

TELEPRESENCE OVER SATELLITE

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Abstract

The utilisation of distributed medical intelligence can contribute significantly to the continuous improvement of patient care and accelerates the qualification process of the medical staff. An efficient way of realisation is the use of satellite networks for telemedical applications, as satellite communication has some distinct advantages over terrestrial communication channels: mesh topology networks, broad geographical coverage, multicast capabilities, etc.. Using off-the-shelf hardware components and a specially designed communication software (WinVicos) various telemedical applications (teleconsultation, telementoring, teleteaching, etc.) have been realized.

Keywords: Telemedicine, Interactive Telecommunication

1. Introduction

The Surgical Research Unit "OP 2000" (Operating room of the Future) has developed and tested several modern interactive telecommunication components in close cooperation with worldwide leading academic and non-academic institutions as well as industrial partners. At present, the operating room of the future in the Robert-Roessle-Clinic does not merely serve to demonstrate the functioning of the new technologies, but at the same time optimisations with respect to ergonomic design and human-machine interfaces are elaborated [1,2].

Modern video-, communication- and computer-technologies have enabled the realization of extended competence networks, which allow students and young and/or inexperienced physicians, although at remote locations, to be trained by experts in a highly interactive way. These training and education possibilities in such competence networks may play a key role in ensuring the quality of medical care in the future. The optimal design of networks for telemedicine should not only meet technical aspects such as transmission bandwidth, delay, data loss, etc., ("Quality of Service") but the networks should also meet the heterogeneous medical requirements ("Class of Service"). Various networks will be presented that are designed to meet demands of different Classes of Service in sufficiently high quality [3-5].

Experience has shown that the goals of telemedicine can only be achieved adequately when a high degree of interactivity is implemented. A very high degree of interactivity is called telepresence. Telepresence includes e. g. remote control of various medical equipment, sufficient transmission quality for teleconsultation (second opinion), telementoring, etc. and allows the remote expert to act as if he was present at the site.

2. Material and Methods

The communication software WinVicos (**W**avelet-based **i**nteractive **V**ideo-**c**ommunication **s**ystem) is a high end interactive video communication software which supplies real-time video-, still-image- and audio-transmission. WinVicos is especially designed for telemedical applications (e.g. telesurgery, teleradiology, telepathology). Up to four video windows can be displayed on the user's desktop simultaneously. Another very useful feature of WinVicos is the use of mouse pointers in every video and document window transmitted to the conference partner. For video compression WinVicos uses a hybrid speed-optimised wavelet-codec (PACC, Patent DE 197 34 542 A1, Deutsche Telekom).

WoTeSa – **W**orkstation for **T**elemedical Applications via **S**atellite is the hardware on which the WinVicos system is operated. The hardware requirements are an IBM-compatible PC with Pentium® IV processor (≥ 3 GHz); 512 Mbytes RAM; an Osprey video capture card (Osprey 100 and/or Osprey 500); a camera with F-BAS and S-Video output as live source (e. g. Canon VC-C4); a second camera as document camera for transmission of non-digital images; standard headset with microphone and small loudspeakers. The video inputs of the Osprey video capture card can be directly connected to the video outputs of the different medical equipment. WoTeSa serves quasi as a medical video hub.

3. Results and Discussion

3.1 MEDASHIP – Medical Assistance for Ships

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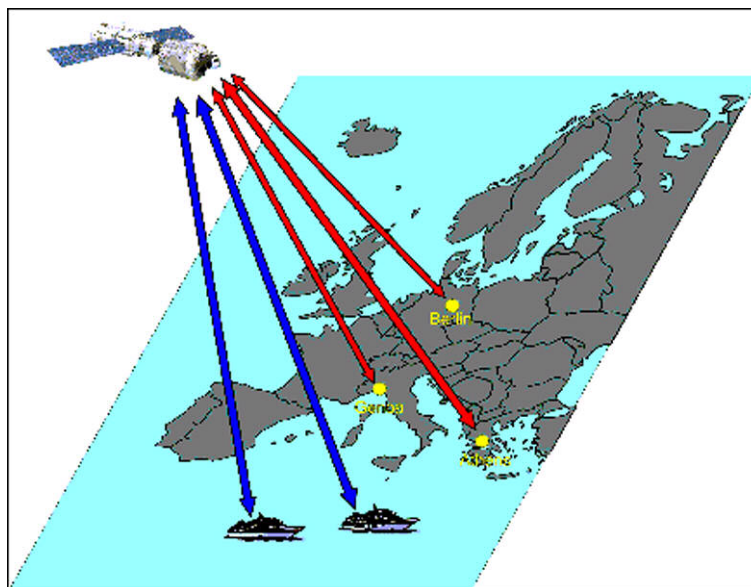


Fig. 1: The MEDASHIP Network

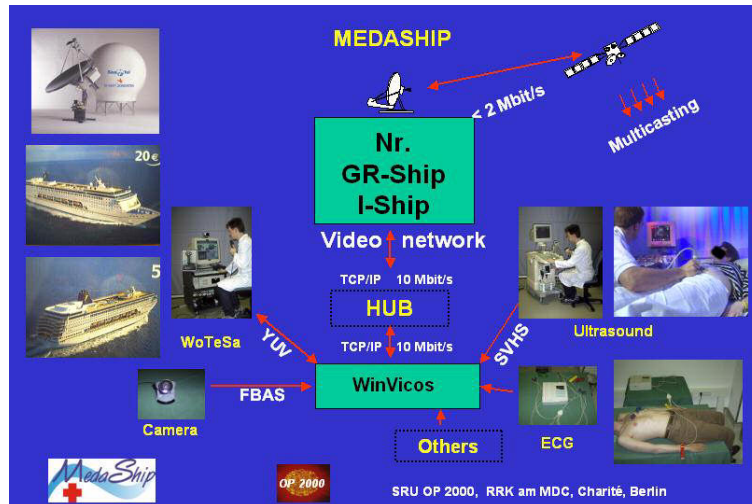


Fig. 2: Connection of different medical equipment in the MEDASHIP system

In **MEDASHIP** an integrated system for telemedical consultations on board of ships was set up and evaluated. Such a system should allow an improved medical care for patients and crew members, probably in a more cost-effective way. In case of medical emergency on board of ships, the usual procedure is that the medical staff contacts the closest support centre via radio and asks for help and advice. However, the medical information that can be transmitted during a radio consultation is clearly too limited for the experts to give valuable advice. Often it is then decided to meet up with a rescue team (e.g. in a helicopter) to have the patient transported to an expert centre for further diagnosis and therapy. This is often accompanied by a forced deviation from the planned route, causing substantial extra costs. During the pilot phase, the ships will be equipped with an ultrasound medical system and an electro-



Fig. 3: Teleconsultation in the MEDASHIP network

cardiograph (12 channels), interfaced to WoTeSa / WinVicos, as well as a satellite terminal (VSAT) on a special platform (e.g. stabilisation of the antenna and satellite tracking). In the course of the project also the integration of existing terrestrial networks will be tested and used to involve other Centres of Excellence. In the project a cost analysis will be performed, combined with an evaluation of both the Class of Service and the Quality of Service. Forensic aspects will also be analysed and juridical protocols developed.

3.2 EMISPHER – Euro-Mediterranean Internet-Satellite Platform for Health, medical Education and Research

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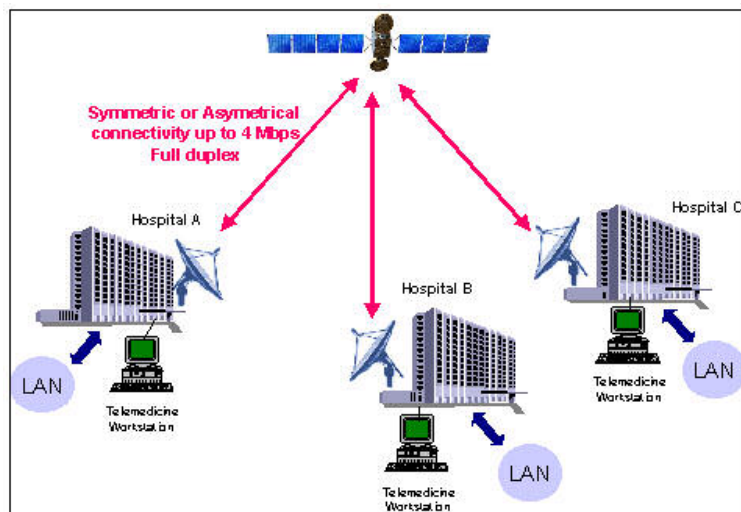


Fig. 4: The EMISPHER Network

The **EMISPHER** project is putting together the cutting-edge European technology, developed in the frame of previous projects, to provide an integrated Internet and Satellite platform, dedicated to health applications and covering the whole Euro-Mediterranean area. Mature satellite technologies, as successfully established in the GALENOS project, can be cost-effective if combined with appropriate internet application services to guarantee the required bandwidth when and where it is required. Thus, the required quality of service (response time, quality of video transmissions and transfer of large medical records, synchronisation of databases etc.) is achieved. Three priority applications are realized :

- e-learning applications to develop the concept of cross-Mediterranean Virtual Medical University (with Teletraining facilities); establish a permanent medical and scientific link and contribute to limit corresponding emigration flows
- real-time telemedicine applications for remote expertise and second opinion and foster cross-Mediterranean cooperation at expert level or for research
- shared management of the medical assistance file in case of repatriation of travellers or expatriates, a service which is expected to significantly contribute to the continuity of care throughout the whole Euro-Mediterranean arc

A network of 10 expert centers (University Medical Schools and leading hospitals in the following countries: Germany, Italy, France, Greece, Turkey, Egypt, Morocco, Algeria, Tunisia and Cyprus) will be permanently interconnected and create a *contribution network* of medical centers able to foster the widest cooperation in the long term. These centers will be equipped with bi-directional satellite terminals enabling a permanent mesh connection between the various regional areas of up to 2 Mbps. It is the intention of the project to extend this network to up to 25 centers, on the basis of public regional or private initiatives.

These centers will work as "hub" centers for a wider network, built on the existing cooperation in the medical assistance area, constituted of 250 medical centers (*distribution network*). These centers will be interconnected, enabling the exchange of multimedia patient record elements and the electronic management of the workflow in relation with medically assisted repatriations. By combining these two networks intimately, a sustainable model for telemedical services in the Euro-Mediterranean area will be evaluated

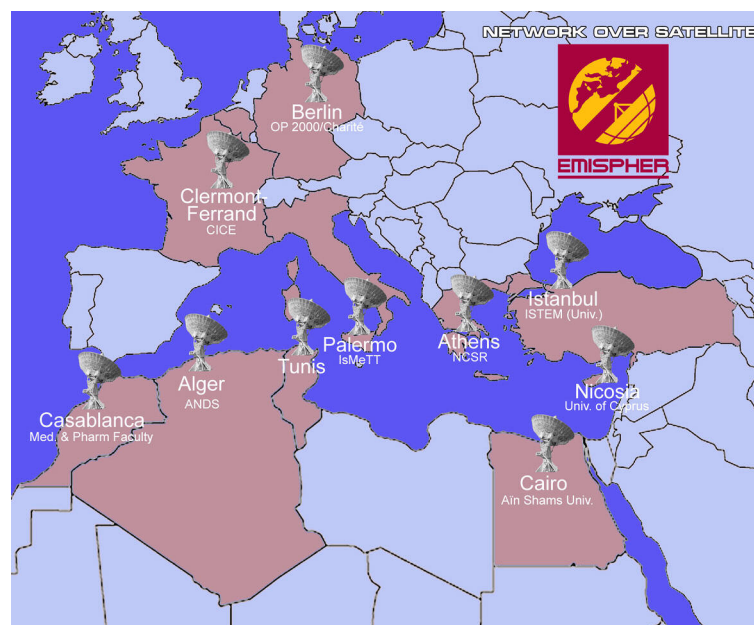


Fig. 5: Expert centres in the EMISPHER project

4. Conclusions

The possibility to get support from external experts, the improvement of the precision of the medical treatment by means of interactive telecommunication systems, as well as online documentation and hence improved analysis of the available data of a patient, will not only contribute to a continuous improvement in treatment and care of patients. Last but not least the use of Teleteaching, Telementoring as well as Telepresence via the interactive networks will contribute decisively to the qualification of the medical specialists.

References

- [1] Schlag P.M., Moesta K.T., Rakowsky S. and Graschew G. Telemedicine – the new must for Surgery. *Arch. Surg.* 1999, 134: 1216-1221.
- [2] Graschew G., Rakowsky S., Balanou P. and Schlag P.M. Interactive telemedicine in the operating theatre of the future. *J. Telemed. Telecare* 2000, vol. 6, suppl 2: 20-24.
- [3] Graschew G., Rakowsky S., Roelofs T.A. and Schlag P.M. Verteilte medizinische Intelligenz in dem EU-Projekt GALENOS. In: A. Jäckel, Ed. *Telemedizinführer Deutschland*, ed. 2001. Bad Nauheim, Germany: Deutsches Medizin Forum, 2001, 269-273.
- [4] Graschew G., Roelofs T.A., Rakowsky S. and Schlag P.M. OP 2000 – Erprobung von telemedizinischen Netzwerken (GALENOS, MEDASHIP, WEBLINC, DELTASS). In: A. Jäckel, Ed. *Telemedizinführer Deutschland*, ed. 2002. Ober-Mörlen, Germany: Deutsches Medizin Forum, 2002, 234-237.
- [5] Graschew G., Rakowsky S., Roelofs T.A., Schlag P.M., Lieber A., Müller U., Czymek R., Düsel W. DELTASS – Disaster Emergency Logistic Telemedicine Advanced Satellites Systems – Telemedizinische Dienste für Katastrophenfälle. In: A. Jäckel, Ed. *Telemedizinführer Deutschland*, ed. 2003. Ober-Mörlen, Germany: Medizin Forum AG, 2003, p. 82-87.