SIEMENS

# Driving Innovation:
# The Wireless LAN in Healthcare

A white paper from
Siemens Enterprise Communication

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# Executive Summary – WLAN in Healthcare

Healthcare is prominent throughout the world. It represents a significant percentage of many countries' GDP and is growing steadily. But the increasing demands on healthcare systems are too often accompanied by shortages in clinical staff. For healthcare organizations to succeed in the 21st century -- to continue to provide quality patient care and not become dangerously "overwhelmed," they are going to have to do *more* with *less*.

Mobile technology and WLAN solutions promise to transform the healthcare industry – Patient-centered care, e-pharmacy, asset tracking, mobile voice and rich media systems are just a few of the solutions that are enabled by WLAN technology.

*"Healthcare is one of the few verticals aggressively developing and extending applications and business processes to the WLAN, making the industry a hotbed of WLAN innovation."**

*Source: US WLAN Equipment 2005-2009 Forecast by Vertical Market, IDC 2005

Siemens has a deep background in healthcare technology with over 100 years of hands-on experience. The company is an undisputed leader in the development and implementation of healthcare products and solutions. Leadership in healthcare solutions and innovation in WLAN product design make Siemens a preferred partner for WLAN and wireless healthcare solutions deployment.

Siemens has enabled numerous WLAN healthcare solutions in leading hospitals, universities and clinics around the world. Siemens has the knowledge, the technology and the experience to create and deploy mobile healthcare solutions that save time, money and lives.

# 1. Wireless LAN Evolution

Since it was first standardized in 1997, the 802.11 “Wireless Ethernet” protocols have generated tremendous media excitement. In 1999 two updated Wireless LAN (WLAN) protocols were introduced that further kindled media excitement and generated considerable consumer interest. The new 802.11b standard provided high data throughputs, and because of the quick commercial availability of low-cost components, it enjoyed tremendous success in the marketplace. One of the biggest contributors to this success was the growth of WLAN ports being included as standard equipment in most new laptops.

The second WLAN standard introduced in 1999 was 802.11a. This protocol seemed technically superior; with 5 times the bandwidth and the ability to support more simultaneous connections. However, a market delay and a generally higher price-point of 802.11a products combined with the established success of 802.11b resulted in slower commercial take-up. It is only recently that the 802.11a standard has taken off commercially. This success is likely to continue as dual-RF WLAN infrastructure grows in popularity.

In June 2003, a much anticipated third WLAN standard, 802.11g, was approved. Because of its higher data throughput and backward compatibility with 802.11b equipment, many manufacturers rushed dual-band hardware to market before the standard was even ratified in 2003. Future WLAN standards promise to provide even higher data throughput, with speeds over 200 Mbps with little risk of interference, thus performing on par with current wireline LANs.

| | 802.11a | 802.11b | 802.11g |
|---|---|---|---|
| Data Rate (Mbps) | 54 | 11 | 54 |
| Operating Frequency (GHz) | 5 | 2.4 | 2.4 |
| Range | 150feet | 150feet | 150feet |
| Interference Risk | Low | Moderate | Moderate |

Corporate CIO’s and network administrators followed the development of the 802.11 standard closely. Increasing bandwidth was important, but equally significant were the security improvements that arose from the June 2004 ratification of the 802.11i Wireless LAN security standard. The availability of Wi-Fi Protected Access (WPA & WPA2) mode provides much needed encryption and authentication capabilities.

This milestone eliminated the last major concern that CIO’s and network administrators held with regard to deploying WLANs within their organizations. In fact, the 2006 Wireless LAN State-of-the-Market Report (www.webtorials.com) reports that over 80% of their CIO respondents had deployed business-class WLANs or were in the process of doing so.

WLANs are becoming so popular that *Infonetics* forecasts WLAN hardware revenue to double over the next four years to almost $4 Billion (USD) by 2009. No industry is more eager for WLAN than Healthcare.

# 2. The State of Healthcare around the Globe

Healthcare systems around the world face a number of challenges, and countries are responding to the challenges in many different ways: OECD countries currently spend an average of 8–10% of their GDP on healthcare, which is projected to increase by 3 to 4 percentage points over the next few decades. For millions living in countries outside the OECD, healthcare is often perceived as a luxury item and has to be paid for by the individual. Despite the huge growth in spending around the world, global healthcare is rapidly approaching a crisis -- aging populations and a growing shortage of physicians and nurses are creating a situation where the majority of healthcare organizations may be “at” or “over” capacity for inpatient care.

More money is clearly not the answer. Despite being the largest sector of the US economy, accounting for over 16% of the GDP in 2004 ($2 trillion), healthcare is not as safe as it should be:

- In 1998 Journal of the American Medical Association stated that over 100,000 people die in hospitals each year due to adverse reactions to prescribed drugs. This number was revised to nearly 200,000 annual deaths in a 2004 report from HealthGrades, Inc.
- The Institute of Medicine estimates that medical errors might account for an additional 44,000 to 98,000 deaths per year.
- 18,000 Americans die each year from heart attacks because they did not receive their prescribed preventive medications, although they were eligible for them.

Beyond a tragic cost in human lives, adverse drug effects (ADEs) and other preventable medical errors have a ripple effect on the economy in general. There is a huge additional burden on the economy due to disability, lost income, decreased productivity and litigation.

Can wireless technologies really improve the quality of healthcare and reduce its cost? A report by The FocalPoint Group, LLC indicates that wireless technologies can cure the ills of the healthcare system as well as boost the quality of patient care. Their 2004 report, entitled "Wireless Data in the Healthcare Arena," provides a comprehensive view of the latest applications of wireless data in the healthcare space. The report states that wireless technologies are the key to increasing efficiency, cutting costs and enhancing care. It projects that more than $7 billion will be spent on wireless data applications in healthcare within the United States by 2010.

The most commonly deployed applications will focus on clinical systems to improve patient care and optimize patient flow and administrative systems that improve staff efficiency and control costs. Some of the most obvious problem areas include:

- Manual patient charting is slow and error-prone
- Adverse Drug Effects are endemic and expensive
- Ineffective and disruptive communications
- Lost time searching for equipment and patients
- Economic patient monitoring

**Manual Patient Charting and Paper Workflow is Slow and Error-prone**

Patient-centered care is not new; it has been discussed for over 20 years, but only recently is it beginning to take hold. Increasingly, patients expect physicians to be responsive to their needs and preferences, to provide them with access to their medical information, and to treat them as partners in care decisions. This means that effective healthcare is now happening at the bedside, and not in the Doctor's office, which makes mobility via wireless technology an essential piece of the puzzle.

Mobility used to mean doctors, nurses and medical technicians using hand-written notes on individual sheets of paper for transcription into a medical record. Healthcare facilities, challenged by increased time demands on clinical staff and/or new federal mandates to increase documentation [HIPAA], spend an estimated $15 billion to $20 billion each year in the US alone for medical documentation and transcription. In addition to the high cost and delay associated with the manual transcription of patient records, there are non-productive activities such as recording redundant data, searching for misfiled and misplaced charts, and loss of important patient data.

**ADEs are endemic and expensive**

Adverse drug effects and preventable medical errors are a problem around the globe.

- An Australian study in 1995 showed that 16.6% of hospital admissions in New South Wales and Southern Australia were associated with an "adverse effect" and that 51% of these were considered preventable.
- A 2001 report in the British Medical Journal showed that 10.8% of patients in two acute care hospitals in Greater London experienced an adverse event.
- A 2004 study from the eHealth Initiative estimates that "over 2.1 million preventable ADEs occur each year in ambulatory care within the USA.

In addition to patient mortality, adverse drug effects (ADEs) are the single largest cause of extending patient length of stay. Patients who experience ADEs are hospitalized 8 to 12 days longer than patients who do not suffer ADEs.

**Reliable, real-time communications required**

The barriers to effective communications within a healthcare facility are numerous. Large, shift-working populations of clinical, operational and administrative personnel are mobile for much of their day; yet reliable, real-time communications is a vital requirement for them to perform their duties safely and efficiently. Traditional alert mechanisms like paging systems are ineffective and disruptive, and new technology advances such as pagers and mobile phones are often uninformative.

In a hospital every second counts, and response time is critical to how well caregivers can meet patients' needs. Multi-media communication systems that integrate wireline and wireless communications, and provide intelligent alerts, telemetry information and even location information can help clinicians evaluate patient needs and deliver appropriate care faster and more efficiently.

**Healthcare workers spend much of their valuable time searching**

Almost everybody and everything within a healthcare facility can benefit from being tracked -- patients, doctors, nurses, equipment and supplies are always on the move. In addition to this constant movement, multiple, parallel supply chains exist and different levels of security and control are required for each. For example, strict control of drugs and blood products is a legal requirement, whereas managing the location and disposition of equipment like wheelchairs and IV pumps is important from a staff efficiency point of view.

- Studies indicated that up to one third of staff time was spent searching for equipment, patients and other hospital personnel.
- Every year hospitals write off between 5% - 15% of their capital equipment budgets due to loss and theft and are then required to spend more money on equipment rentals and long term-leases to replace these losses and to keep their operation running smoothly.

**Effective Patient Monitoring should be cheap and easy**

Optimizing patient throughput is an important concept within healthcare management. Critical care beds cost a hospital $2000 - $3000 per night, whereas standard care costs a fraction of that. One-to-one nursing and expensive dedicated monitoring equipment are the largest factors involved. To reduce costs, hospitals are motivated to move patients through their system as quickly as possible, but at the same time they need to improve staff efficiencies, response times and patient outcomes. Advances in monitoring equipment and new approaches to patient flow can make this possible. Using low-cost multi-purpose monitors that are connected to a WLAN allow a patients status to be monitored in the ER, OR, ICU and ward using the same equipment.

# 3. WLAN Driven Healthcare Solutions

It is imperative that today's healthcare organization become "connected" to narrow the gap between revenue/funding and expenditures. WLAN driven healthcare solutions are focused on information management and "connecting" healthcare organizations – real-time clinical, operational, and administrative information gathered, integrated and displayed across the entire healthcare enterprise.

- Operationally, a "connected" healthcare organization is able to improve enterprise-wide processes, make strategic, mission-critical decisions, measure desired outcomes and improve patient satisfaction.

- Clinically, a "connected" healthcare organization is a seamless, uniform work environment with anywhere, anytime access to patient information that allows clinical staff to improve patient safety and efficiently manage risk factors to produce superior patient outcomes.

- Administratively, a "connected" healthcare organization complies with all federal and local regulations, while maintaining cost-effective patient flows and maximizing patient satisfaction.

**Using HIS to Improve Bedside Matters**

Health Information Systems (HIS) are all about improving the accuracy and consistency of patient information. The effectiveness of any HIS is only as good as the quality of data that enters it. Using CPOE or EHR software on a wireless tablet, PDA or bedside terminal saves time and provides caregivers with complete, up-to-date information. The result is lower cost, greater accuracy and better clinical outcomes.

- Ohio State University Health System reduced the time for getting medication to patients by 65 percent from 5.28 hours to 1.51 hours. They also reduced Radiology turnaround from 7.37 hours to 4.21 hours.

- Maimonides Medical Center reported 30.4 percent reduction in average length of stay from 7.26 to 5.05 days. They also realized organizational efficiencies by preventing duplicate ancillary tests.

- Heritage Behavioral Health experienced 70 percent reduction in cost of clinical documentation using EHR.

Another benefit of using wireless technology to "connect" HIS is that improvements in the physician's clinical workflow extend beyond the bedside. Physicians can access up-to-the-minute information on any of their patients whether they are in their offices, elsewhere in the hospital or even at home. When a mobile physician receives a patient-related request, they no longer have to ask a nurse to read results from a chart, possibly missing critical information -- in just minutes they can check a patient's lab results, dictate a note, or write a prescription. This improves patient safety, since a clinician is making decisions based on the most recent results.

Many of the HIS solutions operate wirelessly via custom clients installed on devices such as handheld, tablet or notebook PC's. Others operate using a standard web-browser interface on a WLAN capable client device.
Either solution enables clinicians to spend more time treating patients and less time accessing, organizing and charting clinical information. Mobile HIS includes security features designed to protect patient privacy while enabling mobile access and data entry to the electronic patient chart. Thus, using their ordinary personal digital assistant (PDA), clinicians have current clinical profiles at their fingertips so that access to critical data is quick, convenient and mobile.

### E-Pharmacy -- Automation and Verification of Medication

Improved patient safety and cost savings from reducing ADEs are compelling enough reasons to adopt e-prescribing, but efficiency improvements in physician, pharmacy and hospital workflows can result in additional cost-benefits. Using mobile technology, physicians can write prescriptions on mobile devices and forward them directly to pharmacies. As part of this process, each prescription is checked for drug-drug and drug-allergy interactions and formulary compliance. A big advantage of this process is that the e-prescribing application can provide the physician with a complete list of all medications the patient uses so that when medication is administered, the right patient receives the right medication at the right time in the correct dosage.

In 2003, the Center for Information Technology Leadership (CITL) estimated that nationwide implementation of advanced ambulatory CPOE systems would eliminate nearly 13 million physician visits, 190,000 admissions and over 130,000 life-threatening adverse drug events and save $44 billion per year.

### Communications means more than just Voice

There are many barriers to effective, real-time communications within a healthcare facility. Large, shift-working populations of clinical, operational and administrative personnel are mobile for much of their day, yet reliable, real-time communications is a vital requirement for them to perform their duties. Voice over IP (VoIP) is growing in popularity in all business sizes; from SOHO through the SME and into the large enterprise. According to a recent report from Insight Research, 2009 will be the “crossover” year in which VoIP phones in the enterprise will represent the majority of the installed PBX base.

The healthcare market is excited by VoIP because of its potential to transmit more than simple voice. Rich new media types such as images and video promise to turn the company “phone” system into a more capable “communications” system. When you leverage VOIP into the wireless space (VoWLAN), it becomes even more compelling. Users can send/receive multi-media communications onto a wireless device like a phone, PDA or laptop as they roam the corridors. Rich content such as graphical charts, images, and videos can be exchanged locally to help brief the care giving team, or they can be forwarded remotely for consultation. This flexibility ensures that each patient gets the best possible care exactly when they need it.

To be successful, a healthcare organization that is planning for enterprise VoIP and VoWLAN should consider all of the possible components; from convergent IP/TDM PBX’s to 802.11 networking infrastructure and dual-mode handsets. Everything has to work together flawlessly to fully deliver on the promise of VoIP and VoWLAN for healthcare.

**Using RFID to track what you need tracked**

Hospitals can regain control and significantly reduce costs by using RFID (Radio Frequency Identification) technology to track clinical staff, patients, supplies, medication and equipment. Solutions matching WLAN with RFID create one of the hottest areas of interest in healthcare today. RFID technology and location systems improve staff efficiency, reduce theft and loss of equipment, and can provide a secure system for controlling medications and blood products.

A study released by Chicago-based Fast Track Technologies Ltd. predicts the health care market for radio frequency identification technology will soar to $8.8 billion by 2010. In another report by Spyglass Consulting, the number of hospitals using RFID tags to track assets will skyrocket from 10 percent in mid-2005 to 45 percent by the end of 2007. Such programs promise to cut not only costs, but also the time that clinicians and engineers spend searching for equipment, and the time patients spend waiting for it.

**Alternatives for Perioperative Patient Monitoring**

Perioperative patient monitoring solutions can wirelessly connect the enterprise and department levels with the acute point of care. Complete solutions enable wireless patient monitoring across the entire patient care continuum; from Emergency Care, the OR/Anesthesia to Critical Care, Perinatal Care and Home Care.

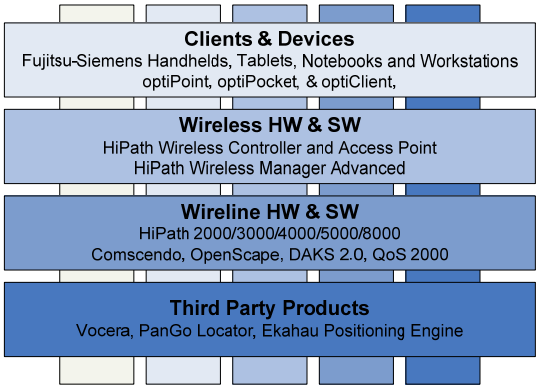
The choice of the right standards-based wireless technology can lead to significant improvements in productivity and workflow, reduce medical errors, and work to decrease the costs of patient care. It is important that a patient monitoring and remote access application directly integrates with the hospital's WLAN. This enables information monitored patients to be automatically integrated with the hospital HIS, and then be distributed wirelessly throughout the facility or beyond allowing clinical information to be readily available and accessible through WLAN enabled tablet PCs and even standard PDAs. The result is uninterrupted patient monitoring and enhanced patient care. This will help healthcare institutions build a "connected" clinical environment, provide a ubiquitous patient record, and improve outcomes by empowering clinicians to make evidence-based decisions quickly and accurately from the patient bedside, their office or even their home.

# 4. Siemens Knows Healthcare

Siemens' has been a key player in healthcare since they helped to introduce the X-ray machine in the late 19th century. Over 100 years later, Siemens has several dedicated divisions that provide solutions and services into the healthcare industry. ***Siemens Medical Solutions – Health Services*** is one of the largest suppliers to the healthcare industry in the world. It employs approximately 33,000 people and operates in more than 120 countries around the world. ***Siemens Business Services (SBS)*** is one of the world's largest providers of global IT solutions and managed services, employing another 40,000 people in over 45 countries. ***Siemens Enterprise Communications*** delivers ITC Solutions to healthcare enterprises around the world.

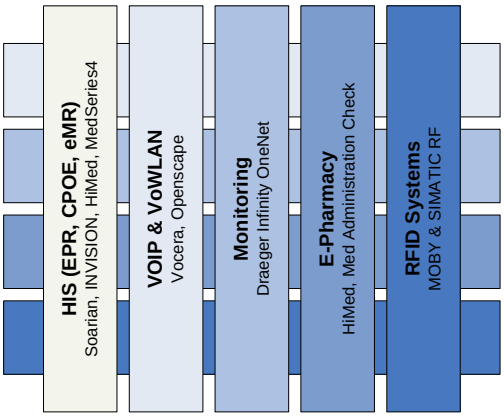
Siemens is positioned to help healthcare organizations in many different ways. From a horizontal product perspective, Siemens is able to provide a complete portfolio of communications technology of all sizes and capabilities. They offer IT/IS infrastructure to healthcare organizations that need IP capable PBX solutions, WLAN infrastructure and even basic IT/IS equipment such as tablet PC's, notebooks, desktops and servers. All of Siemens HW & SW products from the smallest handheld to largest enterprise IP switches are manufactured in accordance with Siemens reputation for engineering accuracy and quality.

**Horizontal Products**




Siemens also maintains a large portfolio of vertical solutions for the healthcare industry. Some solutions such Health Information Systems, like Electronic Patient Records (EPR), and Computerized Physician Order Entry (CPOE) systems, provide an extensive management of healthcare information and integrated federal regulation compliance. Other vertical solutions are more narrowly focused on specific challenges in healthcare, such as the prescription and administration of medication, tracking patients, staff, materials and assets, and improvements in the effectiveness of patient monitoring.

**Vertical Solutions**



**Siemens and WLAN in Healthcare**

A defining element in Siemens healthcare solutions is the underlying wireless LAN infrastructure from Siemens HiPath Wireless. WLAN makes it all work better --from the smallest palliative care facility to the largest national medical center, wireless controllers, access points and management software work together to create a reliable and secure communications backbone that provides “anywhere, anytime” access to vital information. By accessing systems where and when they need to; clinical and operational personnel are more efficient and accurate, which reduces errors and improves patient outcomes.

Because of the sensitive nature of patient information, healthcare IT infrastructures are tightly regulated. In the United States, Title II of the Health Insurance Portability and Accountability Act (HIPAA) aims to create standards for the use and dissemination of health care information, with specific attention paid to keeping that information secure and private. The HiPath Wireless Portfolio offers several capabilities that pertain specifically to HIPAA and more generally to keeping patient records confidential.

- WPA2 security implementation provides data encryption and user authentication.
- HiPath Wireless Manager's HiGuard reporting module offers hospital administrators an innovative automated tool for continually monitoring and reporting on all activity on the WLAN and ensuring that it complies with the full HIPAA standard.
- The portfolio's SNMP implementation features configurable community names, addressing a common network attack and complying with a specific condition laid out in the HIPAA regulations.

Together, these features make it especially easy to bring HIPAA-regulated wireless networks into compliance, and ensure that they stay that way.

**Siemens and RFID in Healthcare**

RFID (radio frequency identification) in healthcare is gaining momentum as many pilot programs are proving successful. In 2005, Siemens worked with New York’s Jacobi Medical to implement an RFID wristband system for patient identification and medication administration, replacing Jacobi’s manual process of identifying patients, in its two acute-care departments. The RFID system improved patient safety and care, increased productivity, and helped cut costs. According to Daniel Morreale, Chief Information Officer, “the RFID trial saved one hour per nurse per shift. If the application is rolled out network-wide, it could potentially save $1 million a year, but more importantly this creates two to three hours during every nursing shift for additional patient contact and care.”

In addition to their own solutions, Siemens works with industry leading partners to make their RFID technology more powerful and easy to use. The Ekahau Positioning Engine 3.1 (EPE) is an open and future proof location platform that can leverage any existing Wi-Fi network. EPE is capable of pinpointing Ekahau T201 Wi-Fi Tags, laptops, PDAs and other Wi-Fi enabled devices, with floor-, room- and door-level accuracy.

**A Complete VoWLAN Product Portfolio**

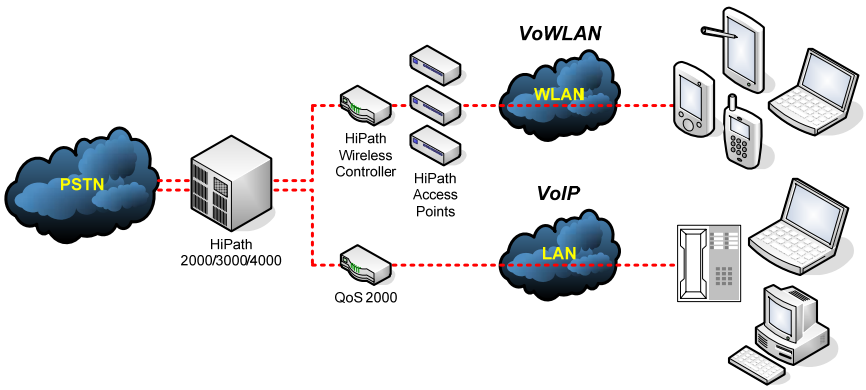
Siemens provides all of the hardware and software required for a complete VoWLAN solution.

This includes;

- IP convergent platforms and QOS appliances. The HiPath 2000/3000/4000/8000 are cost-effective IP convergence platforms for small to large enterprises. They can be used in stand-alone as well as in IP networked configurations to combine the benefits of IP with the feature richness and availability of circuit-switched systems.

- Wireless LAN infrastructure including; wireless controllers, access points and Management Software. The HiPath Wireless Access Point is an enterprise-class dual band (802.11a/b/g) access point that provides radio frequency coverage anywhere that wireless service is required. Together with the Scalence W line of “ruggedized” indoor/outdoor access points, complete enterprise coverage is possible. The HiPath Wireless Controller is a full-functioning centralized WLAN controller that aggregates all wireless traffic from Scalence W and HiPath Wireless Access Points as well as third-party access points. Together with HiPath Wireless Manager, these products provide cost-effective, flexible WLAN deployment in any healthcare environment.

- A full range of client devices; phones, handhelds, tablet PC’s and Notebooks. Dedicated VoWLAN clients such as the optiPoint WL2 professional phones support familiar telephone features such as polyphonic ringer tones, graphical display and plenty of applications. The optiClient 130 and optiPocket soft clients provide full VoWLAN functionality on wide variety of PDAs, laptops and other 802.11 devices, including; Fujitsu Siemens handheld PC’s, tablet PC’s and notebook computers.




All Siemen’s VoWLAN components are based on open architecture structures and standards such as 802.11, SIP and H.323, and therefore can inter-operate with third party products following the same standards.

# 5. Conclusion

Siemens knows Healthcare. With over 100 years of hands-on healthcare experience, the company is an undisputed leader in the development and implementation of healthcare products and solutions. As an innovative product company, Siemens uses their renowned engineering capabilities to manufacture hardware system for healthcare organizations; from the smallest handheld PC to the fully scaleable enterprise servers and IP convergent PBX's, Siemens makes it all. As a world-class solutions company, Siemens, through its HiPath, Medical -HS and SBS divisions, has created a broad portfolio of software solutions to improve healthcare staff efficiency and reduce costs -- award-winning HIS solutions, easy to install and manage VoWLAN infrastructure and innovative RFID systems are just some of what Siemens has to offer to healthcare organizations around the globe. Siemens offers their healthcare solutions as both a managed service and as a customer premise equipment based solution – providing answers for any size of healthcare environment.

More important than the bursting portfolio of award-winning hardware products and innovative software solutions is Siemens' basic philosophy about being a good partner and making healthcare organizations more successful. By focusing on open standards, avoiding proprietary solutions and willingly partnering with third-parties, Siemens proves time and time again that their primary concern is for the long-term success of their healthcare organization customers.

This document is just an introduction to incredible breadth and depth of Siemens' healthcare offerings. With almost 500,000 employees working in over 190 countries around the globe, it is obvious that Siemens is a major player in almost every market and industry. Further information about the company is available on the Internet at: www.siemens.com.