televisions, desktop computers

TECHNOLOGY SUMMARY

Technology Solutions

The chart below details the technology solutions that can support a layered security approach in a commercial building.

TECHNOLOGY	Property Perimeter	Reception and Registration	Specialty Units	Emergency Room	Pharmaceutical Assets	Biomedical and Diagnostics
Category 6 structured cabling systems	✓	✓	✓	✓	✓	✓
Category 6A structured cabling systems		✓	✓	✓	✓	✓
Fiber optic structured cabling systems	✓	✓	✓	✓	✓	✓
Distributed Antenna Systems (DAS)		✓	✓	✓	✓	✓
Small cell wireless connectivity		✓	✓	✓	✓	✓
Wi-Fi connectivity		✓	✓	✓	✓	✓
HDBaseT video		✓	✓	✓	✓	✓
VoIP and unified communication		✓	✓	✓	✓	✓
Video surveillance and access control	✓	✓	✓	✓	✓	✓
Intelligent LED lighting	✓	✓	✓	✓	✓	✓

Anixter's Technology Support Services can offer further insight to your specific application. For more information, contact your local Anixter representative.

anixter.com/healthcare

SUPPLY CHAIN SOLUTIONS

As you develop a smart building roadmap, it's also important to consider the physical migration from the existing environment to the building's future state. This entails identifying the challenges and risks during the installation phases of technology deployment. Coordination between material deployment and installation schedules can have an impact on the productivity, efficiency and connectivity of work environments.

Properly coordinated deployments allow for tangible savings in time, reduced installation costs and increased efficiencies, all while reducing the risks of lost productivity associated with the physical migration of the building environment.

Challenge	Service	Save Time	Reduce Costs	Increase Efficiency	Mitigate Risk
Creating a functional roadmap for material deployment from our site, contractor site or the job site to limit disruptions in business operations	Material staging and inventory management solutions	✓	✓	✓	✓
Reducing on-site installation time and interruptions	Pre-assembly and configuration	✓	✓	✓	✓
Coordinating deployment of multiple system components that correspond with the contractor installation schedule	Scheduled deliveries and specialized delivery services (lifts, etc.)	✓	✓	✓	✓
Reducing critical component failure at start-up	Off-site burn in and DOA check			✓	✓
Confirming installation adheres to uniform standards	Work area outlet kitting options	✓		✓	
Reducing on-site waste removal and enhancing critical system deployment schedules	Rack/cabinet/enclosure pre-assembly and configuration	✓	✓	✓	✓
Maintaining standards-based labeling schemes for ongoing asset utilization and maintenance	Patch panel and patch cord labeling	✓		✓	
Delivery tracking for on-site components between trades and technologies	Color-coded floor consolidation solutions	✓	✓	✓	✓

For more information, contact your local Anixter representative.

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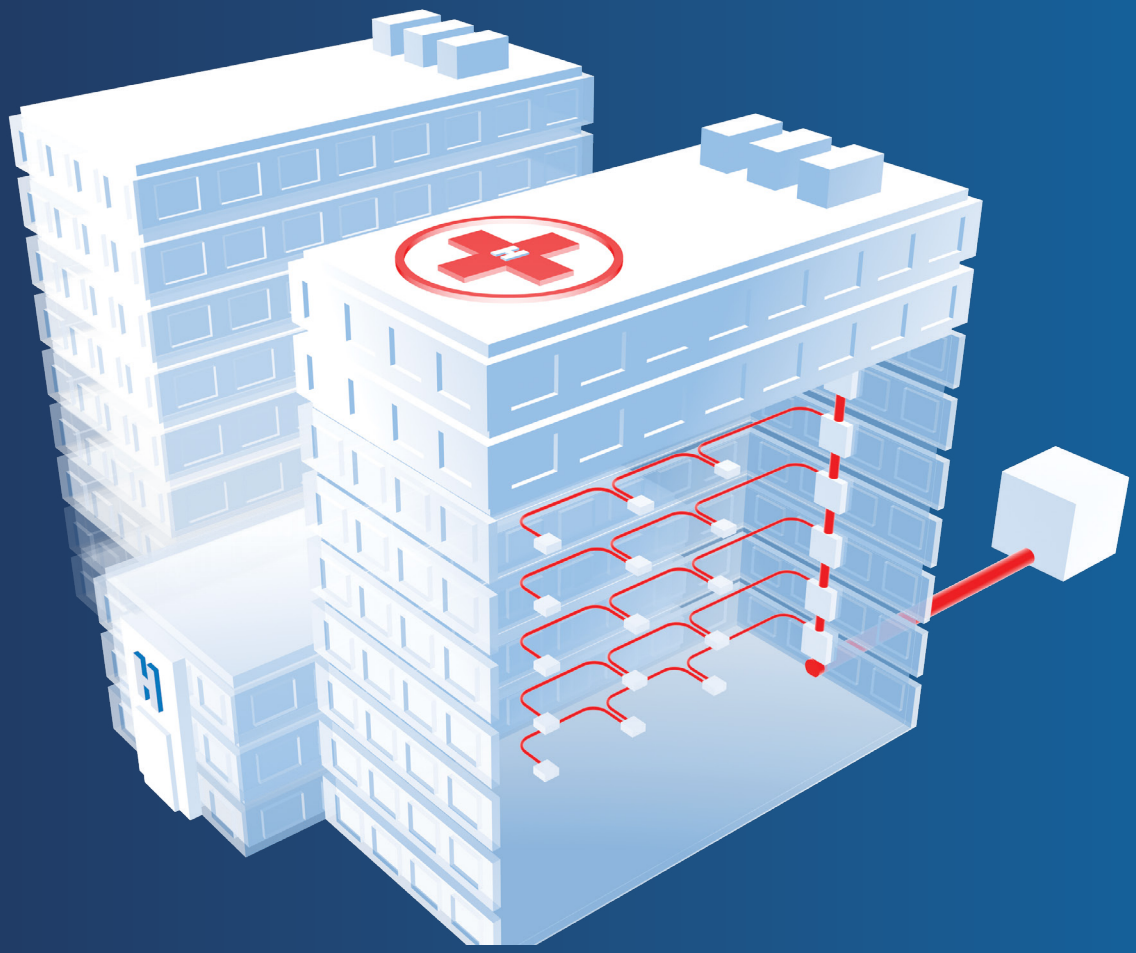
ANIXTER

GLOBAL TECHNOLOGY BRIEFING

POWER OPTIMIZATION BEST PRACTICES

THE CRITICAL POWER CHAIN



INTRODUCTION

In recent years, energy usage by healthcare organizations has increased by 36 percent, making it the second most power-intensive industry behind food sales and service. In addition, hospitals have 2.5 times the energy intensity and carbon dioxide emissions as similar-sized commercial office buildings.

The potential for savings through power optimization and efficiency is obvious. The challenge is maintaining a 24/7 critical power environment that can ensure consistent conditions for patient care.

Industry standards provide guidelines for emergency power as well as power quality, including hardened connectivity, grounding and bonding.

Designing the infrastructure to optimize power in a healthcare facility can have multiple benefits, including reducing operating costs, limiting potential outages and reducing the negative environmental impact, which increasingly is tied to funding for healthcare facilities.

In recent years, energy usage by healthcare organizations has increased by **36 percent**, making it the second most power-intensive industry behind food sales and service.

Source: U.S. Department of Energy.

CONSIDERATIONS

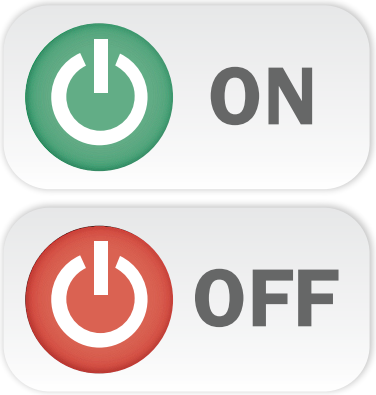
Always-On Environment for Critical Patient Care

Several organizations provide guidelines around backup power, often tied to accreditation for a facility. The American Osteopathic Association requires 72 hours of emergency power, while Joint Commission accreditation requires 96 hours.

Unlike in an office building or other commercial buildings, power disruption is not just about lost productivity or disruptions to business services. In a healthcare facility, maintaining power—whether that power is tied to overall building systems, patient data or specific pieces of medical equipment—is essential to the well being of patients.

Think about a surgical procedure and the increase in usage of automated technology and medical tools that aid in the precise delivery of care. Disruption of power is simply not acceptable in this kind of environment.

Key standards, including EN 60601-1, help define patient care areas within a hospital that require special attention and help protect patients from electrical hazards. A patient care area is understood as, at minimum, a six-foot radius around the patient, and up to seven feet above the patient.



Quality Power

Power quality can influence the quality of care—with the potential for diminished performance, excessive downtime, and premature equipment failure. On the other side, it influences the cost of care—with the potential for lost revenue, higher cost of service and delayed discharges.

Power quality depends upon the power source, the grounding, the surge protection, and the ability to condition power and monitor problems. Power quality begins with what comes into the facility and whether or not it is within the parameter of voltage and frequency. If it is outside those parameter, it is difficult for the equipment to do its job. There are UPS solutions which boost the low-voltage and turn down the high-voltage power, and if the initial frequency is too far off, it won't pass through and will switch to battery.

Power supplies operate with a ton of noise, depending on external conditions or deviations from the power line, and this can wreak havoc with X-ray machines or, for example, with a sensitive ultrasound. Clinicians are counting on a clean power supply to get high-quality medical imaging.

Isolation transformers also become important. These are designed to block noise and provide power with no connection or reference to the supplied power.

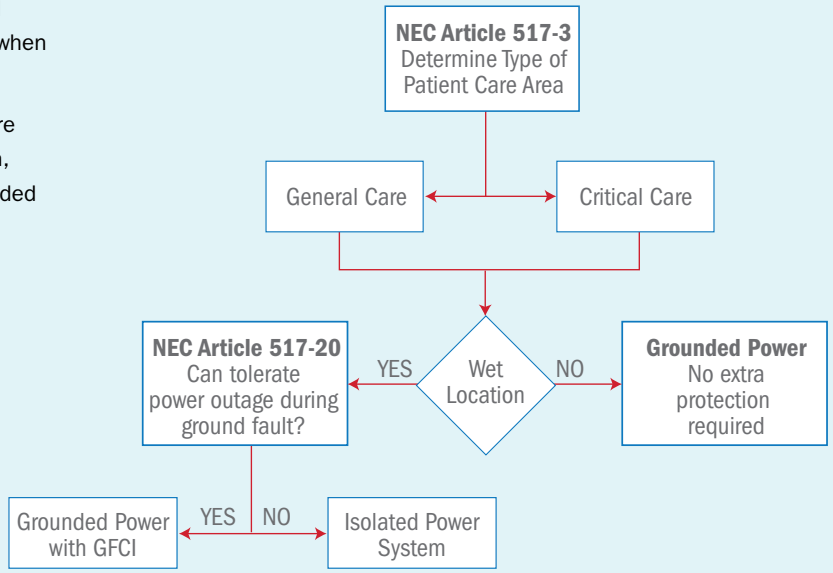
Power quality in IT space can mean not turning on a complete rack because of the load it draws. The more you explore power quality, the more opportunities you will find to implement it.

Rough wave vs. clean wave

Healthcare Power Equipment Decision Chart

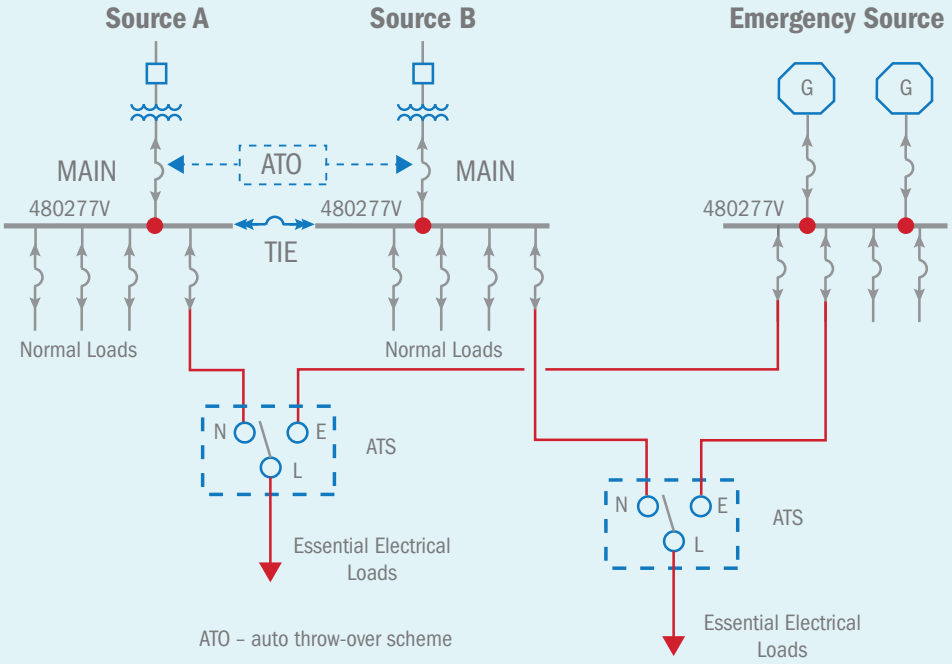
This chart is intended to show the theoretical decision model that a hospital goes through when selecting parts for their power infrastructure.

Considerations include the kind of patient care area, whether or not it is a wet or dry location, and if it is an isolated power system or grounded power with GFCI.



Secondary Selective—Generators

This sample diagram is for multi-redundant power coming into the building.



ATO – auto throw-over scheme

POWER OPTIMIZATION BEST PRACTICES

Energy Efficiency

Energy Star has conducted several studies that show that each dollar saved through better energy performance can be equivalent to generating up to $20 in new revenue from patients.

“In addition to providing emergency power to critical devices, an energy-efficient UPS can cut energy losses by 30-55% while protecting against power surges, voltage drops and frequency distortions.”

Energy Star

For a system to be energy efficient and energy capable, it should be accounted for early in the system design process. This involves developing an energy strategy and selecting technology that enables that strategy.

Healthcare facilities are all about peak load and peak demand. The electric bill is based on what the peak load may be during the day. By managing the peak to a lower level, healthcare facilities can realize significant savings.

Ultimately, facility managers require visibility so you can see how the systems are functioning. You want to be able to optimize it through the use of intelligence for monitoring and management, turning data into action.

Lowering Costs of Utility Bills

Step	BEHAVIORAL actions to lower your utility bills, carbon emissions
1	**Set energy use goals** and hire a professional responsible for keeping tabs
2	Use **more sustainable equipment** being produced by manufacturers
3	Search for **“leaking” electricity**
4	Take a look at your **laundry services**
5	Redesign **waste management**
6	**Upgrade computers** and other office equipment
7	Consider **renewable source** of energy

Step	TECHNOLOGY actions to lower your utility bills, carbon emissions
1	Controlled **LED lighting systems**
2	Smart networked **energy metering** and **monitoring** solutions
3	**Variable frequency** drives (VFO’s) for HVAC systems
4	Modern 99% **efficient UPS**
5	UPS with **payback measured** in weeks and months
6	Harmonic mitigating Energy Star and new CSL **efficient transformers**
7	**Isolation panels** with good electronic shielding

IEC and NFPA Standards

A number of standards exist to help healthcare facilities ensure safety, meet performance goals and provide installation requirements. These standards are tied to Joint Commission accreditation, as well as guidance from the Center for Medicare and Medicaid.

The IEC (EN or UL in North America) provides a number of standards related to power, including 60601-1 regulating medical device equipment.

The NFPA 99 provides standards for healthcare facilities, while others cover electrical hazards, fire hazards and emergency power requirements.

These standards are consistently updated to keep pace with innovations in technology and new goals for patient safety.

ORGANIZATION	STANDARD	DESCRIPTION
UL IEC	UL 60601-1	Medical device engagement
	UL 1363A	Power strips (integrated)
	UL 1363	Power strips (standalone)
	UL 1449	Surge protection (non-patient areas)
NFPA	NFPA 99	Healthcare facilities
	NFPA 70	Electrical hazards
	NFPA 101	Fire hazards
	NFPA 110	Emergency power

UL Standards

UL/IEC 60601-1

Series of technical standards for the safety and effectiveness of medical electrical equipment.

UL 1363A

For power strips integrated as components of a larger system where they supply power to movable equipment.

UL 1363

For power strips that stand alone and are not designed as components of a larger system.

UL 1449

For enclosed and open-type surge protective devices outside of patient care vicinities, designed for repeated limiting of transient voltage surges.

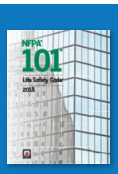
NFPA Standards

NFPA 99

Establishes minimum criteria for the installation, performance, and operation of a wide range of systems and equipment in health care facilities.

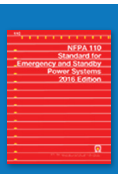
NFPA 70

Benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards.



NFPA 101

Strategies to protect people based on building construction, protection, and occupancy features that minimize the effects of fire and related hazards.



NFPA 110

Performance requirements for emergency and standby power systems providing an alternate source of electrical power in the event that the normal electrical power source fails.

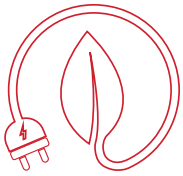
CHALLENGES

Challenge I: Meeting Goals for Energy Efficiency

With the cost of care rising and healthcare facilities generating 2.5 times the energy intensity of similar-sized commercial buildings, there is an enormous amount of pressure to look for ways to reduce operational costs.

The challenge is in the sheer size and complexity of a healthcare facility. On top of that, compared to an office building, a hospital is always full of energy-hungry equipment, and efficiency is not as important as the quality and dependability of the equipment.

There are multiple systems in a hospital, and sometimes not a lot of coordination between the owners of these systems.



ENERGY STAR Hospital Rating and Cost Savings Calculator

The ENERGY STAR Score for Hospitals applies to general medical and surgical hospitals, including critical access hospitals and children's hospitals. The objective of the ENERGY STAR score is to provide a fair assessment of the energy performance of a property relative to its peers, taking into account the climate, weather and business activities at the property.

Utilize the tools on the ENERGY STAR Healthcare Energy Savings Financial Analysis Calculator website to effectively measure the ongoing savings potential of your facility.

Healthcare Energy Savings Financial Analysis Calculator

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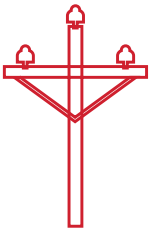
https://www.energystar.gov/buildings/tools-and-resources/energy-star-healthcare-energy-savings-financial-analysis-calculators

Challenge II: Preventing Accidental Outages

Humans are the number one cause of accidental outages, but when and where these outages will occur is unpredictable. Multiple people have access to telecommunications rooms or shared access to technical spaces. It's important to think comprehensively to mitigate the risk of accidental outages because these can directly affect patient care and safety.

Monitored and intelligent hardware can also aid in predictive maintenance, greatly diminishing unforeseen issues with healthcare facility systems.

Challenge III: Restrictions of Legacy Electrical Infrastructure

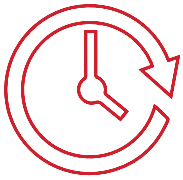


Whether due to space or budget limitations, many healthcare facility owners and operators must meet the challenges associated with legacy electrical infrastructure when considering enhancements.

This can include issues with current code, including NFPA 70, 99, 101 and 110, as well as inefficiency with un-intelligent or un-monitored power infrastructure.

It's a continual balance between upkeep, maintenance and testing, and realizing the benefits of smart infrastructure that leads to improvements in patient comfort, patient care and operational efficiency.

Challenge IV: Ensuring an Always-On Environment



Many considerations go into providing an always-on environment, including the regulations set by organizations such as the Joint Commission and others.

Examples of disruption in healthcare facilities include the following:

- Loss of HVAC systems that rely on electricity for heating, cooling and ventilation
- Loss of respiratory devices and other critical equipment for patients in intensive care, neonatal or cardiac units
- Loss of lighting for high-risk surgical procedures and potential blackout of rooms with no emergency lighting
- Loss of pressure in water distribution systems
- Potential loss of access to other hospitals and healthcare facilities if they are also affected
- Inability to access electronic patient medical records and other hospital data
- Loss of the patient signaling system for assistance by medical and hospital staff
- Potential loss of access to medication, vaccines and other medical supplies requiring keyless entry

Challenge V: Reducing Utility Costs

As healthcare is the second most energy-intensive industry, there is tremendous savings potential related to utility costs in a healthcare facility. Understanding key technologies can enable an organization to set ambitious goals and provide long-term sustainability.

Healthcare ranks as the country's second most energy-intensive industry, with hospitals spending more than

$10B EACH YEAR.

SOURCE: Premier Safety Institute

Each dollar saved through better energy performance is equivalent to generating up to

$20 IN NEW REVENUE

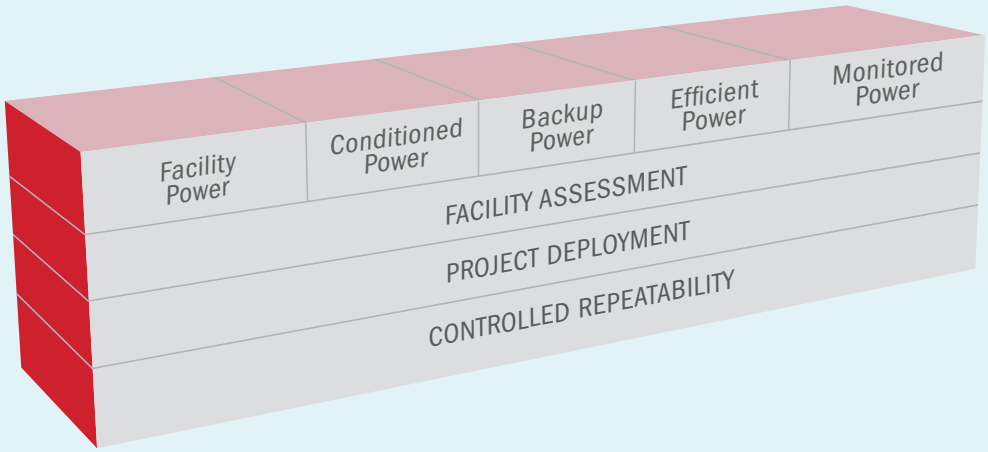
SOURCE: Energy Star

SOLUTIONS

The Anixter Approach
The Critical Power Chain

Quality patient care requires uninterrupted power throughout a facility. Building a critical power chain can help you achieve an always-on environment, while also reducing costs through energy-efficient solutions.

We provide healthcare facility managers with a clear set of guidelines, best practices and measurement techniques in order to help you obtain the performance data you need to optimize your power chain.



Best Practice I:
Facility Power

Design scalable solutions that cater to healthcare growth and flexibility.

Considerations

When optimizing facility power, it is important to consider:

- ☐ What is the age of your electrical infrastructure?
- ☐ How long would it take to recover from electrical failure?
- ☐ What is your plan to meet future facility capacity needs?

Recommended Solutions

Backup Power Generators
For medical facilities such as hospitals, healthcare facility backup power generators aren't just important—they're vital. That's why the National Electrical Code (NEC), as well as many state codes, mandate that hospitals and critical care facilities have backup power systems that will start automatically and be running at 100% capacity within 10 seconds of power failure. Running multiple parallel generators makes the odds of total failure statistically astronomical and ensures care facilities can power every possible piece of equipment, no matter what voltage it requires. In the event of an outage, certain emergency generators can be capable of covering all electrical loads for up to 120 hours or more without refueling.

Automatic Transfer Switch
An automatic transfer switch is often installed where a backup generator is located, triggering when it senses one of the sources has lost or gained power.

Switchgear
Switchgear is the combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to de-energize equipment to allow work to be done and to clear faults downstream. This type of equipment is directly linked to the reliability of the electricity supply.

Best Practice II:
Conditioned Power

Maintain continuous voltage and protect against surges with conditioning technology.

Considerations

When optimizing conditioned power, it is important to consider:

- ☐ How do you handle abnormal voltage, surges and spikes?
- ☐ How do you manage external and internal electrical transients?
- ☐ How do you cope with brownouts and blackouts?

Recommended Solutions

Line Conditioning Solutions
Line conditioning solutions help to correct voltage sags while maintaining uptime and productivity and providing isolation and noise suppression. This is critical in patient care environments that rely on precision and exactness in procedures to eliminate the potential for error and risk.

Harmonic Correction Unit
Active harmonic filters provide dynamic harmonic correction by actively injecting the required currents into the customer's electrical distribution system to cancel the entire spectrum of damaging harmonic currents at the point of connection.

Electronic Voltage Regulator (EVR)
An electronic voltage regulator reduces equipment downtime and improves performance of critical equipment through constant voltage regulation and line noise reduction.

Power Isolation and Noise Suppression
Power isolation and noise suppression solutions provide superior protection against damaging electrical disturbances and safeguard critical sensitive equipment from all forms of RFI/EMI electrical noise.

Power Line Conditioning System
A power line conditioning system provides exceptional system reliability through ultimate power protection against sags, surges, swells, spikes and electrical noise.

Grounding and Bonding
Article 517 of the National Electrical Code (NEC) outlines the purpose of grounding and bonding solutions, which are meant to reduce low-voltage potential differences between electrically conductive surfaces that may be reached by a patient or care provider in the patient vicinity. Two independent means of grounding are required for the patient care areas and are connected in parallel. This limits the voltage and, thus, the electrical currents that the patient is exposed to, reducing or eliminating the electrical shock hazard.

Examples of grounding and bonding solutions include:

- Bonding straps and jumpers
- Grounding and ESD hardware and accessories
- Grounding busbars and strips
- Grounding compression connectors and covers
- Grounding mechanical connectors

Best Practice III:
Backup Power

Provide optimal settings for quality patient care with an always-on environment.

Considerations

When optimizing backup power, it is important to consider:

- ☐ How do you quantify savings for energy efficiency?
- ☐ What are your most inefficient areas?
- ☐ How do you account for future power capacity and scalability?

Recommended Solutions

UPS Systems

A variety of design approaches are used to implement UPS systems, each with distinct performance characteristics. This table outlines the various UPS types:

UPS TYPE	Benefits	Limitations
Standby	Low cost, high efficiency, compact	Uses battery during brownouts, impractical over 2kVA
Line Interactive	High reliability, high efficiency, good voltage conditioning	Impractical over 5kVA
Standby On-Line Hybrid	Excellent voltage conditioning, low efficiency, low reliability, high cost	Impractical over 5kVA
Standby Ferro	Excellent voltage conditioning, high reliability	Low efficiency, unstable in combination with some loads and generators
Double Conversion On-Line	Excellent voltage conditioning, ease of paralleling	Low efficiency, expensive under 5kVA
Delta Conversion On-Line	Excellent voltage conditioning, high efficiency	Impractical under 5kVA

UPS Healthcare Applications

UPS systems support regulated power, battery backup and regulatory code compliance to support various healthcare applications. These include:

Clinical Lab Equipment

Prevent data errors to provide accurate test results. Prevent diagnosis and treatment delays that compromise patient care. Prevent waste of costly testing materials and lab/staff time.

Medical Equipment

Provide regulated power to ensure flawless performance. Provide UL 60601-1 compliance. Keep mission-critical equipment operational 24x7. Reduce service, repair and replacement costs.

Diagnostic Imaging Systems

Prevent lock-ups, system errors, malfunctions and poor image quality that require rescans, compromise patient comfort/convenience and delay physician review/diagnosis.

Healthcare IT Equipment

Protect valuable data from loss or corruption. Keep vital communications operational. Prevent downtime and lost productivity. Support continuous operation during generator startup.

Mobile Power Applications

Add AC power to new or existing mobile medical carts and other equipment. Customize OEM mobile power solutions. Provide UL 60601-1 compliance and full isolation. Accommodate multiple battery types. Eliminate the need for rebooting when moving between rooms.

POWER OPTIMIZATION BEST PRACTICES

Backup Power Generators

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Switchgear

Switchgear is the combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to de-energize equipment to allow work to be done and to clear faults downstream. This type of equipment is directly linked to the reliability of the electricity supply.

Best Practice IV:
Efficient Power

Consider highly efficient solutions that maximize power quality and minimize operational expenses.

Considerations

When optimizing efficient power, it is important to consider:

- ☐ How do you quantify savings for energy efficiency?
- ☐ What are your most inefficient areas?
- ☐ How do you account for future power capacity and scalability?

Recommended Solutions

Controlled LED Lighting
In specialized settings such as healthcare facilities, lighting can account for 43 percent of annual electricity usage. Understanding your lighting needs and implementing energy-efficient lighting solutions can help save money. Lowering the lighting energy will also have a positive effect on lowering the cooling load in summer.

Networked Energy Metering and Monitoring Devices
Monitoring power quality and energy consumption of facilities can be done from a single console, either on site or remotely. With this capability, building owners are able to measure, sense and trend how the building is operating and performing.

ENERGY STAR Certified UPS Systems
The ENERGY STAR program specification for UPS systems establishes minimum average efficiencies based on different input dependency characteristics—voltage and frequency dependent (VFD), voltage independent (VI) and voltage and frequency independent (VFI). Utilize UPS systems that operate at 99 percent efficiency with the ability to cut energy losses by 30-55 percent and have a payback range of three to five years.

Variable Frequency Drives (VFD) for HVAC
VFDs optimize power consumed by HVAC fans, speeding up or slowing down the fan based on climate demands. These ultra-efficient drives offer flexibility and adaptability for many applications, including positive/negative pressure and isolation environments. Managing HVAC fan speeds can save 10–50 percent in energy costs.

Harmonic Mitigating Transformers
Energy-efficient harmonic mitigating transformers with zero sequence flux cancellation technology is specifically designed to treat the harmonics generated by computer equipment and other nonlinear power electronic loads. ENERGY STAR-rated transformers have the potential to pay for themselves three to six times over their lifespan.

Best Practice V:
Monitored Power

Adopt an integrated power solution that can be metered, monitored and designed for continuity.

Considerations

When optimizing monitored power, it is important to consider:

- ☐ Do you have continuous visibility throughout your healthcare facility power chain?
- ☐ How do you detect power problems before damage occurs?
- ☐ What is your upgrade priority for legacy equipment?

Recommended Solutions

Metered PDU

A metered PDU can locally monitor load level and avoid potential overloads with a built-in digital current meter while offering reliable rack-mount, multi-outlet single or three-phase power distribution from any protected UPS, generator or main input power source.

Monitored PDU

While similar to a metered PDU, a monitored PDU goes one step further with its ability to remotely monitor single- or three-phase voltage, frequency and load levels in real-time via a built-in network connection. Output current consumption is displayed locally via a visual meter to warn of potential overloads before critical input sources become overloaded.

Connecting additional equipment to a PDU can overload it or the supply circuit, causing breakers to trip or equipment to fail. Both metered and monitored PDUs display load levels in real-time, allowing additional equipment to be connected safely. The primary input plugs into an online UPS system. The secondary input plugs into a wall outlet. If the UPS system is taken off line for maintenance, repair or replacement, the PDU keeps the load powered by automatically switching from the primary input to the secondary input because of its ATS functionality. When the UPS system is restored, the PDU will switch back to the primary input.

Switched PDU

A switched PDU allows you to remotely monitor, connect or disconnect your data center loads. A switched PDU can locally monitor load level and avoid potential overloads with a built-in digital current meter. It can also remotely control individual outlets for the rebooting of locked equipment to avoid costly service calls, custom power-on/power-off sequences and load-shedding of non-essential loads during blackouts to extend battery backup runtime for critical equipment. Unused PDU outlets can be electronically locked off to prevent the connection of unauthorized hardware. The built-in local digital display and remote web/network interface reports detailed voltage, amperage and kilowatt output values per breaker bank/phase with additional reporting options for power unbalance percentage, IP address and optional sensor-based temperature and humidity data. The PDU's network interface connects to an Ethernet jack. Remote users can switch each of the PDU outlets on or off via SNMP, web or telnet.

UPS Monitoring Software

UPS power monitoring software provides the tools needed to monitor and manage power devices in your physical or virtual environment, including safe system shutdown and innovative energy management capabilities. This solution ensures system uptime and data integrity by allowing you to remotely monitor, manage and control each UPS as well as the other devices on your network, helping to maintain continuity in your healthcare facility.

POWER OPTIMIZATION BEST PRACTICES

UPS Network Management Cards

Network management cards offer remote monitoring and control of an individual UPS by connecting it directly to the network. They also allow for secure monitoring and control of an individual UPS via web browser, command line interface or SNMP, keeping you informed of problems as they occur.

DCIM Energy Management

Monitoring power within a hospital data center environment allows facility managers to efficiently utilize existing data center infrastructure. Data center health maps, power analytics, cooling charts and reports alert you to potential trouble and help you understand real-time power load, trends and capacity at all levels of the infrastructure. Most solutions come with configurable dashboards that provide views of power capacity, environmental health and energy consumption.

TECHNOLOGY SUMMARY

Technology Solutions

The chart below details the technology solutions that can support critical power chain in a healthcare facility.

TECHNOLOGY	Facility Power	Conditioned Power	Back-up Power	Efficient Power	Monitored Power
Switchgear	✓		✓		
Low- and Medium-Voltage Cable	✓			✓	
Remote Distribution Cabinets	✓		✓	✓	✓
Remote Power Panels	✓		✓	✓	✓
Power Whips and Cords				✓	
Rack PDUs					✓
UPS Systems		✓	✓		✓
Automatic Transfer Switches	✓		✓		
Power Conditioners		✓		✓	
Building Entrance and Surge Protection	✓			✓	
Grounding and Bonding		✓		✓	✓
Environmental Monitoring	✓			✓	✓
Retrofit Monitoring and Metering	✓			✓	✓

Anixter's Technology Support Services can offer further insight to your specific application. For more information, contact your local Anixter representative.

anixter.com/healthcare

SUPPLY CHAIN SOLUTIONS

As you develop a smart hospital roadmap, it's also important to consider the physical migration from the existing environment to the building's future state. This entails identifying the challenges and risks during the installation phases of technology deployment. Coordination between material deployment and installation schedules can have an impact on the productivity, efficiency and connectivity of the facility, as well as patient experience and outcomes during the deployment.

Properly coordinated deployments allow for tangible savings in time, reduced installation costs and increased efficiencies, all while reducing the risks of lost productivity associated with the physical migration of the building environment.

Challenge	Service	Save Time	Reduce Costs	Increase Efficiency	Mitigate Risk
Creating an installation schedule that maximizes business productivity	Staged deployment	✓		✓	
Kitting similar solution components for coordinated installation	One part number for each unique configuration	✓	✓	✓	✓
Managing integrator SLAs and maintenance agreements	Asset management and managing maintenance costs and upgrades		✓		✓
Creating a functional roadmap for material deployment that limits disruptions in business operations	Inventory management	✓		✓	
Reducing on-site installation time and interruptions	Site-ready equipment	✓	✓	✓	✓
Critical component failure at start-up	Off-site burn in and DOA check	✓	✓	✓	
Delivery tracking for on-site components between trades and technologies	Color-coded floor consolidation solutions			✓	✓

For more information, contact your local Anixter representative.

anixter.com/services

ANIXTER

GLOBAL TECHNOLOGY BRIEFING

COMMUNICATION EFFICIENCY BEST PRACTICES

TARGETED HEALTHCARE ENGAGEMENT

INTRODUCTION

Nearly 70 percent of treatment delays in hospitals are caused by communication breakdowns. This is according to a Joint Commission study on root causes by event type. In addition, in the past decade, poor communication cost the U.S. healthcare system alone $1.7 billion in malpractice costs and nearly 2,000 lives.

Good communication leads to good patient outcomes. Poor communication has the reverse effect. Innovations in technology and the way people capture, consume and relay information are providing an opportunity for healthcare organizations to improve the ways they deliver care.

Nearly 70 percent of treatment delays in hospitals are caused by communication breakdowns.

CONSIDERATIONS

Changing Care Methods

Healthcare is a constantly changing field. This change has been intensified in recent years with the digitization of care, where the way we collect and store information has changed from a paper-based and analog model to cloud-based information collection.

Cloud-based information collection enables telemedicine, mobile device engagement and digital medical records.

Another trend is the abundance of devices used by a number of people throughout the facility, including clinicians. More than 70 percent of clinicians use smartphones on the job, a number that is increasing every year.

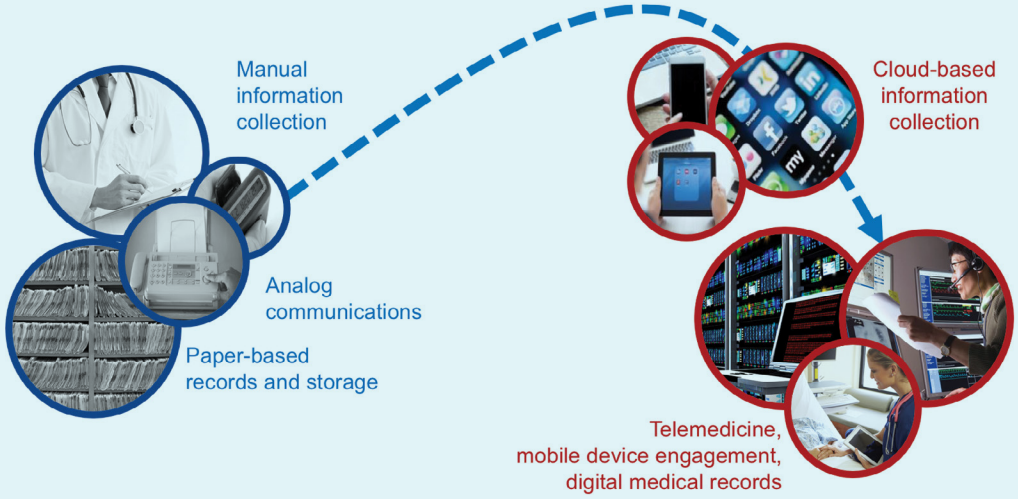
Device Monitoring and Analytics

In smart hospitals, connecting medical devices to Electronic Health Records (EHR) systems has reduced the time it takes to enter vitals from 7-10 minutes to less than 1 minute per patient.

On top of this, Real-Time Locations Systems (RTLS) are now used for a variety of purposes around a hospital. For one, they track key assets, such as pharmaceuticals and available equipment, which can help maintain safety and improve speed of response. In addition, RTLS systems are used to monitor patient movements, including infants, and alert staff to potential issues.

All of these technologies are enabled by the strength of the facility's network connectivity.

Sources: Pew Research Center.
Becker Health IT & CIO Review, The Connected Hospital.



Telemedicine

Telemedicine, or virtual care, has been expanding rapidly in recent years. Organizations like the Facilities Guidelines Institute have been helping healthcare facilities design spaces that can better accommodate virtual care, whether that means connecting with a medical specialist in another facility, or connecting with patients in their homes or regional clinics.

The guidelines provided by these organizations may include recommendations for equipment, acoustics, lighting, room location, room size and layout, and wall color.

Facility Guidelines Institute Telemedicine Services

2.1-3.2.4 Accommodations for Telemedicine Services

- Patient experience

2.1-3.2.4.1 General

- Telemedicine service types

2.1-3.2.4.2 Telemedicine room

- Design considerations
- Equipment
- Architectural details
- Sizing considerations
- Acoustic considerations
- Lighting considerations
- Controlling glare
- Interior surfaces
- Site identification

2.1-3.2.4.3 Support areas for telemedicine rooms or areas

- Infection prevention considerations

Public Safety DAS

A public safety distributed antenna system (DAS) is crucial to the speed and effectiveness of response to issues of violence in a healthcare facility, as well as crisis response during natural disasters or terrorist emergencies. It works in tandem with a commercial DAS, which healthcare professional can utilize to reach out to first responders for assistance and provide a view of what is going on.

When lives hang in the balance, first responders should not be hampered by poor signal coverage. Voice communications, location information and video streaming are vital tools in an emergency. Unfortunately, many hospitals have coverage holes, such as elevators, garages, tunnels and stairwells, where wireless communications may be impeded.

To achieve sufficient coverage, buildings must have a public safety distributed antenna system installed. In some U.S. cities, this is a requirement for obtaining an occupancy permit. The most widely accepted standards for public safety DAS are set by the National Fire Alarm and Signaling Code (NFPA 72) and the International Fire Code. However, the specific coverage requirements vary by location and are not always enforced. Facility owners and managers should not aim for minimum compliance, but rather to provide a safe environment for everyone in and around the facility.

Current NFPA 72 code consists of the following:

24.5.2.2.1
Critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and other areas deemed critical by the authority having jurisdiction shall be provided with 99 percent floor area radio coverage.

24.5.2.3.1
Minimum inbound signal strength of -95 dBm, or other signal strength as required by authority having jurisdiction, shall be provided throughout the coverage area.

24.5.2.3.1
Minimum outbound signal strength of -95 dBm at the donor site, or other signal strength as required by authority having jurisdiction, shall be provided from the coverage area.

24.5.2.2.3
Buildings and structures that cannot support the required level of coverage shall be equipped with radiating cable system or distributed antenna system (DAS) with FCC-certified signal booster, or both, or with a system that is otherwise approved, in order to achieve the required adequate coverage.

24.5.2.5.2
All repeater, transmitter, receiver, signal booster components and battery system components shall be contained in a NEMA 4- or 4X- type enclosure(s).

Healthcare Fire and Life Safety Standards

ORGANIZATION	SECTION	DESCRIPTION
NFPA72	24.5.2.2.1	✓Coverage areas
	24.5.2.3	✓Signal strength
	24.5.2.2.2	✓General building areas
	24.5.2.2.3	✓Amplification components
	24.5.2.5.2	✓Component enclosures
Intl Fire Code	510.01	✓Emergency responder radio coverage in new buildings
	510.4.1	✓Radio signal strength
	510.4.2.1	✓System design | amplification system allowed
	510.4.2.3	✓System design | secondary power
	510.5.3	✓Acceptance test procedure

Emergency and Mass Notification

Healthcare facilities need to communicate with wide audiences, but it's not always under dangerous or critical circumstances. Developing a mass notification strategy that can deliver information with digital signage and sound and paging solutions can improve efficiency of care and patient experience.

These same technologies, in addition to emergency response systems and public safety DAS solutions, will also support efficient public communication in emergency situations.

Example of Emergency Notification Checklist

This emergency notification checklist is a helpful resource to make sure you have the technology required to respond quickly and effectively in a variety of situations.

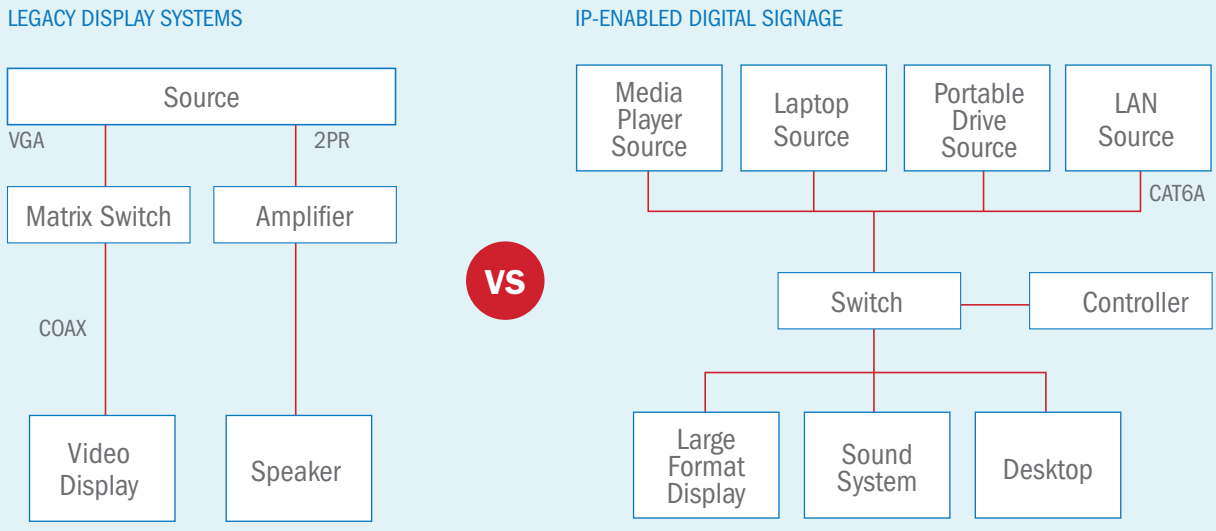
Key devices	Do you have the ability to	Yes	No
 Overhead Paging	Send notifications in multiple formats, including		
	a. Phone calls		
	b. SMS text messages		
 Mobile Devices	c. Push notifications		
	d. Email		
	Monitor and trigger alerts for severe weather?		
 Desktop Computers	Gather key personnel instantly via a conference call?		
	Communicate building evacuation information quickly?		
	Designate recipient groups to receive certain notifications?		
 Landline Phone	Receive alerts when 911 is called?		
	Record 911 calls from your campus?		
	Send notifications with the push of a button?		
 Digital Signage	Integrate notification systems with the Internet of Things?		
	Conduct live, ad hoc or pre-recorded pages?		
	Easily lockdown your building when there is a threat?		

CHALLENGES

Challenge I: Improving Responsiveness of Patient Care

Responsiveness in care means both speed and accuracy of information and care delivered. Healthcare providers are continually looking for ways to improve the speed of care, where seconds can make the difference between different health outcomes. Now more than ever, the speed of connectivity is a key determinant of speed of care. Visual alerts, text messaging and wireless mobility can all help reduce delays in communication and information access.

Digital Signage Platform: Contrast Between Legacy vs. New Communication Methods

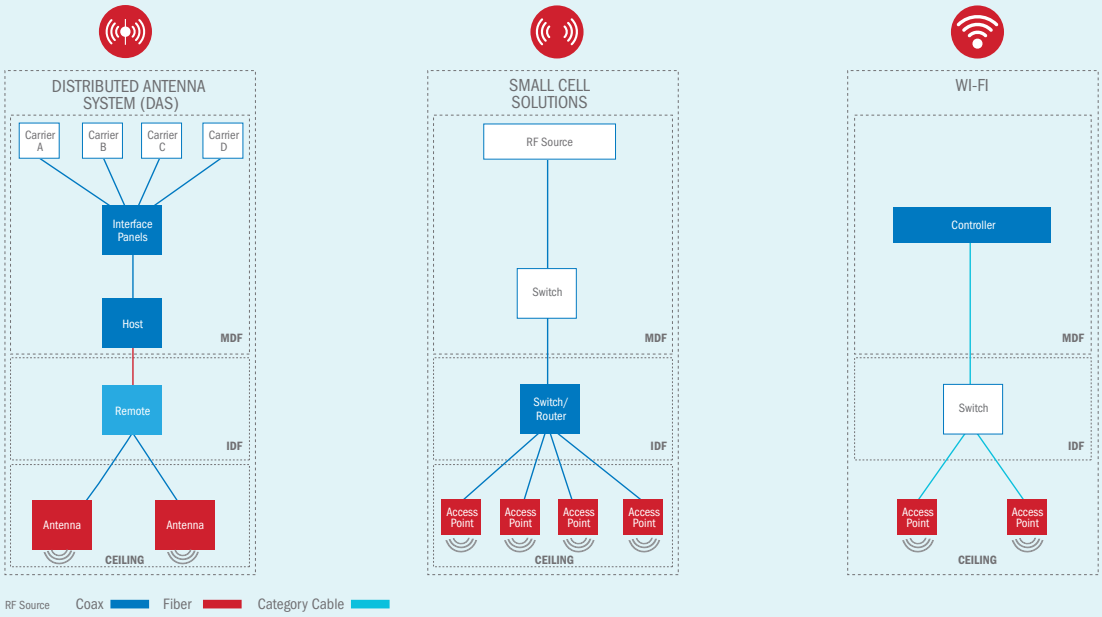


Challenge II: Administer Seamless Wireless Availability

A healthcare facility should provide the same access to information and healthcare tools, whether a patient, clinician or visitor is in an area with a wired connection or not.

This requirement not only addresses providing the same quality of service throughout the facility but supporting the proliferation of mobile devices from clinicians and visitors, while maintaining proper levels of security.

Common Wireless Topologies



Challenge III: Providing Directional Guidance

Directional guidance, or wayfinding, can be delivered in multiple ways. Traditionally, it has been communicated with static signs and arrows, but as new technologies have evolved, digital signage now allows for things like digital paging, advertisements or cutting-edge technology like GPS-enabled mobile apps to show visitors and employees how to get from one location to another.

Wayfinding is crucial for patient satisfaction and limiting delays in treatment.

A few considerations:

- 30 percent of first-time visitors get confused and lost in hospitals.
- 25 percent of hospital staff says they can't locate some destination within their own facility.
- Wayfinding problems can cost an institution more than $200,000 annually.

30 percent of first-time visitors get confused and lost in hospitals.

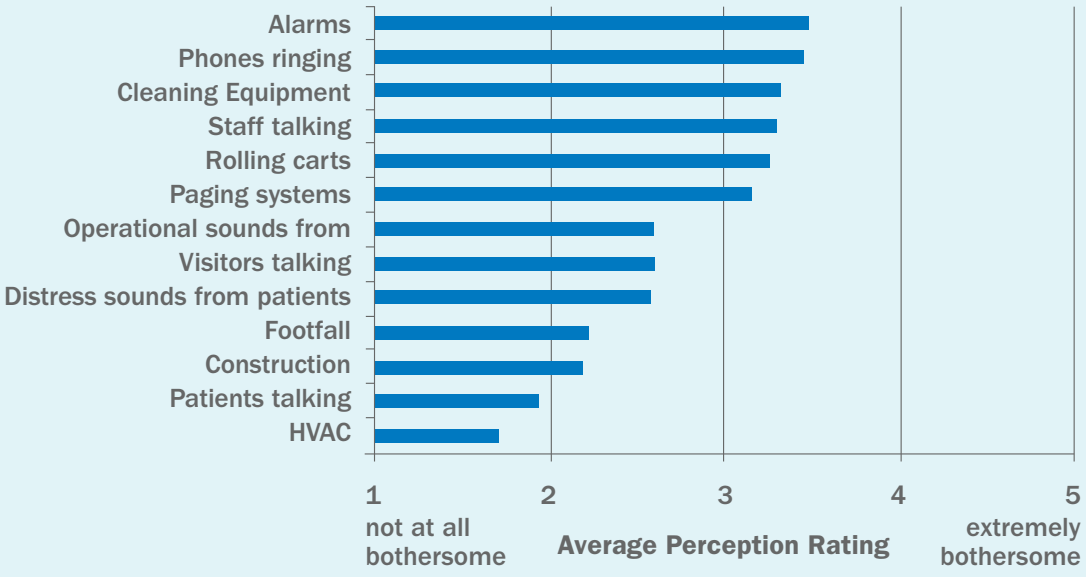
Sources: Deloitte Digital.
Emory University Hospital Study.

Challenge IV: Reducing Noise Pollution

Excessive noise can disrupt the healing process, lower patient satisfaction scores and potentially lead to HIPAA violations with patient privacy concerns.

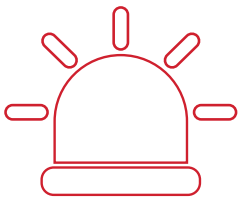
Not only does a noisy hospital environment disturb patient sleep—it can weaken patients' immune systems and impact recuperation. Studies show that patients in rooms with sound masking find that it helps to shorten the time they take to fall asleep and prevents unwanted noises from disrupting their sleep. Some studies have even shown that patients who sleep better have lower rates of re-admittance.[5]

Common Causes of Noise Complaints



Source: ASHRAE

Challenge V: Initiating Emergency Management



When the worst happens, the first place a community turns to is the local hospital. Healthcare facilities must have an emergency preparedness and response plan in place to support almost any eventuality, enabling a seamless transition from standard operations to crisis response.

A critical element of this plan is communications, from notifying key constituencies and requesting additional resources to potentially identifying other locales for current patients to go and coordinating with local, regional, state or federal entities.

Investing in key communications technologies as part of a thorough emergency preparedness strategy is necessary to quality patient care.

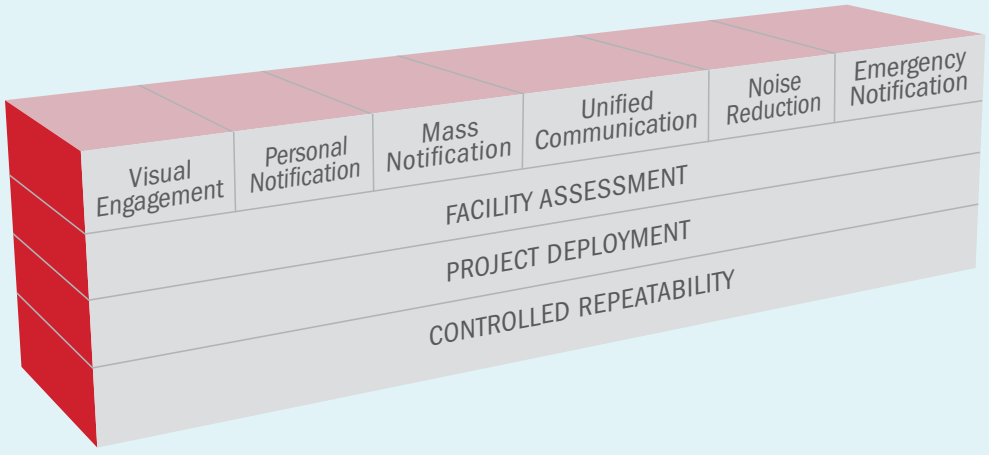
The Crisis/Emergency Management Technology Ecosystem

SOLUTIONS

The Anixter Approach
Targeted Healthcare Engagement

Research shows that good communication is the driving force behind quality care. Improving responsiveness, providing seamless wireless availability and reducing noise pollution require targeted healthcare engagement, where new technologies can simplify the flow of information between healthcare staff, patients and administrators.

Our approach to improving communication in a healthcare facility helps you answer the question—how do you improve care with the efficient and accurate flow of information?



Best Practice I:
Visual Engagement

Support the new ways that people deliver and consume information through digital signage and mobile devices.

Considerations

When enabling visual engagement, it is important to consider:

- ☐ How do you share content with patients, visitors and staff?
- ☐ What is your telemedicine plan?
- ☐ What is your digital signage strategy?
- ☐ How do you communicate in an emergency event?
- ☐ Where do you control centralized content?

Recommended Solutions

Networked Digital Signage Infrastructure

Networked digital signage allows for directed messaging to patients and staff based on need and location, and provides the ability to monitor patients as they move through procedures. It also allows staff to used content stored on network drives. Managed within a single building or across multiple locations, a networked system provides fresh content on a regular basis, empowering the delivery of the right information to the right audience at the right time.

High-Definition Large-Format Displays

With a networked digital signage infrastructure in place, high-definition displays represent the best way to communicate a message in a short amount of time to patients and visitors. It is important to utilize commercial-grade displays in an always-on hospital environment, as this will provide longer life for the product and more flexibility for use. The larger size and clear resolution also aids patients with visual impairment.

Video Walls

Many healthcare settings are enhancing the impact of high-definition large-format displays through organization on a multi-display wall, often arranged in patterns of three by three or five by five. This collection of screens can be used to analyze multiple pieces of data at once—for example, not only in control rooms or security environments but also in diagnostic areas for collective analysis, in nursing stations to monitor the status of patients, or in reception areas to manage visitor traffic.

Mass Notification Solutions

When an emergency event takes place, mass notification allows for audio and visual communication to be distributed to patients, staff and visitors alike. With a networked digital signage infrastructure, an organization can deliver unique content and instructions to signage, in addition to overhead speakers, individual devices and computers, all based on predetermined zones.

Best Practice III:
Personal Notification

Simplify individual communication between medical staff, patients and administrators to increase satisfaction and accuracy.

Considerations

When supporting personal notification, it is important to consider:

- ☐ What is your nurse call IP migration plan?
- ☐ How do you centrally manage your paging systems?
- ☐ How do you support mobile coverage with in-building wireless?
- ☐ What systems do you use to communicate with patients?

Recommended Solutions

Cabling Considerations—Future Expansion
As projections for bandwidth demands continue to skyrocket, a key tactic to ensure scalable growth is over-provisioning the initial cable deployment. It is much simpler and less expensive to upgrade edge wireless technologies than to undergo the disruption necessary to upgrade infrastructure. Deploying Category 6A cable helps ensure the highest bandwidth and best Power-over-Ethernet performance.

Distributed Antenna System (DAS)
A well planned DAS can allow for expansion in capacity, coverage and the carriers involved. As patient expectations and care delivery methods drive additional requirements, DAS is able to grow with additional remotes and carriers. Visitors, employees and vendors are able to bring their own devices with multiple carriers on one system.

Small Cell Wireless Solutions
This system is based on Category cable, with each carrier having its own system. It allows for additional radiating points to be deployed by pulling additional cable.

Wi-Fi
With an over-provisioning of the initial cabling, Wi-Fi allows for densification of the system with an easy installation of additional access points. It is important to support the latest generation production with the greatest bandwidth, currently 802.11ac. As technology evolves to 802.11ad and beyond, the bandwidth and speed will continue to increase in the access points.

Nurse Call Solutions
Nurse call solutions and two-way communication integrates critical messaging, clinical workflows, real-time location, hardware components and reporting to enable efficient patient response.

Best Practice III:
Mass Notification

Capture the attention of staff and visitors and deliver vital information through mass notification solutions.

Considerations

When supporting mass notification, it is important to consider:

- ☐ How do you communicate to various audiences throughout the facility at one time?
- ☐ How does your infrastructure support this plan?
- ☐ How is critical information distributed across multiple media channels?
- ☐ How do displays, speakers, pagers and phones connect to mass notification?

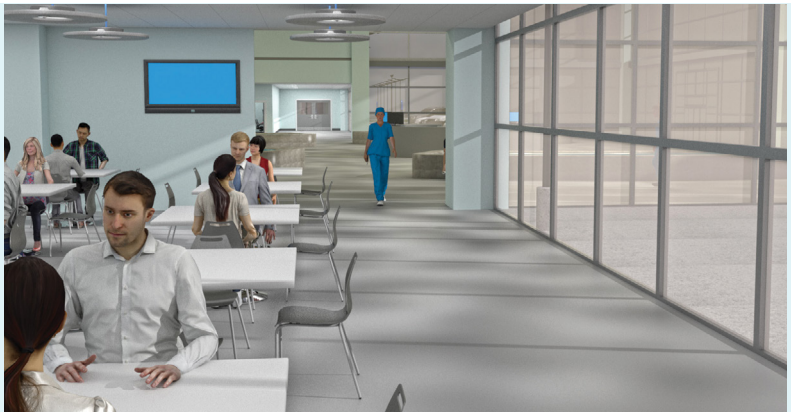
Recommended Solutions

High-Definition Large-Format Displays
With a networked digital signage infrastructure in place, high-definition displays represent the best way to communicate a message in a short amount of time to patients and visitors. It is important to utilize commercial-grade displays in an always-on hospital environment, as this will provide longer life for the product and more flexibility for use. The larger size and clear resolution also aids patients with visual impairment.

Networked Digital Signage Infrastructure
Networked digital signage allows for directed messaging to patients and staff based on need and location, as well as the ability to monitor patients as they move through procedures. It also allows staff to used content stored on network drives. Managed within a single building or across multiple locations, a networked system provides fresh content on a regular basis, empowering the delivery of the right information to the right audience at the right time.

Broadcast Paging Systems
Professional sound quality systems offer high-grade audio performance, flexibility, ease-of-use and the highest energy efficiency, allowing a healthcare facility to quickly relay messages to select audiences.

Cabling Considerations—Future Expansion
As projections for bandwidth demands continue to skyrocket, a key tactic to ensure scalable growth is over-provisioning the initial cable deployment. It is much simpler and less expensive to upgrade edge wireless technologies than to undergo the disruption necessary to upgrade infrastructure. In emergency situations, there is typically a surge in network traffic. It is essential to maintain standard patient care, while also responding effectively to any emergency.



Best Practice IV:
Unified Communication

Choose the appropriate communications equipment to provide a high-quality voice, data and video experience for employees.

Considerations

When enabling unified communication, it is important to consider:

- ☐ How do you ensure a high-quality voice and video experience?
- ☐ What type of architecture do you adopt for voice, data and video communication?
- ☐ How does a patient contact a nurse in an emergency?
- ☐ How do you support your telemedicine communication strategy?

Recommended Solutions

VoIP Telephones
VoIP technology is mature and allows for easy movement or provisioning of phones to support the needs of the healthcare facility. Additional cost of VoIP is minimal, and it provides flexibility for different kinds of patient care environments within a hospital. VoIP can be used to access different applications and provide a consistency of experience for the user across devices.

Wired and Wireless Headsets
Flexible headset solutions can assist multiple areas of a facility, including administration and reception, nurse stations as well as telemedicine. The ability to move to a private space while on a call can be important, in addition to multitasking with hands-free capabilities. Offering both wired and wireless capacity on a VoIP-enabled device provides an adequate amount of flexibility to support the specific needs of staff.

Conferencing Equipment
VoIP-enabled conferencing equipment should be able to support the application of choice for particular organizations and provide a consistent experience in different kinds of meeting environments. This is key in huddles rooms or other care consultation settings, as well as with telemedicine and digital forms of patient care.

Nurse Call Solutions
Nurse call solutions and two-way communication integrate critical messaging, clinical workflows, real-time location, hardware components and reporting to enable efficient patient response.

Best Practice V:
Noise Reduction

Increase patient satisfaction and outcomes in various environments with well-designed noise reduction solutions.

Considerations

When supporting noise reduction, it is important to consider:

- ☐ How do you manage noise in your patient care areas?
- ☐ What are the major sources of noise in your facility?
- ☐ How do you ensure privacy during patient consultations?
- ☐ How do you ensure privacy during the registration process?

Recommended Solutions

Sound Masking Solutions

Sound masking is the process of adding background sound to reduce noise distractions, increase patient comfort and privacy, and maintain HIPAA patient confidentiality standards. A variety of elements can address noise control and speech privacy by absorbing, blocking or covering sound, often referred to as the ABCs of acoustic design.

Soft Closing Doors and Automated Egress

In hospitals patients are exposed to an excess of loud sounds as they try to recover from illnesses and procedures. For medical staff, distracting background noises can lead to serious errors while on the job and inefficiency as they try to focus on administrative tasks associated with patient care. Hospital doors with good acoustics can provide a more peaceful, soothing setting where patients can fully recover and employees can work with fewer sound distractions.

Best Practice VI:
Emergency Notification

Provide direction to act and communicate to multiple groups, enhancing responsiveness and improving care.

Considerations

When supporting emergency notification, it is important to consider:

- ☐ What is your emergency preparedness plan?
- ☐ How do your communication technologies and infrastructure support this plan?
- ☐ How is critical information distributed across multiple media channels?
- ☐ How do displays, speakers, pagers and phones connect to mass notification?

Recommended Solutions

Emergency Call Stations
Emergency stations are used to offer immediate assistance to individuals and to help quickly assess emergency situations. Manufactured to be integrated with CCTV systems, the emergency stations meet the latest ADA regulations and requirements, including station lettering, Braille signage, a call status indicator light, and the call button mounting height on towers.

Public Safety DAS
While DAS can be essential for medical staff, patients and visitors to communicate effectively on an everyday basis, public safety DAS is installed to enable first responders within the building to communicate during an emergency. It must be on a different spectrum than commercial wireless and cover the entire building, including basements and stairwells—areas you likely aren't concerned with having commercial wireless. Public safety DAS must also have battery backup in case of a power outage.

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TECHNOLOGY SUMMARY

Technology Solutions

The chart below details the technology solutions that can support targeted engagement in a healthcare facility.

TECHNOLOGY	Visual Engagement	Personal Notification	Mass Notification	Unified Communication	Noise Reduction	Emergency Notification
DAS		✓	✓			✓
Small cell		✓	✓			✓
Wi-Fi		✓	✓			✓
Public safety DAS			✓			✓
Mass notification	✓		✓	✓		✓
Digital signage	✓	✓	✓	✓		✓
Sound and paging		✓	✓	✓	✓	✓
Conferencing	✓			✓		✓
Nurse call systems		✓	✓	✓		✓

Anixter's Technology Support Services can offer further insight to your specific application. For more information, contact your local Anixter representative.

anixter.com/healthcare

SUPPLY CHAIN SOLUTIONS

As you develop a smart hospital roadmap, it's also important to consider the physical migration from the existing environment to the building's future state. This entails identifying the challenges and risks during the installation phases of technology deployment. Coordination between material deployment and installation schedules can have an impact on the productivity, efficiency and connectivity of the facility, as well as patient experience and outcomes during the deployment.

Properly coordinated deployments allow for tangible savings in time, reduced installation costs and increased efficiencies, all while reducing the risks of lost productivity associated with the physical migration of the building environment.

Challenge	Service	Save Time	Reduce Costs	Increase Efficiency	Mitigate Risk
Coordinating installations by kitting similar solution components	Headset, workstation, wireless, lighting and patch cable kits	✓	✓	✓	✓
Creating a functional roadmap for material deployment from our site, the contractor site or the job site to limit disruptions to patient care	Material staging and Anixter inventory management solutions	✓	✓	✓	✓
Reducing on-site waste removal and dust contaminates	Product pre-assembly and off-site configuration	✓	✓	✓	✓
Utilizing standards-based labeling schemes for ongoing asset utilization and maintenance	LED lighting assembly, labeling and kitting	✓		✓	

For more information, contact your local Anixter representative.

anixter.com/services

ANIXTER

GLOBAL TECHNOLOGY BRIEFING

IoMT ENABLEMENT BEST PRACTICES

THE FIVE SENSES OF AN INTELLIGENT HOSPITAL

INTRODUCTION

People make decisions based on information. This is also the ultimate goal of intelligent hospital design. By capturing information about the environment, analyzing it and making real-time adjustments, smart hospitals are able to maximize their potential for patient care and operational efficiency.

When a hospital can support digital methods of clinical care and control disparate building systems, it is then able to provide a unique and specialized experience for patients, visitors, employees and building operators.

To this point, we have explored the various components for migrating to a smart hospital platform. The final element brings them together, enabling the Internet of Things for healthcare facilities, or what we call the Internet of Medical Things (IoMT). This requires leveraging an open-architecture environment to simplify the task of managing risk, enhancing performance, optimizing power, improving communication and reasonably future-proofing an asset to adopt new technologies over its life cycle.

IoMT Outcomes

Simplifies Risk

A proactive approach to safety and security provides security professionals with enhanced analytics and risk detection.

Enhances Performance

High performance network infrastructure can enable innovative solutions to the most complex business challenges.

Optimizes Power

A critical power chain can help ensure an always-on environment and reduce operational costs through energy efficiency.

Improves Communication

Innovative wireless and professional audio-visual solutions allow healthcare providers to enhance communication techniques, ultimately improving patient experience and outcomes.

CONSIDERATIONS

Digital Revolution

The U.S. spends almost 20 percent of its GDP on healthcare. It is estimated that the digital revolution can save more than $300 billion annually. In order to take advantage of these potential cost savings, it is critical to have the right network infrastructure and IoMT strategy.

There are a number of other trends related to the digital revolution in healthcare:

- Four million patients globally will remotely monitor their health conditions by 2020.
- The value of improved health of chronic disease patients through remote monitoring could be as much as $1.1 trillion per year in 2025.
- IoT-enabled connectivity in healthcare will significantly improve diagnostic testing, and home healthcare technologies will increase by a factor of 5 by 2020.

The digital revolution is changing the landscape of the type of infrastructure required to support new healthcare models.

The U.S. spends almost 20 percent of its GDP on healthcare. It is estimated that the digital revolution can save more than $300 billion annually.

Source: Direct2Dell, How the Internet of Things Will Impact Healthcare.

IoMT Devices and Analytics

The Internet of Things is having a profound impact across every industry, including healthcare. A recent report suggested that there are nearly 4.5 billion medical-oriented devices capable of connecting to the Internet. To this point, connected medical devices account for nearly 30 percent of all IoT-capable devices. For many of these devices, the sensor-based technology and the ability to capture, analyze and act upon data is critical.

On the patient side, the Internet of Medical Things includes various technologies that read patient data and are supported by a single network. The data from various IoMT devices and platforms interacting can lead to improved diagnoses, treatment and care management.

The Internet of Medical Things operates similarly on the facility side, where technologies such as connected lighting, environmental sensors and video surveillance solutions, all working together, can lead to improved productivity, energy efficiency and scalability for the hospital.

A strategic approach to analytics can optimize both patient care and the operational value of a healthcare facility.

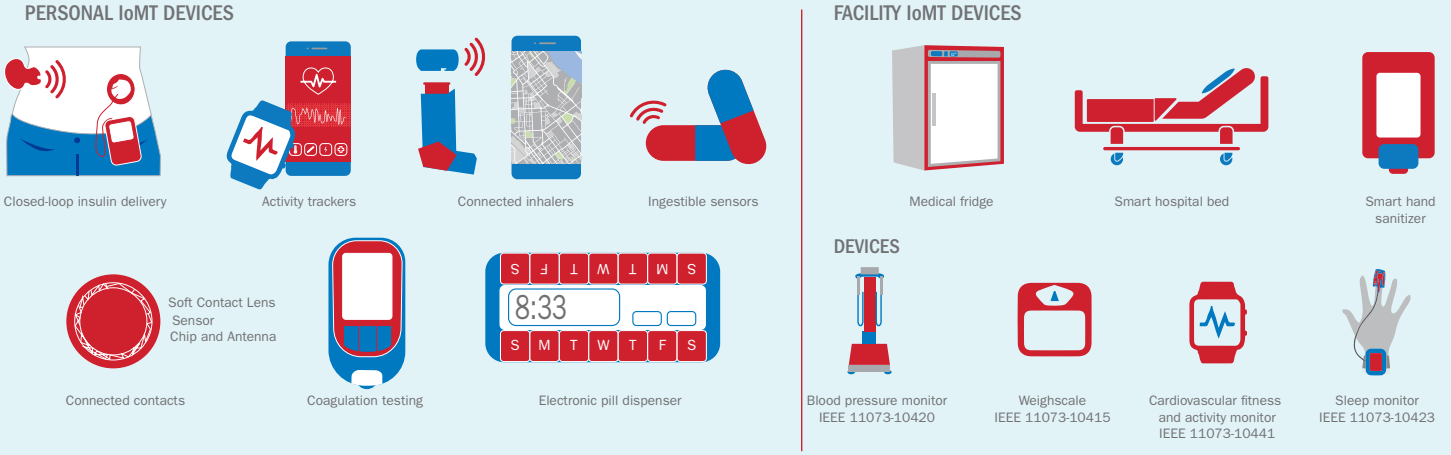
Examples of Personal IoMT Devices

- Closed-loop insulin delivery
- Activity trackers
- Connected inhalers
- Ingestible sensors
- Connected contacts
- Electronic pill dispensers

Examples of Facility IoMT Devices

- Medical refrigerator
- Smart hospital beds
- Smart hand sanitizers
- Blood pressure monitor
- Glucose meter
- Weighscales
- Electrocardiograph (ECG)

Source: Frost & Sullivan, Internet of Medical Things Forecast to 2021.



Real-Time Health Systems

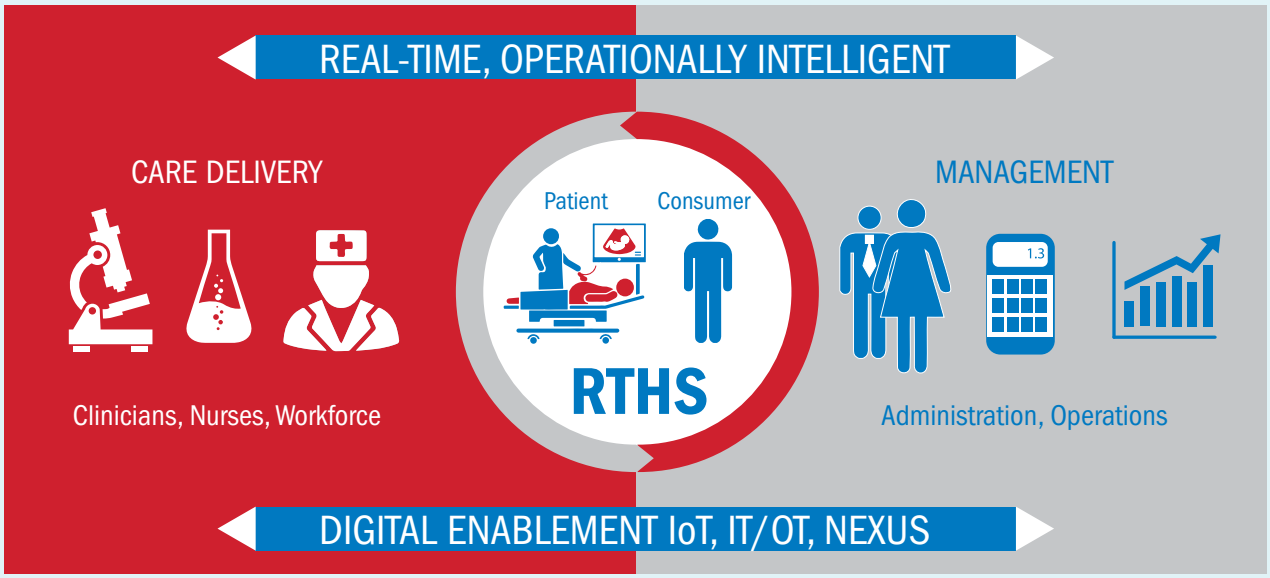
Gartner defines the future of healthcare as the "real-time health system," or the transformation of the healthcare delivery organization into one that is more aware, collaborative and patient-centric.

Real-time healthcare will give rise to a new, more agile ecosystem that makes better use of its various systems.

- Alarms and notifications
- Analytics and algorithms
- Business continuity management
- Consent management
- Digital signage
- End-to-end user monitoring
- Enterprise mobility services
- Experiential way finding
- Health information exchange
- Integrated building system controls
- Interoperability, IoT and API management

These are examples of the type of IT innovation that modern healthcare facilities must be able to support.

Source: Gartner, Hype Cycle for Real-Time Health System Technologies.



Information Management

The core of smart hospital design is useful information, or in other words, actionable data that can help a building run more efficiently. Building owners and operators are under pressure to run a more efficient operation and do more with less, and as the old adage states, you can't manage what you don't know.

Healthcare facilities increasingly house mountains of data, and industry leaders are discovering ways to unleash this data's potential.

The Risk of a Paralyzed Operation

Collecting and analyzing information is critical to the decision- making process. Not doing so can increase the risk of paralysis, making it difficult to make predictive decisions, plan for the future and have an understanding of the building's current state.

For example, without collecting, monitoring and analyzing the right information, there can be no basis for current and future planning, which can potentially lead to a state of confusion or disorder in a critical environment. Without timely and comprehensive reports, it is difficult to highlight inefficiencies that are costing the business. Without live feeds, there is an overall lack of awareness.

Vulnerabilities across Control Systems

In a 2015 Industrial Control Systems Cyber Emergency Response Team (ICSCERT) report, 74 percent of critical infrastructure members reported an increase in security vulnerabilities across connected control system infrastructures.

While cyber attacks on customer records and credit card information receive more public attention, healthcare facility operators increasingly have automation systems, life safety systems and critical environmental technology all connected to the same network. Failure of these systems could be life-threatening in a healthcare environment, so facility operators must protect these connected systems against catastrophic events and attacks.

Source:Johnson Controls and Booz Allen Hamilton Inc., Cyber Smart Buildings: Securing Your Investments in Connectivity and Automation. February 2017.

Operating in Silos

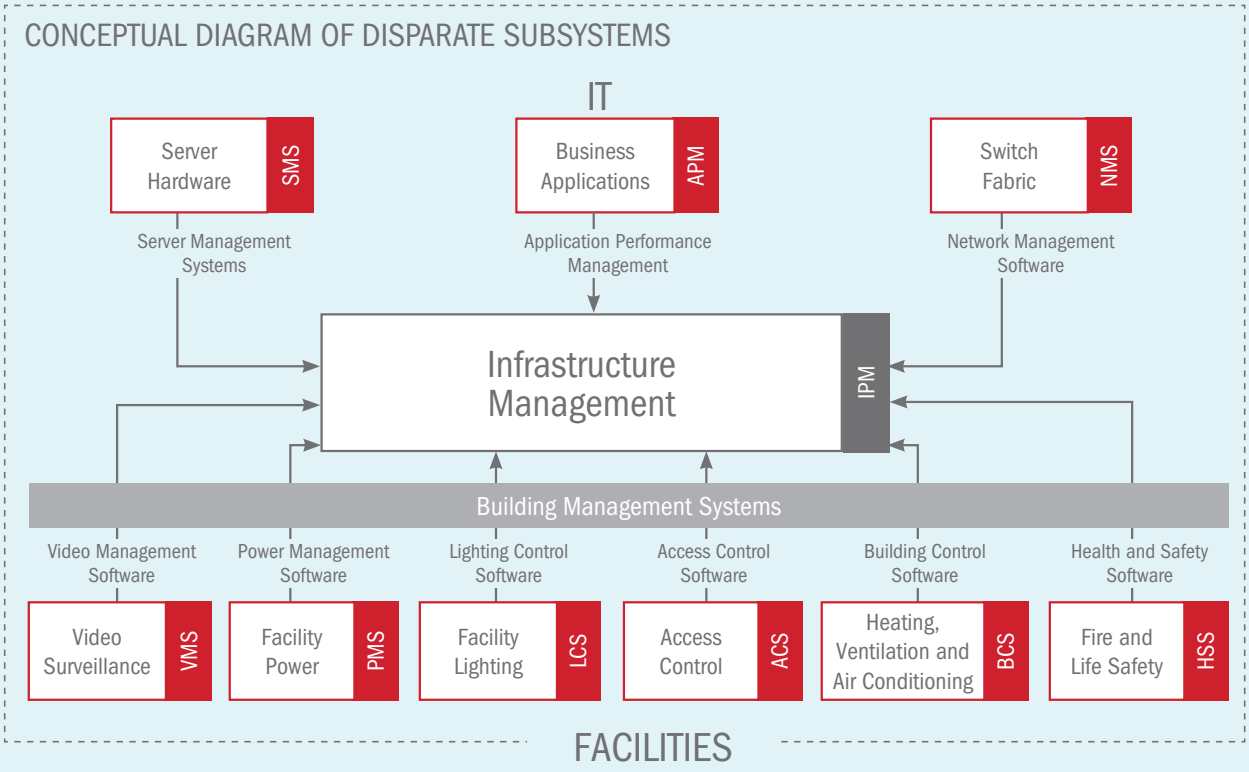
Some healthcare facility owners and operators can be frustrated with the lack of interoperability and integration between infrastructure management tools and current IT systems, or the high costs of achieving interoperability and integration.

Infrastructure management systems between facilities and IT have traditionally operated in silos, whereby functions overlap but don't talk to each other, resulting in poor workflow practices.

Building Management Systems

Existing building management system (BMS) protocols such as BACnet, LonWorks and Modbus provide for device connectivity across a wide variety of building subsystems. While each has distinct advantages and disadvantages relating to scalability, cost and device interoperability, there isn't a single approach that facilities managers can use to deploy BMS systems that can seamlessly integrate into IT management platforms. As the building controls market evolves from traditional serial-based applications that are present in many BMS platforms deployed today towards fully connected Ethernet-based systems, it's important for building planners to assess the technical and financial trade-offs associated with the various communications design approaches.

Infrastructure Management Topology



CHALLENGES

Challenge I: Interdepartmental Conflict

Despite the potential of automated solutions, there is an equally notable potential for interdepartmental conflicts to occur between facilities and IT.

This is an opportunity to use the knowledge of IT, including network design and cybersecurity best practices, when adding or retrofitting healthcare building systems, which increasingly require network connectivity for modern functionality. It does not make sense to rely solely on a traditional vendor (for example, mechanical or electrical), who may not have the experience to provide a network that meets the standards expected of IT infrastructure.

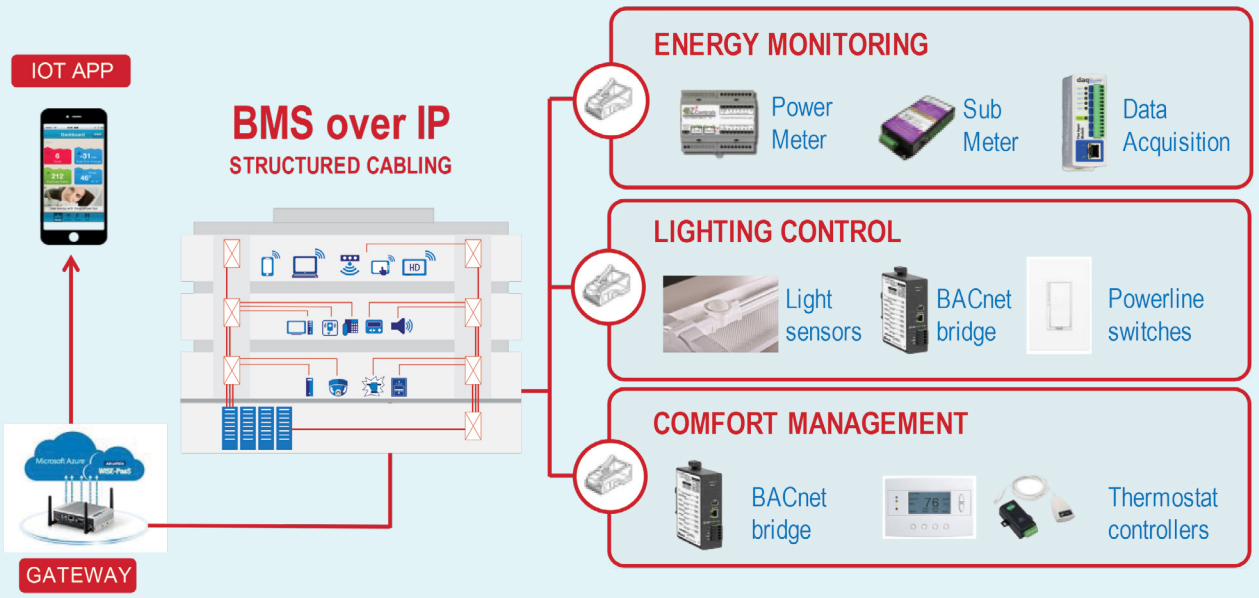
Challenge II: Supplier Integration Competency

Selecting the right solution relies heavily on how well the technology integrates with existing and future systems. Determining integration capabilities can be difficult because there are a number of intelligent implementation models.

Challenge III: Migrating to an IP Platform

In addition to restrictions of legacy systems and the investment required, the lack of a clearly identified standards-based approach increases the complexity of migrating to an IP-based platform.

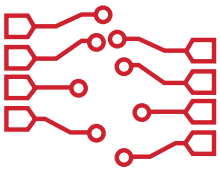
IP-Enabled Sensors



Challenge IV: Justifying the Cost of Efficiency

Establishing ROI metrics and key data points in advance can enable continual justification of efficiency; however, this requires a proactive approach to the solution.

Challenge V: Limitations of Existing Infrastructure



An IoMT-enabled environment requires a foundation that can support increased bandwidth and multiple applications. This can be particularly challenging in a healthcare environment, which often has outdated infrastructure that is not easy to connect to a network.

SOLUTIONS

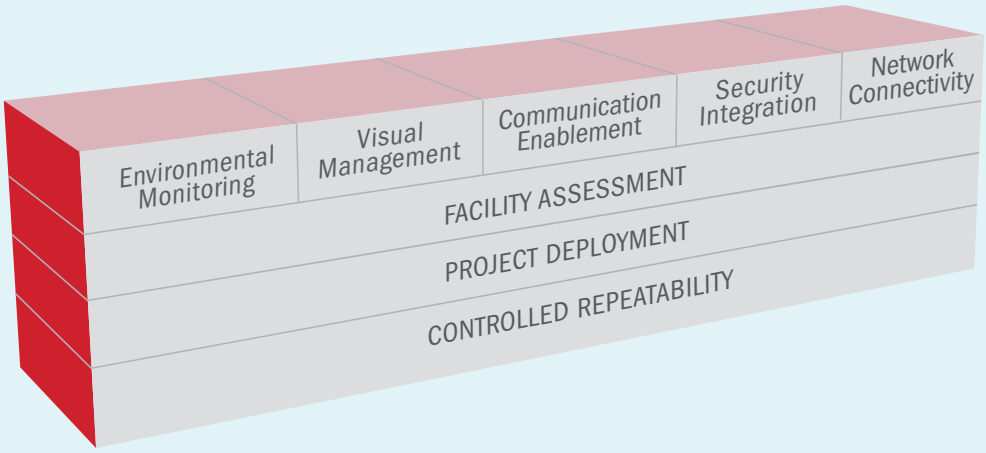
The Anixter Approach
The Five Senses of an Intelligent Hospital

Cost and efficiency, life cycle management and improved patient care are the main drivers behind the need to enable an IoMT environment. By defining the various elements that provide valuable information about your healthcare facility, our approach tailors a solution that can meet your specific challenges.

The five sense of an intelligent building include the following:

- Environmental monitoring
- Visual management
- Communication enablement
- Security integration
- Network connectivity

Additional opportunities include decreasing capital costs of construction through network convergence and driving operational efficiencies through better access to the data in connected systems.



Best Practice I:
Environmental Monitoring

Use occupancy, intelligent lighting and temperature sensor technology to achieve optimal comfort and energy efficiency.

Considerations

When monitoring your environment, it is important to consider:

- ☐ What is your ability to manage facility equipment?
- ☐ How does your facility cater for patient comfort?
- ☐ What are your optimum building energy profiles?
- ☐ What tools, if any, do you use to manage your facilities?

Recommended Solutions

Energy, Metering and Management
More than 50 percent of a facility's power budget can be tied to operation of the HVAC and lighting systems. Effective monitoring and management of these systems is critical to ensuring the building is operating as energy efficiently as possible.

Equipment Protocol Bridges
Migration to IP-based systems is becoming the norm for traditional analog systems such as video surveillance, but the movement to native Ethernet platforms is occurring much more slowly for building management systems. In order to deliver the interoperability advantages that an IP-based solution can provide, the use of protocol conversion bridges or gateways is required.

Smart Thermostat, Occupancy Sensors and Lighting Control
Sensors that can acquire data on how building spaces are utilized can transform the way BMS platforms operate.

Sustainable Infrastructure Solutions
LED lighting, energy-efficient UPS systems and BMS controls that operate over the Ethernet network create efficiencies in healthcare facility operations by provisioning services as needed.

Best Practice II:
Visual Management

Support centralized management of content through integration of digital signage, projection technology and mobile devices.

Considerations

When providing visual management, it is important to consider:

- ☐ How do you collect and analyze data for patient movement?
- ☐ What wayfinding technologies do you use?
- ☐ How does your safety policy adopt video features?
- ☐ What is your ability to leverage cloud-based patient data?
- ☐ What is your strategy to run your building A/V over IP?

Recommended Solutions

Video Analytic Software
Creating a safe and secure environment can be enhanced through the use of video analytics such as motion detection, facial recognition and license plate reader (LPR) technology.

Integrated Digital Signage Platforms
Integrating video content databases with digital signage over the IP network provides for a more scalable platform to deliver information throughout a healthcare facility.

Professional HDbaseT A/V Solutions
Leveraging the structured cabling systems to support HDBaseT reduces cost and complexity to the A/V platforms within a healthcare facility.

Large-Format Screen and Connectivity Kits
Large HD displays can deliver visual information to patients, visitors and staff.

Media Adapters and Converters
While many healthcare facility applications are migrating onto the IP-based network, there are many legacy infrastructure A/V, security and BMS platforms that support legacy protocols. One strategy to consider is the use of protocol-converting gateways or transceivers that can adapt serial-based protocols such as RS-422, RS-485, and BACnet into an IP-based transport that can be delivered over an Ethernet network.

Best Practice III:
Communication Enablement

Adopt a flexible wired and wireless network architecture to integrate voice, data and video experience.

Considerations

When planning for communication enablement, it is important to consider:

- ☐ How do you cater for telemedicine?
- ☐ How are the following systems currently networked?
  - Emergency notification
  - Registration
  - Nurse call
  - Patient data

Recommended Solutions

QoS Networking Switches
Without the use of Quality of Service (QoS) on networks, all network traffic would be treated with equal levels of priority. To avoid performance degradation, time-sensitive applications such as real-time voice and video should receive higher priority over standard data-centric applications such as email and web browsing.

Category 6/6A PoE Cabling
Due to the larger 23 AWG conductor size that is typical of many Category 6 and 6A cable constructions compared to 24 AWG Category 5e cable, these Category 6 and 6A cable types are better suited to dissipate heat due to remote powering applications over communications cabling, such as Power over Ethernet (PoE) and HDBaseT.

Networked Digital Signage Infrastructure
Networked digital signage allows for messaging to patients and staff based on need and location. This can enable hospitals to track patients as they move through procedures—for example, through the use of monitors at nurse stations or waiting areas. It can also allow staff to used content stored on network drives. Managed within a single building or across multiple locations, a networked digital signage system can provide targeted content on a regular basis, empowering the delivery of the right information to the right audience at the right time.

IP-Enabled Professional AV
The best-in-class solutions now run on IP networks and allow for the best options for collaboration zones with seamless use across locations. Solution categories include digital signage, sound and paging, conferencing, collaboration and control.

Collaborative Furniture with Integrated Cabling
Modular furniture solutions that integrate both power and communications cabling enhance the ability of an area to adapt and scale with the needs of its occupants. This provides flexibility for patient care settings as well as workspaces and common areas.

Best Practice IV:
Security Integration

Create interoperability between video surveillance, access control and intrusion detection systems.

Considerations

When supporting security integration, it is important to consider:

- ☐ How do you record, store and manage video surveillance activity?
- ☐ How do you control access to hospital areas and assets?
- ☐ What is your ability to act on video analytics alerts and alarms?
- ☐ How is mass notification supported by your security network?

Recommended Solutions

Video Management Software Tools
IP-based video management platforms allow for quick retrieval and storage of surveillance footage captured at the perimeter, clear zones, visitor entry points, building interior area and technical spaces.

Video Analytics
Simple video analytics such as motion detection can enhance the physical security of a healthcare facility by tracking occupants in a given space. More complex analytics such facial recognition can offer an additional layer of authentication and verification of individuals within the building.

Integrated IP Video and Access Control
Ethernet networks provide the foundation for open-architecture video surveillance and access control systems by allowing them to exchange data in an integrated fashion.

DAS, NAS and Video Optimized Servers
A number of storage methods can be used to store IP-based surveillance footage. These include directly attached storage devices that are only accessible from the host (DAS) and networked storage servers that allow for convenient file sharing (NAS).

Best Practice V:
Network Connectivity

Provide a standards-based IP platform that can run multiple applications and be remotely managed and measured.

Considerations

When establishing network connectivity, it is important to consider:

- ☐ How do you connect legacy non-IP sensors?
- ☐ What is your PoE strategy for your healthcare facility?
- ☐ What is your strategy for intelligent lighting?
- ☐ How do you monitor and manage energy consumption?
- ☐ How do you future-proof your infrastructure?

Recommended Solutions

Cross Connect and Port Administration
Utilizing intelligent patching solutions to deliver detailed visibility of the physical layer can provide a dynamic platform that enables efficient moves, adds and changes to the network infrastructure while improving network resilience.

Entrance Facility Solutions
The environmentally controlled centralized space for telecommunications equipment is usually more complex than a telecommunications room (TR) or telecommunications enclosure (TE). It usually houses the main cross-connect (MC) [Distributor C] and may also contain the intermediate cross-connects (ICs) [Distributor B], horizontal cross-connects (HCs) [Distributor A], or both.

Category 6/6A - PoE Ready Cabling Solutions
Due to the larger 23 AWG conductor size that is typical of many Category 6 and 6A cable constructions compared to 24 AWG Category 5e cable, these Category 6 and 6A cable types are better suited to dissipate heat due to remote powering applications over communications cabling such as Power over Ethernet (PoE) and HDBaseT.

IP-based LED Lighting Sensors and Controls
LED fixtures have the advantage over traditional fluorescent fixtures in longevity and luminous efficacy. Coupled with PoE lighting controls, these LED systems increase installation simplicity and long-term operational efficiency.

Metered, Managed and Switched PDUs
Intelligent power distribution units (PDUs) that provide metered, managed and switched capability in the telecommunications room allow integration into the building management systems to improve energy efficiency.

THE FUTURE OF SMART HOSPITALS

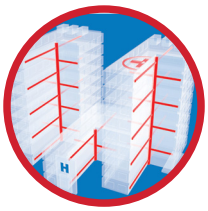
Innovation is a hallmark of the healthcare industry. As the population ages and healthcare costs continue to rise, innovation will be essential to maintaining levels of care.

Healthcare facilities must constantly evolve to keep up with the radical innovation in medical equipment and care methods. The approach of looking at each division of an operation through the lens of smart technology will allows facility managers to find real solutions to real challenges and achieve improved patient outcomes and operational productivity.

As the smart hospital approach develops and gains widespread adoption, so will the technological standards that enable an open-architecture environment.

Smart hospitals and the people who occupy them are inherently part of the surrounding environment. The future of smart hospitals lies not just in the interconnectedness within the building, but in how the building is connected to its surrounding environment—its city, region, and ultimately, the world.

RISK MANAGEMENT



NETWORK PERFORMANCE

POWER OPTIMIZATION

COMMUNICATION EFFICIENCY

IoMT ENABLEMENT

CONCLUSION

As the complexities of managing a healthcare facility continue to grow, so do the vast opportunities to improve the overall environment with enhanced efficiency and patient care.

Intelligent building standards such as ANSI/BICSI 007-2017 are providing direction for commercial building design, but smart hospital design and interoperability are still subject to a lack of standards and contradictory definitions, which can result in varied expectations. For this reason, it is important to define and set your own organization-wide criteria and success metrics for a smart hospital solution. Once a smart platform path is defined and implemented, the enhancements to your healthcare facility's capabilities and systems, current and future, can deliver measurable improvements over legacy technologies that are not aligned with your business objectives.

The process of evaluating, selecting and implementing smart hospital solutions that adhere to the recommendations outlined in this report can help you run a more efficient and productive healthcare facility. More importantly, it can help you provide the seamless, personalized healthcare experience that today's patients, visitors and clinicians expect in a connected world.

NOTES

NOTES

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