The Choice of a Commercial Broadband Communication System for ABC4CarE

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Abstract

In order to inquire the hard- and software possibilities for broadband communication applications, an inventory was made of specific solutions for the three main goals of the ABC4CarE project: teleconsulting, teleguiding and teleteaching.

As the project plans for ABC4CarE are maturing, three of these telecommunication applications have been chosen, and a thorough survey was made on the usefulness of the application in each specific situation.

For the Groningen-Leeuwarden X-ray cathlab teleconsulting connection the Philips VISU solution will be used because of the low cost. For the Amsterdam-Alkmaar X-ray cathlab teleconsulting and teleguiding connection, the Lucent MediaBuilder solution was chosen because of the broad spectrum of possibilities. The Rotterdam-Rotterdam echocardiografic teleguiding connection uses a home built application using a toolkit from Berkeley University.

1. Introduction

In the Netherlands, the number of clinical requests for bi-directional broadband Internet connections between cardiology centers is still growing. The need for peripheral clinics to share data with expert centers becomes of current interest now broadband networking applications are reality. Therefore, the networking solutions chosen in the ABC4CarE (Advanced Broadband Communication FOR CARdiology care and Education) project [1] can undergo a second opinion. ABC4CarE is a large ICT project, initiated by the Interuniversitary Cardiology Institute of the Netherlands, in which on-line teleconsulting, teleguiding, and teleteaching is aimed at. Depending on the specific hardware and software in the cardiology departments of joining hospitals, communication solutions are chosen and accommodated for this project. This study has looked into the current state (2003) of broadband communication solutions, fit for current and future ABC4CarE use, taken into account the limiting conditions of the cardiology environment in the Netherlands and the clinical and technical wishes and demands. In a pilot the communication between the VU Medical Center Amsterdam (VUmc) and the Alkmaar Hospital (MCA), between University Hospital Groningen (AZG) and Leeuwarden Hospital (ZNB) will be evaluated for teleconsulting of cathlab X-ray images and teleguiding of echocardiography images from the Erasmus University Medical Center Rotterdam (EUMC) will be evaluated.

2. Demands on the possible applications

At first it should be stated that the term 'broadband communication solution' is somewhat ambiguous. It is possible to look into different levels of communication. At first in the technology domain, there is a basic level (communication media, communication protocols, data formats), an interface level (at what level and how does data transfer between modality and carriers) and a presentation level (what is the end-user software and its user interface). In terms of clinical use, there is a level of connectivity with present medical- and information systems, a level of practical performance (speed, resolution, sound) and the level of user interface.

Above that the ABC4CarE project defines three not necessarily independent goals: teleconsulting, teleguiding and teleteaching/telelearning. It is most likely not possible to select one preferable single application for all three of these goals, but probably it is not possible to achieve one preferred application for one of the goals, either.

To get insight into the total spectrum of clinical and technical wishes and demands, they are stated in such a way that the possibility of multi-vendor solutions is kept open. In order to make the list clear, the demands were delimited to three main aspects of the project:

1. demands on broadband communication protocols between hospitals
2. demands on specific applications for teleconferencing between hospitals
3. demands on specific cardiac viewers and dedicated consulting tools for referring and treating cardiologists

2.1. Clinical demands

A number of important clinical demands for ABC4CarE installations have been defined.

For all three goals the main demand for clinicians is *user friendliness*. The practical use can only be established when clinicians' wishes are looked into. Items like single logon for multiple shared software packages and easy to use applications (already familiar to the doctors wherever possible) are of crucial importance in teleconsulting and teleguiding. Also the *guarantee on data integrity* (are both sides of the line looking at the same image at the same time) is essential. The *security of the data connection* is not only a doctor's wish, but also a legal demand, for which technical solutions like encryption of data and firewalls have to be incorporated into the system. With respect to the shared software it is important that the *use of specific clinical viewing tools* is supported, like DICOM viewers when regarding clinical images. Being accustomed to the viewing software on both sides of the communication line is essential for teleconsulting and teleguiding success. Features like *updating speed* and *image resolution* have to be within practical limits. Using a gigabit network as described in ABC4CarE, it should be possible to have a 'real time' connection even with streaming data in a diagnostic resolution. However, security checks can delimit the broadbandness significantly and medical modalities do not always support these data rates up till now. In most teleteaching connections, data can be transmitted on beforehand; furthermore real time transmission will be rarely necessary. In acute teleconsulting and teleguiding situations however, seeing the data 'real time' mostly is a necessity.

Regarding teleteaching like in a virtual classroom, aspects like *sound quality* become important, especially when bi-directional sound connections are used. This will not only have implications on the software, but on the audiovisual hardware on both sides as well. For teleguiding applications, the time between the end of a scan (e.g. the time between release of the x-ray pedal in a catheterisation lab and the start of the viewing of the recorded run in the other hospital, or the time between ending an ultrasound scan and transmission) is a critical parameter. Items like *storage: local and/or distant* have to be looked into. In general the statement *focus on the patient data, not on the doctors* will have to be obeyed.

2.2. Technical demands

The clinical demands in the previous section lead to a number of technical demands and (im)possibilities. *Security* has to be taken care of using proper encrypting tools and firewalls. *Data speed* has to be monitored and where critical, possibilities of prefetching have to be investigated in case of large studies. *Time synchronisation* has to be established in a reproducible way.

Items like *image resolution* and *sound quality* provide restrictions not only to software but also to the hardware, and can conflict with another, economic, item: *cost effectiveness.*

The *user friendliness*, mentioned first in the previous paragraph, can only exist when *integration with existing software applications and data repositories* is established. Therefore couplings have to be used or built, and wherever possible integrated views on electronic patient records are required. Finally the *stability* of the integral system, application as well as communication part, has to be adequate.

3. Comparison of applications

Last year, telemedicine applications of a number of vendors have been investigated. Looking primarily at the cathlab x-ray modality, both Siemens and Philips had no adequate solutions for teleconsulting and teleguiding till recently. Before last year (2002), Philips stated that Easyweb™ would be the solution for cardiology teleconferencing, and Siemens had an application as well. Both applications however proved to be inadequate for the ABC4CarE clinical demands: no diagnostic images could be transferred (necessary for teleconsulting), and the time between recording and viewing was more than 20 seconds (too long for real time teleguiding). Of all other vendors, only MedCon™ (represented in the Netherlands by Fysicon Inc.) had reasonable telemedicine solutions.

3.1 Available clinical software

For teleconsulting the available clinical software can be divided into two main groups. The first group uses the 'send and view' principle: the information is sent first to the other side, and while conferencing two separate viewing applications are started, synchronized by the send and view 'add on' in the application. The other group can be called 'viewing at once', the viewing application only works at the sending side and a viewing window, or a complete desktop, is copied at once to the distant viewing monitor.

Both approaches have pros and cons. The 'send and view' applications are already in cardiac clinical use, for viewing cathlab X-ray angiograms. However the synchronicity signal is based on proprietary protocols, specific for the application. Furthermore 'send and view' is useless in teleguiding applications. In the 'view at once' solution it appears that sometimes mouse sharing is not working properly. Also the performance as a whole is not always satisfactory, not due to bandwidth but e.g. to local capacity of the sending computers. Furthermore tuning of image quality is not possible, because many applications are constructed not only for broadband Internet (not yet the standard) but also for lower bandwidth, e.g ISDN communication.

3.2 Non-clinical software

In order to complete the list, some non-clinical software tools have been looked into as well. Computer sharing applications like NetMeeting™ (Microsoft Corp., Redmond, USA), PcAnywhere™ (Symantec Corp., Cupertino, USA), freeware like VNC™ (AT&T Laboratories, Cambridge, USA) and protocols like Citrix™ (Citrix Systems Inc., Ft. Lauderdale, USA) share data and applications using computer networks. However, they all have technical and practical limitations, due to the fact that they are not intended to provide real time diagnostic clinical data transfer and communication.

3.3 Comparison of the applications

A specialist cardiac software tool, VISU™ (Philips), one platform for multi-media telemedicine, MediaBuilder[*] (Lucent Technologies) and an RTPtv application built with a specific software tool have been compared. In table 1, an overview is given of these applications, and their fulfilling of the demands stated previously.

VISU™, Philips

Philips has developed a multimedia telemedicine solution under MS Windows2000 for communication, consultation and videoconferencing called VISU™[2]. Especially applications as secure exchange of complex multimedia patient images and data, urgent remote consultations, and full-scale video conferencing using medical images and patient files are declared as the potential of the software. It supports and converts images into DICOM.

The user has to decide whether the system will be used for medical videoconferencing or for acute teleconsulting. Both applications require a different installation.

The system is new on the market (since 2002) and is not yet permanently installed in a hospital setting.

The University Hospital Groningen – Hospital Leeuwarden X-ray cathlab teleconsulting communication connection will be the first one using this application in the ABC4CarE project, because of its low costs and relatively userfriendliness. Installation is expected by the end of this year, the first evaluation will take place within half a year from the start.

MediaBuilder[*], Lucent

In 1998 Lucent has created a software platform for multimedia collaboration. This platform, MediaBuilder[*][3], supports services over a distance. In a client/server architecture, encrypted data streams are handled from client to client without interference of the server. The software is the middleware between the local network devices, multimedia devices and applications.

The VUmc Amsterdam – Hospital Alkmaar X-ray cathlab teleconsulting communication connection is likely to use this application in the ABC4CarE project, because of its broadness and multiple possibilities. Installation is expected by the end of this year, depending on the Alkmaar Hospital's connection to the broadband Internet. First evaluation will take place within half a year from the start.

RTPtv software, Berkeley University

Because of the stricter demands on time delay, for the transmission for teleguiding of echocardiographic data from the Erasmus University Medical Center (EUMC) in Rotterdam no commercial application was found. The solution now in practice is built using a toolkit developed at the university of Berkeley (San Fransisco, CA, USA) using a Linux operation system with real time transport protocol television (RTPtv) software, providing tv over IP[4]. This requires a bandwidth of approximately 20 Mbps for the video and 1.5Mbps for the audio. This provides diagnostic quality of the ultrasound images.

4. Discussion

Comparing the 3 systems described gives a marginal view on the real medical and especially cardiac performance. It was noted that MediaBuilder[*] performed very well in a clinical setting, but was tested only in the scheduled teleconsulting environment. The VISU™ system can be of use in specific cases: best performance is achieved during acute teleconsulting cases, but also scheduled teleconsulting runs quite smoothly. For teleconferencing with larger groups non-medical applications prove to be best performing. Especially the video and audio possibilities of such systems are more balanced and give better performance than web-cam based pc-software solutions.

For the real time teleguiding the only possible option found is the RTPtv software built with the 'Berkeley toolkit', used in Rotterdam.

Table 1. Overview of the three telemedicine applications for ABC4CarE.

	VISU™ (Philips)	MediaBuilder[*] (Lucent)	RTPtv (Berkeley)
operating system	W2000	WNT, 2000, XP	Linux
communication lines	ISDN, LAN/WAN	ATM and IP networks	High speed (100Mbps)
clinical compliance	DICOM, HL-7, HPRIM	possible using good viewers	streaming video grabbing and sending
cardiac teleconsulting	on demand teleconferencing, or acute teleconsulting	especially designed for teleconferencing	no application sharing yet
cardiac teleguiding	not possible	no design goal	yes
cardiac teleteaching	multi- and broadcast possible	virtual classroom possibilities	no
costs (approx, in €) for 4 workstations	12k, excl. hardware	14k, excl. hardware	16k, incl. hardware
clinical installations	a few	1	1
comments	all images dicomized, only 1 viewer	development will be continued	high quality, only teleconsulting

5. Conclusions

For the ABC4CarE project software is going to be tested in three pilot projects. The main goals at first will be scheduled and acute teleconsulting of cathlab X-ray images and teleguiding of echocardiography.

Amsterdam (VUmc-MCA) will use the Metabuilder[*] application for teleconsulting on X-ray images, Groningen (AZG-ZNB) will use the cheaper VISU application. Rotterdam uses the RTPtv (Berkeley) solution for teleguiding.

Special attention will be given to the user friendliness and the stability of the systems. Furthermore all wishes and demands, stated in the second paragraph, will be evaluated during the pilot.

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