

Bedside Terminal Technologies

An Overview

Executive Summary

Hospital IT professionals are having an enormous impact on patient well-being and satisfaction because they're equipping patient bedsides with modern devices for vitals monitoring, entertainment and communications. However, architecting a patient information and entertainment solution is complex, and IT departments must decide which technologies best meet patient expectations, clinical initiatives, staff processes and return on investment (ROI) targets.

Fortunately, the necessary technologies for the back office and bedside terminals are established and proven. Still, considerable effort is required to evaluate features, integrate different technologies and implement new use models, such as doctors showing CT images to patients at their bedsides. This white paper presents some of the use models for bedside terminals and discusses many of the related technologies and features that hospital IT departments should consider.



A Historical Perspective

In many ways, the information age is influencing patients' expectations for bedside entertainment and information services. There has been tremendous change over the past two decades. Twenty years ago, patients in U.S. hospitals walked to a communal room to watch television. Then, in the late 1990s, the UK National Health Service (NHS) initiated the "patient power programme" mandating that all NHS hospitals provide telephony and entertainment at the bedside. An industry shakeout followed, and after the installation of around 90,000 terminals, two equipment suppliers emerged as the strongest.

Eventually, plans were scaled back because of the government's reluctance to use the installed networks for accessing patient records, and consequently, only the inadequate revenue from telephony and entertainment services was left to sustain the initial business model. Other global markets were slow to adopt the new technology due to a lack of reference sites and evidence of successful, new business models based on a complete bedside solution.

Today, other markets such as Europe and Asia have emerged, and new installations are being justified primarily for the clinical benefits and secondarily for entertainment and telephony. For example, nursing staff efficiency is improved and billing time is reduced with a wireless infrastructure that helps monitor patient vital signs, manage efficiency surveys and track all patient orders.

Hospital IT will continue to explore opportunities to reduce cost and improve service with technologies that increase the efficiency of their workflow processes. Bedside terminal suppliers are working with bed manufacturers to increase I/O connectivity; this makes it easier to incorporate more functionality, such as terminals operating the bed, displaying bed cleaning instructions and showing vital signs captured by patient sensors. The installed network will also be used for closed circuit TV information in the waiting rooms and the hall, so there's only one system to manage. Hospitals are now deploying newer technologies, like RFID, ultrasonic tracking and voice recognition, at the patient bedside. It will take some time for the latest, more interesting technologies to be deployed, but as installations grow, new unique applications will emerge.

Bedside Terminal Use Models

Entertainment

Patients require entertainment to pass the time and take their minds off their condition or illness. Peoples' expectations around entertainment access are growing with the proliferation of service options like cable, satellite and IPTV companies, video-on-demand and DVD rental-by-mail. Patients want more than a hospital television with limited channels, and the majority are willing to pay reasonable tariffs for "normal-life" services. With bedside terminals, patients can choose from a wide variety of services, such as TV, radio, interactive games, hospital information, event notices and more, as shown in Figure 1.



Figure 1. Bedside Terminal

Communications

Whether using telephones or e-mail, patients need to stay in close contact with family members and friends, especially those unable to visit. Cell phones are a way of life for many people, but often aren't permitted in hospitals, and people must rely on telephones in their rooms. To keep noise down, some bedside terminals have flashing call indicator lights to alert patients of incoming calls, as shown in Figure 2. These phones typically support Voice over IP



Figure 2. Buzzer on Terminal

(VoIP) with lower long distance charges than the public switched telephone network (PSTN), providing cost savings that hospitals can pass on to patients. VoIP packet-based infrastructure also supports e-mail, allowing patients to plug laptops into bedside terminals if necessary.

Information Access

People are accustomed to surfing the web for information like news, TV listings, and even medical advice. With packet-based infrastructure, hospitals can give patients access to the Internet and educational resources, like treatment and hospital information, via their own web site or data repositories.

Doctor Consultations

When doctors pull up X-rays and CT scans at the patient's bedside, as shown in Figure 3, they are able to deliver more informative consultations. A clearly displayed picture, along with an explanation, helps patients better understand their medical condition and treatment options. While with patients, doctors can read all patient records in real-time such as up-to-date drug dispensing logs. Bedside terminals may be used for medical charting, eliminating messages on grease boards and hard-to-read notes, which is an important step toward storing all patient information electronically. These capabilities require a bedside terminal with a high-quality display and a connection to the patient records database.



Figure 3. Bedside Consultation

Dietary Services – Ordering Meals

A significant amount of staff time is often spent gathering meal requests. Alternatively, patients who don't require a dietician, can use bedside terminals to place meal orders, which are immediately sent to the kitchen without staff assistance.

Bedside terminals offer new service possibilities for entertainment, information and communication and opportunities to improve infrastructure scalability and hospital workflow processes, as shown in Table 1. These advancements increase patient satisfaction and potentially influence which hospitals patients choose for medical services. Additionally, bedside terminals eliminate some mundane tasks and make it easier to communicate with patients, which leads to greater hospital staff satisfaction and efficiency.

Table 1. Benefits from Bedside Terminal Solution

Benefits of Bedside Terminals	Services and Opportunities
Increased patient satisfaction	<ul style="list-style-type: none"> • Enjoy more entertainment options • Access Internet and e-mail • Make menu selections in real-time • Send non-urgent requests to nurse (e.g., glass of water) • Avoid annoying other patients by using headphones • Decrease telephony charges via VoIP
Increased nurse satisfaction	<ul style="list-style-type: none"> • Spend less time with entertainment system and menus • Use informational films in different languages to ease communication challenges
Improved infrastructure scalability	<ul style="list-style-type: none"> • Extend platform to clinical initiatives at the patient bedside • Track all orders from patients, thus reducing billing time

Network Topology

Bedside terminals connect to the hospital network infrastructure through edge switches, as shown in Figure 4. Card vendors, also in the ward, enable patients to pay for video-on-demand services. The edge switches communicate with the hospital back office through the core switch, which provides the connectivity to all the other network equipment and service providers, including:

- PSTN services through a VoIP gateway
- Internet services through a router or cable modem
- Terrestrial, cable or satellite television through a TV headend

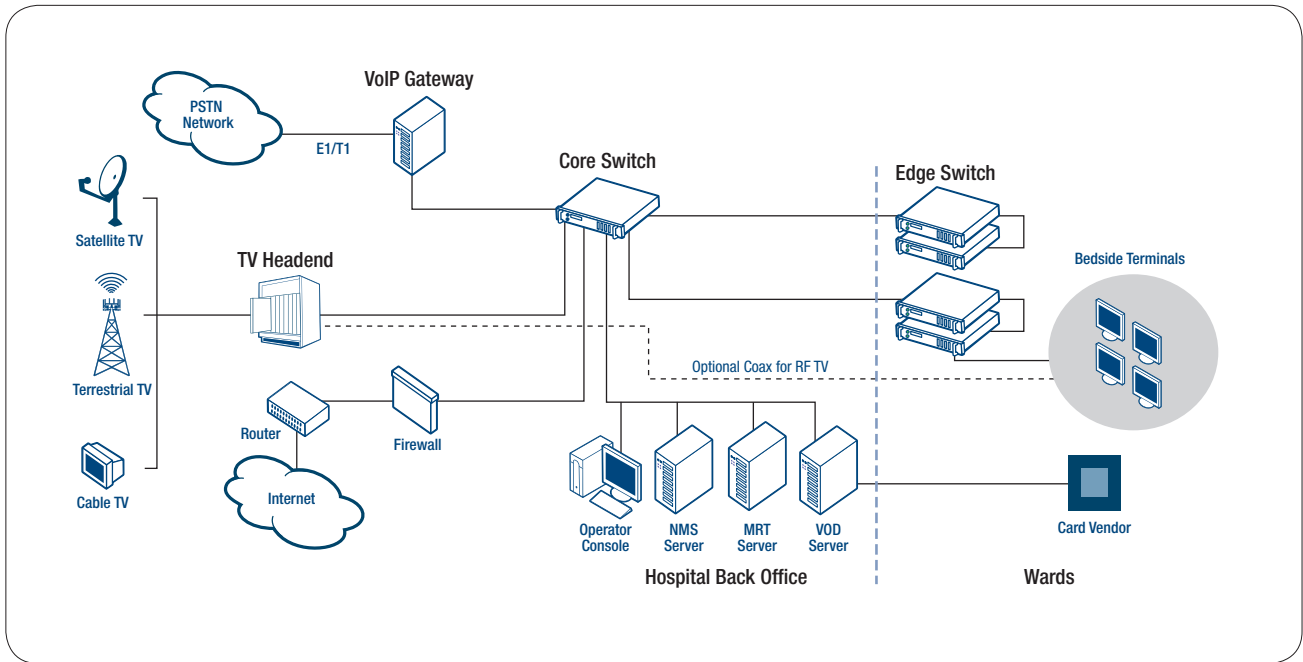


Figure 4. Network Topology Supporting Bedside Terminals

Infrastructure Requirements

In addition to architecting a network topology, IT departments should ensure their back office equipment has sufficient capacity to support all the bedside terminals in the hospital. Capacity requirements will depend on whether the bedside terminals are thin clients or performance clients. Deciding between these two approaches normally entails a choice between cost and performance. Low-cost thin clients are typically equipped with relatively low-performance processors, no hard disk drive and little system memory; the server does the majority of the work and streams everything to the thin client. Performance clients have more processing resources and memory, enabling them to perform demanding image processing, like rendering CAT scan or decoding H.264 and MPEG4 for video playback. For either scenario, IT personnel needs to adequately size back office servers to handle the services available to patients and staff.

The back office infrastructure normally comprises enterprise servers, switches, security appliances, video servers and so on in a rack, as shown in Figure 5. As previously mentioned, the layer 3 core switch connects to the edge switches in the wards. In support of bedside terminals, back office equipment provides the following functions:

Table 2. Back Office Functions

Reception and distribution of television and radio channels
Telephony support and PABX functionality
Data and information server support
Internet connectivity <ul style="list-style-type: none"> • Security (firewall) • Content filtering
Network Management Services <ul style="list-style-type: none"> • Reporting • Management • System monitoring • Diagnostics

Top 10 Bedside Terminal Technologies

Patient information and entertainment solutions bring together a wide range of technologies that IT departments must evaluate as part of a comprehensive solution. The following lists some of the top computer, communications, security and materials technologies worthy of consideration.

1. Biometric Security

Ensure secure terminal logon for doctors, nurses and patients using fingerprint recognition, which doesn't require a keyboard or password management.

2. VoIP Telephone

Reduce infrastructure and vendor complexity by consolidating data and telephony onto a common network, which saves costs and decreases the number of service providers (e.g., no PSTN line to every room).

3. Wireless Connectivity

Eliminate wires for the television, telephone and LAN for e-mail, thereby providing a safer and tidier environment for patients and staff.

4. Low-Power Fanless Processing

Deploy fanless terminals with low-power processors because patients will appreciate their silent operation, and the low power consumption minimizes venting holes, thereby reducing bacterial buildup and susceptibility to dust ingress for improved reliability.

5. Touchscreen User Interface

Avoid keyboards and mice and choose a touchscreen for easy, intuitive interactions with applications, especially when patient ambulatory capability or space is limited.

6. Barcode Scanner

Use barcodes to simplify data entry (e.g., patient medications and room relocations) and reduce recording errors, as well as confirm medicine distribution in real-time.

7. Magnetic Stripe Reader

Simplify service payment or safeguard restricted information, such as patient records, menus and schedules, by allowing patients to swipe a credit or identification card at their bedside.

8. Anti-bacterial Materials

Protect patients and staff with terminals that incorporate anti-bacterial and flame-retardant plastics and a membrane keypad.

9. RFID

Improve medical equipment and patient tracking with RFID tags and wristbands that identify equipment and patient location; this can decrease the risk of performing incorrect medical procedures, also called wrong-site, wrong-patient events.

10. Ultrasonic Microphones

Allow patients who cannot physically touch bedside terminals to control them with voice commands, using a microphone and voice-recognition software.

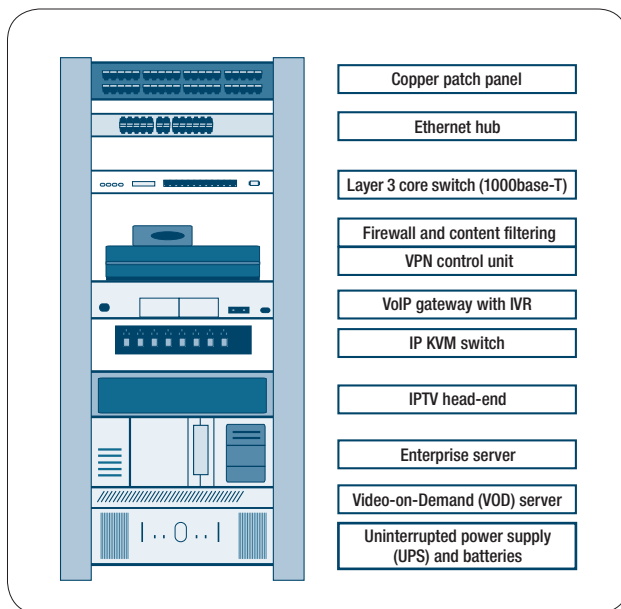


Figure 5. Back Office Rack System

Economic Considerations

When patient information and entertainment solutions were first deployed, hospitals expected phone revenues alone would pay for the requisite infrastructure. In reality, the phone-only model wasn't profitable. Today, new medical installations view the superior services offered by bedside terminals as essential for boosting patient satisfaction and generating revenue.

Generally, the breakeven for the infrastructure is two to three years, which comprehends the additional back office equipment, wiring, bedside arms and terminals, ranging from \$2,500 to \$3,000 (USD). This leaves years three to seven years to produce a positive return on investment (ROI). The revenue model works because patients are increasingly willing to pay for improved entertainment options and Internet access. Additionally, some of the infrastructure investment cost has come down, as many newer hospitals already have CAT5/CAT6 wiring, although coax is sufficient for bedside terminals. Staff and nursing productivity gains would also be expected which are not included in the breakeven estimate.

Moving forward, hospitals may expand their ROI analysis for bedside terminal solutions to include the substantial cost savings that are achieved from a single real-time repository for patient records. Future systems are likely to become more modular and standards-based, which will enable more cost-effective upgrades and enhancements and greater vendor choice.

Patient Information and Entertainment Solutions

Customer perception and satisfaction is increasingly linked to how service businesses, like hospitals, supermarkets and banks, deploy technology to improve the overall experience. Technology is a gateway between companies and customers, providing a personal touchpoint that invokes a strong impression about the proficiency and appeal of a company. In hospitals, IT professionals are well-aware of the impact of technology on patient service and satisfaction, and they must determine which networking, communications and entertainment solutions provide the greatest cost/benefit.

Helping bring all these technologies together, JAOtech is a market leader in the design and manufacturing of a world-class, innovative range of embedded Smart Terminals™. Thousands of these UL60601-compliant patient entertainment terminals have been installed in hospitals worldwide in partnership with Lincor, Philips and other renowned solution providers.

The family of Smart Terminals is specifically designed for use as a communication and entertainment device within hospitals. The terminal enables patients to view terrestrial, satellite and cable television from their beds. Other features include movies, on-demand, radio, audio books and Internet access. Patients typically receive a unique bed extension phone number, enabling them to dial and receive IP telephone calls effortlessly.

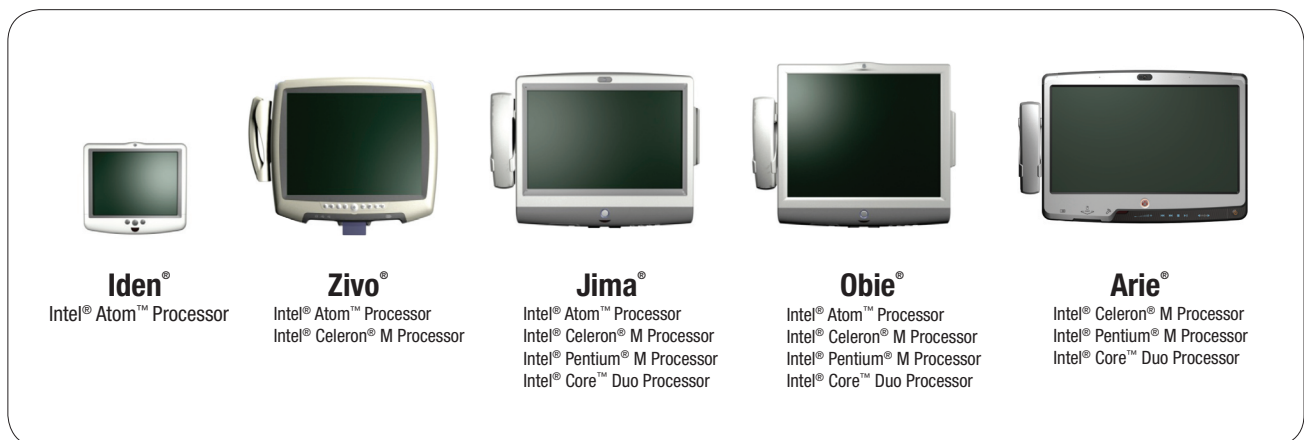


Figure 6. JAOtech's Family of Smart Terminals™ Using Intel® Processors

Smart Terminals, shown in Figure 6, are fanless and feature power-efficient Intel® embedded processors with long life support. Since these Intel® processors are code-compatible, JAOtech can use the same software code base across all its models. This flexibility allows JAOtech to lower development costs and select the right processor to reach specific price performance targets across a family of terminals. Intel processor platforms are also standards-based, which greatly simplifies the task of integrating the latest networking, communications, wireless and security technologies.

JAOtech also works with existing hospital information system (HIS) software companies and third-party integrators to enable advanced functions such as providing doctors access to patient records at the bedside. This secure system can be accessed through many of the terminal's peripheral devices, such as biometric finger print recognition, keyboard log on (wireless or cabled) or an individual code stored on a patient's magnetic swipe card or smartcard. The cards provide access to other terminals if patients are moved from bed to bed and will configure the user profiles for patients if they need to log on to other Smart Terminals. The following key functional requirements are supported:

Table 3. Functional Requirements

High-quality video displayed on a 17-inch TFT touch display
Bedside client architecture based upon embedded Intel® processor with high-performance video playback from built in NTSC/PAL TV tuner, IP multicast feed or hard drive
Fanless design for low noise and high reliability
Integrated IP telephone which provides telephony services
Additional expansion ports on terminal for patient and medical staff peripherals such as keyboards and remote controls, barcode readers, etc.
Optional mounted swipe card reader, which can act as a patient's payment device that gives medical staff secure access to EPR data systems
Built-in speakers with optional headphone connection

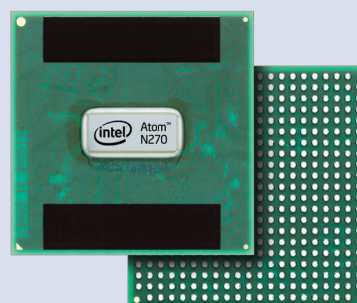
For more information on the JAOtech healthcare solutions, please visit www.jaotech.com.

Additional information about Intel® embedded products can be found at www.intel.com/products/embedded/index.htm.

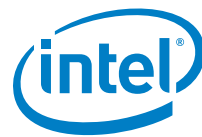
Benefits of Intel® Atom™ Processors in Healthcare Terminals

The Intel® Atom™ processor series delivers the benefits of Intel® architecture for small form factor, thermally constrained embedded applications. Coupled with the Mobile Intel® 945GSE Express chipset, this computing platform supplies the processing performance and features required by small form factor bedside terminals:

- **Low-power processor, 4 watts thermal design power (TDP) at 1.6 GHz**
 - Enables low-cost, small form factor designs
- **512K on-chip L2 cache memory**
 - Decreases medical image render time
- **Integrated graphics, audio**
 - Enhances the video experience
- **PCI Express,* USB support and other connectivity options**
 - Delivers full complement of interfaces for peripherals (e.g., IP phone, barcode scanner and magnetic strip reader)
- **Wired and wireless connectivity**
 - Supports 802.11 b/g Wi-Fi* and 10/100 Ethernet LAN



The Intel® Atom™ Processor N270



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