



## IP NETWORK

# Dynamic Changes in Healthcare Create Challenges in Hospital Campus Networks

Extensive data center network experience enables Brocade to meet the requirements for next-generation hospital campus networks, which require increased reliability, performance, and security—while controlling costs.

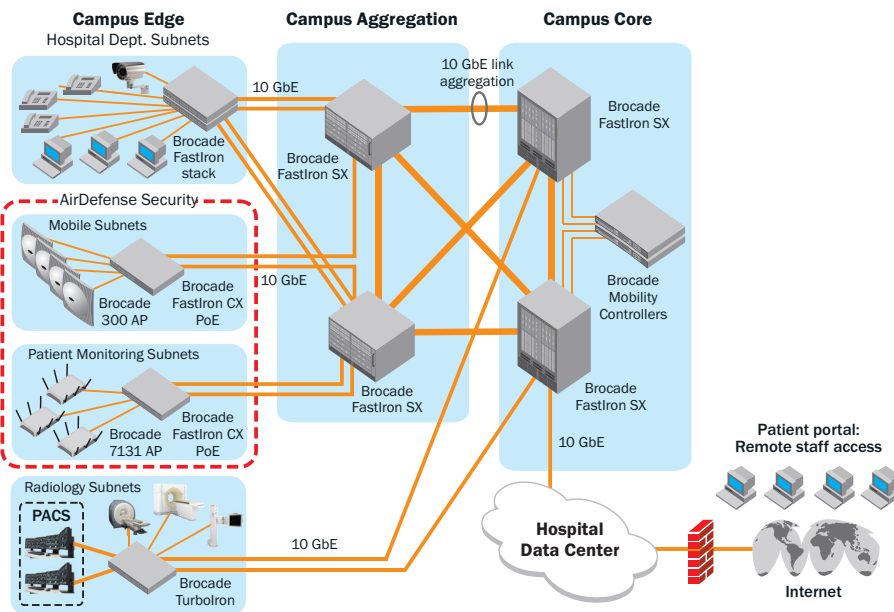
**Hospital networks have played an important role in healthcare delivery with new applications that improve patient care and drive down spiraling healthcare costs. However, rapid changes in next-generation wired and wireless healthcare applications mean that the network is no longer an option, but a necessity. CIOs are under increasing pressure to provide an infrastructure that can be optimized for these next-generation applications.**

**Applications such as Electronic Medical Records (EMR) and wireless monitoring and the increasing use of handheld devices and broader imaging distribution all drive the need for network upgrades to provide a more robust, higher-performing, and secure network infrastructure. This infrastructure is critical to reduce staff wait times and allow staff and patient mobility, equipment tracking, and broader integration of data systems. Even with the need to control costs, CIOs are still expected to fund network growth as more and more devices are connected via the wired and wireless network.**

**Although higher performance and lower Total Cost of Ownership (TCO) may be conflicting goals, CIOs and IT directors find that Brocade® solutions can not only exceed performance and cost expectations, but can do so while providing a more secure and flexible network infrastructure that can scale to meet growing connectivity demands.**

#### **ARCHITECTURE FOR HOSPITAL CAMPUS NETWORKS**

Depending on the size and function of the institution, hospital network architectures can vary significantly in complexity and scope. Most medium and large hospital complexes typically implement a traditional three-tier network design with edge, aggregation, and core layers, with the edge including both wired switches and wireless access points. This three-tier architecture accommodates the large number of diverse workstations, laptops, PDAs, phones, monitoring equipment, imaging modalities, and other hospital equipment at the network edge. These devices, in turn, are brought into the central network via an aggregation layer, which ties the network edge to the network core.



**Figure 1.**  
A typical three-tier hospital network architecture.

As shown in Figure 1, the network edge is the user-facing component of the hospital network and provides initial connectivity for a wide range of services, including:

- Patient admission and patient records generation and tracking
- Wired and wireless communications for hospital staff
- Patient monitoring equipment, diagnostic imaging, and pharmacology

As more and more patient information is digitized, the network edge must scale in both size and diversity of connectivity technology to deliver performance that is adequate for the non-disruptive operation of key functions. Edge switches establish the initial connection between client devices and the network and are available in models designed specifically for a required type of connectivity.

Due to the large number of wired edge devices and the need to control capital and operational costs, Brocade has worked with hospitals to leverage higher-density modular aggregation switches, such as the Brocade FastIron® SX for edge connectivity. This enables a pay-as-you-grow blade strategy in the wiring closet. With the proliferation of powered devices—Voice over IP (VoIP) phones, wireless access points, and security or patient monitoring cameras—hospitals require a very high concentration of wired connectivity with Power over Ethernet (PoE) or PoE+ for higher-power devices, such as security cameras with pan-tilt. Existing networks were not designed to support this level of power demand and provide only a fraction of the PoE ports required for growth. High-density PoE and PoE+ capabilities in Brocade stackable and modular chassis solutions with advanced power monitoring meet growth requirements and can be optimized to ensure power to the most critical devices.

Different network requirements from different departments can also dictate changes in network design and deployment. For example, the radiology department requires significantly more bandwidth because of the high volume of image files passed between modalities such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Digital Radiography (DR) to the Picture Archiving and Communications System (PACS) and then to radiology viewing workstations. This means faster connectivity to the imaging modalities or workstations and more uplink ports to the aggregation or core layers so that images can be centrally stored and accessed from the data center. Many hospital networks were already in place prior to PACS or broad image distribution, so they do not have higher-density, multipoint 10 Gigabit Ethernet (GbE) uplinks, which are part of the Brocade wired edge solutions.

### **Brocade Products for Healthcare Campus Networks**

- Brocade FastIron SX Series switches
- Brocade NetIron Series switches
- Brocade IronView Network Manager
- Brocade Mobility wireless controllers
- Brocade Mobility access points
- AirDefense for Brocade Mobility wireless security

With imaging data dispersed to other departments—ORs, ERs, orthopedics, cardiology, oncology, and even to patient rooms—bandwidth demands must be considered across departments as the data is aggregated in the different network layers. To ensure that the display of images is not delayed by other departments, policies and Quality of Service (QoS) may need to be implemented to give radiology and emergency traffic priority in the network. This can be done centrally with Brocade IronView® Network Manager, a comprehensive tool for managing Brocade IP networks.

Each of the network layers must meet stringent requirements for cost containment, availability, and performance without compromising the network mission of providing continuous and secure access to critical patient data. Brocade provides demonstrated value in terms of performance, functionality, and energy efficiency at all three layer levels, with additional security capabilities at the network edge, which is critical as more patient information is accessible via fixed and mobile devices. Pushing data to the network edge is a critical component in improving care while reducing costs, but it falls to the hospital IT staff and CIO to lay the foundation to support the dramatic changes occurring in healthcare.

### **NETWORK CONSIDERATIONS FOR THE DYNAMIC CHANGES IN HEALTHCARE**

With the exception of building new facilities, few institutions have the luxury or budget to design an optimal data network from scratch. In reality, most hospital networks have evolved over time to meet different challenges and they include several generations of equipment and technologies. These are often expensive to maintain, some products may no longer be available, and existing solutions may prove incapable of meeting current and future demands. Addressing the dramatic changes occurring in healthcare have created significant challenges for hospital networks and therefore requires a selective deployment of new, more efficient solutions that can both enhance performance and reliability and keep overall costs under control.

In particular, IT staff must be able to solve challenges such as:

- Transitioning from paper records to Electronic Medical Records (EMR)
- Meeting regulations and securing patient data
- Increasing productivity through staff mobility and WLAN applications

### **Transitioning from Paper Records to Electronic Medical Records**

One of the major contributors to cost, inefficiencies, and errors is the continued reliance on the generation and transport of paper records. The healthcare industry has responded to this challenge with standards initiatives such as Health Level 7 (HL7), which creates uniform templates for the generation and retrieval of electronic medical records. At the same time, however, the transition from paper to electronic records places additional traffic on the hospital data network and elevates the importance of the network and its availability as an essential element of healthcare delivery. As more and more critical patient information migrates to the network, the network must provide adequate bandwidth, security, and data availability to ensure timely delivery of patient information to medical staff and doctors.

Patient records may contain more than just text, as images, audio notes, and rich multimedia data are integrated into the system. Combined with other healthcare applications, they can overwhelm existing networks or cause critical slowdowns, impacting patient care and staff efficiency. These issues could drastically impact the smooth rollout of applications. While older network equipment may not be designed to provide continuous high-performance access, platforms such as the Brocade FastIron Series of switches and the Brocade Mobility Wireless LAN (WLAN) products are engineered for the most rigorous network environments, including wire-speed, end-to-end data delivery and high availability.

## **Meeting Regulations and Securing Patient Data**

Hospitals are subject to regulations and industry performance initiatives both in the US and internationally. In the US, this includes the Health Insurance Portability and Accountability Act (HIPAA), Joint Commission (formerly Joint Commission on the Accreditation of Healthcare Organizations or JCAHO), and Regional Health Information Organizations (RHIOs). HIPAA, for example, in part mandates the confidentiality of patient information, and this in turn impacts a wide range of network services that must be tailored to the secure transport and storage of patient electronic records. Hospitals rely on their CIOs to meet these regulations as patient information is more broadly distributed throughout the hospital in a variety of end devices.

Designed for some of the most sensitive networks in government and private enterprise, Brocade solutions provide a full spectrum of layered security services with both embedded and partner solutions that guard against network intrusion, unauthorized access, snooping, and other attempts to compromise the integrity of the network. In addition, Brocade network solutions support Virtual LANs (VLANs) and Virtual Private Networks (VPNs) for traffic isolation, as well as IP Security (IPSec) for encryption of sensitive patient information across the network. Accepting a solution that is secure but negatively impacts staff performance is also unacceptable and can cause CIOs to be caught between staff needs and regulatory requirements. Brocade offers integrated, next-generation network solutions, which analyze traffic and enforce policies and protection, without reducing staff efficiency.

EMR allows nurses and doctors to bring patient information directly to the patient—increasing efficiency and patient care while reducing errors. However, proliferation of data over a wireless network further complicates securing patient information. AirDefense® for Brocade Mobility Family automates the process of rogue discovery and analysis threat assessment and termination and even correlates the analysis between the wired and wireless networks. A physical port posing a threat can be disabled, eliminating the threat on that port. Integrated security and hotspot services reduce cost at the edge by eliminating the need to purchase and manage multiple network components. This level of security is critical as hospital IT groups are expected not only to offer access for healthcare applications and staff but also to provide Wi-Fi Internet access for patients and their visitors, even bedside entertainment systems, as hospitals compete for value-added services.

## **Increasing Productivity through Staff Mobility and WLAN Applications**

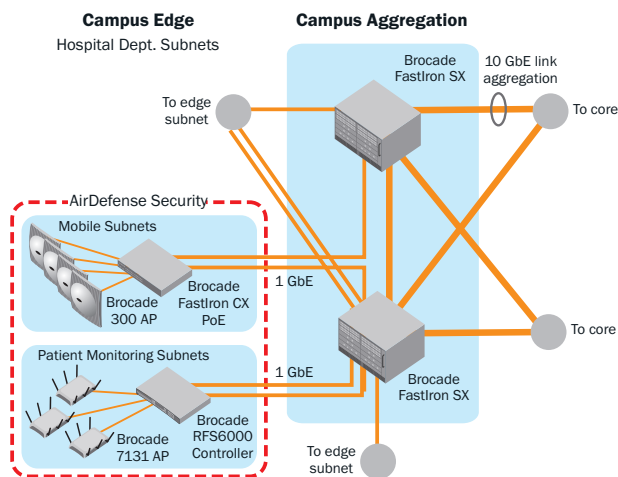
Many hospitals have started to migrate some healthcare applications from wired workstations to wireless access devices such as mobile PC carts, laptops, tablet PCs, PDAs, and other wireless equipment. No longer tethered to wired workstations or PCs, hospital staff members have ready access to patient and other medical information regardless of their physical location in the hospital complex. This both enhances staff productivity and speeds patient diagnosis and treatment.

In many cases, previous-generation 802.11 a/b/g devices, having exhausted their original performance capabilities or reliable coverage, are reaching the end of their useful lives, especially as new applications and levels of coverage become a necessity. Newer applications, such as wireless patient monitoring, can significantly improve patient care with continuous monitoring, eliminating the need to disconnect and reconnect leads as patients are moved throughout the hospital. It also provides an uninterrupted record of their vital signs to a central location, reducing the size of staff required to monitor patients. A change in condition is immediately multicast to appropriate hospital personnel. Remote monitoring requires comprehensive wireless coverage in patient zones and constant regulation of the wireless network to ensure adequate signal strength.

As shown in Figure 2, the Brocade Mobility RFS6000 Controller monitors multiple access points and automatically adjusts radio coverage as required, while also providing safeguards against unauthorized intrusion into the wireless network. Because patient health is directly affected by the integrity of the wireless infrastructure, the resiliency and integrated security of Brocade Mobility solutions play a key role in ensuring continuous and safe coverage.

Other hospital wireless application considerations include mobile equipment tracking throughout the hospital with Radio Frequency ID (RFID) tags and sensors, reducing the amount of lost equipment and allowing it to be quickly found. Patient Internet access, especially for long-term care patients, is also becoming an expected service, further burdening the network from both a bandwidth and security perspective. These types of clinical and services-related wireless applications require more extensive wireless coverage and more bandwidth to eliminate competition between the increasing number of devices with increased security. Hospitals are turning to the Brocade Mobility solutions, which support 802.11n standards, to meet these challenges. A tri-radio expandable design supports high-speed wireless voice and data services with speeds of up to 600 Megabits per second (Mbps), representing two to three times the coverage and self-healing mesh networking to ensure connectivity.

**Figure 2.**  
Implementing a robust  
802.11n WLAN with  
Brocade Mobility Controllers.



Brocade Mobility access points support PoE (or PoE+ for simultaneous radio reception and IPS), which allows them to be powered by Brocade FastIron Series PoE/PoE+ switches, as shown in Figure 2. This eliminates the need for power connectors and transformer bricks at each access point and facilitates higher availability by enforcing power supply redundancy at the switch rather than the access point. With potentially hundreds of 802.11n access points in a hospital data network, PoE-enabled switches helps streamline deployment and support while ensuring maximum availability.

### Integrating Unified Communications

The introduction of Unified Communications (UC) for VoIP, Web conferencing, nurse call, patient video monitoring, and IPTV is another significant cost savings initiative that poses additional challenges for hospital network designs. VoIP, for example, requires low-jitter data delivery for voice clarity, while multimedia applications require multicast support and adequate end-to-end bandwidth. Brocade FastIron Series edge switches with high-density PoE and PoE+ support are compatible with all the major providers of VoIP systems and enforce QoS to ensure clear audio quality as dropped packets are not an option, especially when patient care depends on the call. Likewise, Brocade edge, aggregation, and core switches share advanced, scalable functionality to support multimedia application delivery with no degradation of service. As hospitals collaborate across medical centers, the need for higher-quality HD video conferencing is also becoming a requirement. This may require a network upgrade or redesign to allow for the increased uplink and trunking capabilities available on Brocade FastIron switches.

### Expansion of PACs and DICOM Imaging Access

PACS technology is an integral part of today's healthcare delivery system. Created in response to the inefficiencies of physical film-based medical imaging record management, PACS is part of a broader effort to digitize all medical and diagnostic information to more easily share,



store, and manage patient information. While PACS has been around for years, demands are changing as systems become more open and image data is shared more broadly throughout the hospital. The modalities are also changing as high-speed CTs produce significantly more image slices than prior generations of scanners.

PACS relies on a common image format as defined by the Digital Imaging and Communications in Medicine (DICOM) standard. Because DICOM uses TCP/IP as a communications protocol, PACS data can be routed within a hospital campus network, between hospitals for record transfer, and to remote sites for archiving and disaster recovery.

PACS applications for diagnostic reading are often proprietary configurations sold and supported by a single vendor. However these images need to be transported from the modalities to the PACS, often in raw uncompressed format, thus creating excessive network traffic. With new high-speed CTs, file sizes have more than doubled, further burdening networks and potentially causing slowdowns for radiology staff. Once images are read, hospitals can integrate imaging into the EMR system or install additional DICOM viewers to enable clinical consultation or as reference in surgery, orthopedics, and other specialties. Fortunately compression has helped moderate the level of file transfers somewhat. However, the number of slices have also increased, leading to a losing battle to control bandwidth consumption. The additional use of 3D modeling, which requires significant compute and memory resources on workstations, can also put a strain on the network as these images are transferred within and across hospitals. Imaging will continue to scale and consume available memory, compute, and network resources, creating increasing pressure for the network to scale to meet the growing demands.

Additional network considerations for teleradiology may be required to support radiology reading from remote clinics or hospitals or to allow for a centralized radiology department. Teleradiology will increase network traffic from the wide area network connection through the core to the edge, where images can finally be read.

With support for high-density 100 Mbps, 1 Gigabit per second (Gbps), and 10 Gbps wire-speed performance and the ability to implement high-density link aggregation for higher performance, the non-blocking architecture of Brocade FastIron and NetIron® Series switches enable hospitals to readily expand PACS access throughout the hospital system and to support remote imaging applications such as teleradiology.

## SUMMARY

Although the basic architecture for a hospital network is similar to the architecture of other campus networks, responding to the dynamic changes in improved patient care and cost control requires significantly more planning and strategy than was previously required. Hospital data networks demand greater flexibility in supporting a wide range of medical devices and applications including EMR, PACS, collaboration, handheld devices, wireless patient monitoring, and other services. As more and more wired and wireless services are used and the network must support patient care, an efficient network is no longer a luxury, it is a necessity.

While designing the network can be challenging in any environment, creating the foundation for these new services while also addressing cost and security concerns can be especially daunting in a hospital environment. Fortunately, Brocade networks have proven themselves in the data centers and campus networks of many hospitals and meet the requirements of next-generation applications, while providing greater security and lower TCO. Brocade products and services can help meet current requirements and allow hospital CIOs to respond to the dynamic changes occurring in healthcare technology.

Brocade also has the technology needed for data center storage and IP networks, to allow scaling and security for the increasing volume of digitized patient information, as well as connectivity between hospital groups, clinics, and regional health information exchanges. To learn more about Brocade products, services, and solutions, visit [www.brocade.com](http://www.brocade.com).

## PACS Infrastructure

A PACS infrastructure typically includes the following components:

- Medical imaging equipment (MRI, CT, and other imaging modalities)
- A network for securely transmitting patient imaging results
- Storage systems for long-term archiving and retrieval of image data and reports
- Workstations running special software for image interpretation and diagnosis using high-resolution calibrated monitors

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