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Developing a Hospital-Wide Standardised Communications Platform

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Patient monitoring in Heidelberg University Hospital: Creating customised access to information by developing a hospital-wide, standardised communication platform

Hospital networks must perform a range of diverse tasks. They must provide management with the necessary data and information. Nursing and medical personnel should be able to access all patient information and images, preferably at the bedside. They must safely transmit "life-critical" information from the patient monitoring system in, say, the intensive care unit in order to safeguard patients against harm both in the ward and during transport. To this end, hospitals need to have access to wired and wireless networks. Finally, networks must provide patients with Internet access, which becomes an indispensable convenience during their hospital stay.

Historically, meeting all four challenges at the same time proved an insurmountable challenge for hospital infrastructures. As a result, hospitals frequently created a separate network for their patient monitoring systems dedicated exclusively to managing the flow of vital patient data. This approach ensured that staff monitoring a heart patient, for example, would immediately learn of any deterioration in the patient's cardiovascular condition. Establishing separate networks comes at a cost because as well as the existing hospital network, a separate network infrastructure, including telemetry radio antennae that have to be built into walls, must be purchased, installed and maintained. Clearly, therefore, the use of parallel systems generates significant additional costs.

In 2003, when Heidelberg University Hospital commissioned a new 300-bed internal medicine facility, it decided to seek an alternative to the traditional approach of installing separate telemetry-based networks for monitoring acute patients. Plans were drawn up to develop a shared wired and wireless network infrastructure supported by standard components, which would be used as a common platform for all applications.

Realisation

In order to realise the objectives of the plan, the monitoring system used in Heidelberg University Hospital was integrated

into the hospital-wide IP network. In physical terms, this meant using the hospital's existing data network infrastructure, which consisted of both passive components – the fibre optic routes and copper cables – and active components. In contrast to conventional solutions which rely on physically separate networks, the solution adopted in Heidelberg involved logical separation of the monitoring system from the hospital's other data traffic. This was achieved by developing Virtual Local Area Networks (VLAN).

The patient monitoring system was also selected with a view to eventually integrating it in the hospital's DV network. So-called gateways were installed to connect the two separate networks: the monitoring VLAN and the hospital VLAN. A wide range of data can thus flow into the monitoring VLAN through these gateways (patient master and movement data, laboratory results, etc.), while information from the monitoring VLAN can be transmitted to systems within the hospital VLAN (e.g. monitoring and breathing parameters for immediate display or for use in an intensive system).

A similar approach was adopted regarding the use of bedside PC workstations (POC PC = Point of Care PC). Each workstation PC was fitted with two network cards, one for the monitoring VLAN and the other for the hospital VLAN. This allowed staff to continue to access systems on the hospital network (for instance, the hospital information system, labs, PACS and so forth) while patient monitoring data was displayed on the POC PC. A terminal server device (supplied by Citrix) was selected to provide maximum security, minimise maintenance requirements and protect the medical product character of the POC PC. Only the Citrix server's client device is installed on the POC PC and all hospital applications can run

on this system without having an impact on the monitoring system.

In the mobile area, using standardised Wireless Local Area Network (WLAN) transmission technology made parallel use of the WLAN across a range of applications possible. Dual band access points are used for radio transmission in the 2.4 GHz and 5 GHz bands, which allows various applications to be distributed across different frequencies. The 802.11a/h network is available for use throughout the Heidelberg University Hospital, whereas the 54 MBit/s network is reserved for hospital applications only. The 802.11b/g network is used by the monitoring system and to give patients Internet access. Roughly two-thirds of the hospital's wards currently have this type of WLAN coverage.

Guaranteeing secure transmission of vital patient monitoring data through the shared WLAN infrastructure proved a particularly difficult technical challenge. Given the bandwidth limits of the WLAN system, it was of critical importance to guarantee the necessary bandwidth for monitoring to ensure there was no disruption in traffic and to prevent the loss of data.

The following solution, developed in partnership with industry, proved useful. Devices connected to the system via a WLAN card are assigned a specific access point which, in turn, is connected with a layer two switch. The data from this switched infrastructure then flow through a PacketShaper before being routed into the general hospital network. The PacketShaper then assigns specific bandwidth to each of the various traffic categories (life-critical information, clinical applications and non-critical data). This ensures that vital patient data can traverse the network securely and reach their monitoring destination at all times. The VLANs must then ensure logical separation of the various data. All data traffic is routed via an SSL gateway and transmitted in encrypted form, thus further enhancing WLAN security for clinical applications.

Applications

In Heidelberg the same infrastructure currently supports monitoring, clinical applications and Internet access for patients.

Monitoring

A mobile patient monitor with docking station and a POC PC are located at each bedside in the intensive care and intermediate care units. The wired network is used when the patient is in bed and the monitor is in the docking station. In this case, the patient information is routed via the monitoring VLAN to central monitoring and, simultaneously, to the POC PC at the bedside. From here, it is possible to display all relevant information available on the hospital information system (HIS), using the terminal server.

If the patient is mobile – being transported within the hospital – vital data and alarms will be transmitted by mobile monitoring device to the central monitoring unit throughout the period of mobility. This enables patients to be continuously monitored while in transit. Viewed from the other opposite angle, monitoring data can also be retrieved at every PC in the hospital via the gateway (WebView).

Specialist units such as the chest pain team can clarify specific diagnoses in other areas without impacting on the number of treatment places available. Furthermore, it becomes possible to respond flexibly to structural changes under way in areas where monitoring is obligatory, thereby avoiding additional costs.

Mobile Visits

One of the overriding objectives of the process was to support mobile patient visits by providing access to all available hospital data at a single location. In a "standard workplace" this information includes the following applications: the hospital information system, patient data management systems (PDMS) for intensive care, PACS and archiving systems, all of which are available on the Citrix platform.

The advantage of the new system is self-evident: all necessary information is available directly at the bedside. This has proven extremely important in the cases of X-rays, heart catheter imaging and scanned patient records. The simultaneous blanket introduction of a PACS or document management system (DMS) in internal medicine significantly reduced paper use and made the development of online records of all data held on file an urgent priority. To ensure greater clarity, Heidelberg University Hospital has introduced a pilot project in which mobile trolleys fitted with a laptop and a 20 centimetre monitor are available via WLAN to support the mobile patient visits. Not only does the link between the HIS and WLAN benefit medical personnel, but it also simplifies work for nursing and care staff. For example, meals are now ordered using the WLAN system. Nurses equipped with a laptop visit each bed and enter the patient's preferred options, which are then transmitted directly to the kitchen.

Internet Access for Patients

The third application supported by the new system is access to the Internet for patients. As is the case in other public institutions, patients may surf the Internet for a small fee and those availing of this option are supplied with a personal notebook. A separate 6 MBit/s DSL connection is used to give patients Internet access, whereas hospital staff communicate with the outside world using the broadband scientific network (known as BelWü), access to which is restricted to specific user groups. Payment and access procedures are integrated into the existing patient telephone system.

Synergies and Outlook

As well as being cost efficient due to the shared infrastructure, the new system offers a further important benefit in that it provides access to a shared network environment and utilises existing institutional structures and resources. For example, all communications systems in Heidelberg University Hospital – access points, switches and routers – are integrated in a network management system and the various components can be monitored by hospital staff at a central location. As such, the hospital is able to avoid the additional operational expenditures which would be required if it had introduced a separate, dedicated network for monitoring.

Discussions are under way at the hospital on the feasibility of integrating new applications into the standardised WLAN infrastructure. The main items being considered are RFID (radio frequency ID) for secure patient and equipment identification and the replacement of proprietary telephone and internal paging systems with standardised mobile voice communication systems using Voice Over IP technology (VOIP). In this respect, the goal of the Heidelberg University Hospital is to continue to introduce innovative concepts in its information and medical technologies and, in so doing, further enhance the standard of patient care.

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