From Telemedicine towards Telepresence

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Introduction

The Surgical Research Unit OP 2000 (operating room of the future) of the Max-Delbrueck-Center for Molecular Medicine (MDC) and the Robert-Roessle-Clinic, University Hospital Charité of the Humboldt University at Berlin has developed and successfully tested modern telecommunication modules in close cooperation with leading university and non-university institutions as well as industrial partners. Modern video-, communication- and computer-technologies have enabled the realisation of extended competence networks which allow students and physicians (e. g. at remote locations) to be trained by experts in a highly interactive way (teleteaching, telementoring, telelearning, teleconsultation, second opinion). For an optimal performance of the telemedical applications the networks and communication tools must be optimized with respect to transmission quality, interactivity, user-friendliness, etc. as well as adapted to the heterogeneous medical requirements.

Method

One of the key modules of the concept OP 2000 is the interactive video communication module **WinVicos** (**W**avelet-based **in**teractive **Vi**deo **co**mmunication **s**ystem) for telemedical applications, training of the physicians in a distributed environment, teleconsultation and second opinion. WinVicos combines the flexibility of IP-based communication protocols with sufficiently high quality of the live video transmission using moderate bandwidths (0,5–1 Mbit/s). The communication software WinVicos has specially been designed and developed for different telemedical applications and provides real-time video, images and audio transmission. The video conference partners can see each other, talk, exchange images and even use remote pointers to point at certain details. Beside the main user interface up to four windows can be shown on the user's desktop: a self-view with the live-source being sent to

Fig. 1: Live intraoperative teleconsultation

the video conference partner, guest-view showing the video stream received, up to two windows showing still-images sent to the partner or received from him. The user can perform standard actions including calling the conference partner and during a connection changing the bit rate, frame rate, video size and microphone and speaker volume.
WinVicos runs on **WoTeSa** (**Wo**rkstation for **Te**lemedical applications via **Sa**tellit) which is an IBM-compatible PC with Pentium® IV processors (2 GHz or higher), 512 Mbytes RAM, an Osprey Video-capture board (Osprey 100 or Osprey 500); a camera with F-BAS and S-Video output as live source (enhanced camera sensitivity in the near IR enables a good picture even under low-light intensities); a second camera as document camera for transmission of non-digital images; standard headset with microphone and small speakers. The analogue video outputs of various medical imaging equipment can be fed directly into the Osprey video capture board. With an enhanced hardware configuration (cascading 1-5 Osprey boards) WinVicos supports the use of up to 15 different medical and non-medical video sources.
Satellite communication has some distinct advantages as compared to terrestrial communication channels: broad geographical coverage, multicast capabilities, etc.. In the projects presented, mainly VSAT-Linkway satellite terminals with LAN interfaces are used for communications with a bandwidth of up to 2 Mbit/s.

Results and Discussion

In the **DELTASS**-project (Disaster Emergency Logistic Telemedicine Advanced Satellites Systems, funded by ESA, in cooperation with: CNES (F); MEDES (F); EADS: EADS-MS&I (F); Alcatel Space Industries (F); SPACEBEL (B); EADS – MOSYS (D)) a disaster scenario was analysed and an appropriate telecommunication system for effective rescue measures for the victims was set up and evaluated. Based on WoTeSa / WinVicos a satellite-based telecommunication system was realised and optimised for the telemedical communication between a Mobile Field Hospital (MFH: at a place in or close to the disaster area) and a Reference Hospital (RH: OP 2000, Charité; at a place outside the disaster area). By providing interactive telemedical communication tools of sufficient quality (in terms of image transmission) medical experts at the RH will be able to give optimal and maximal support in

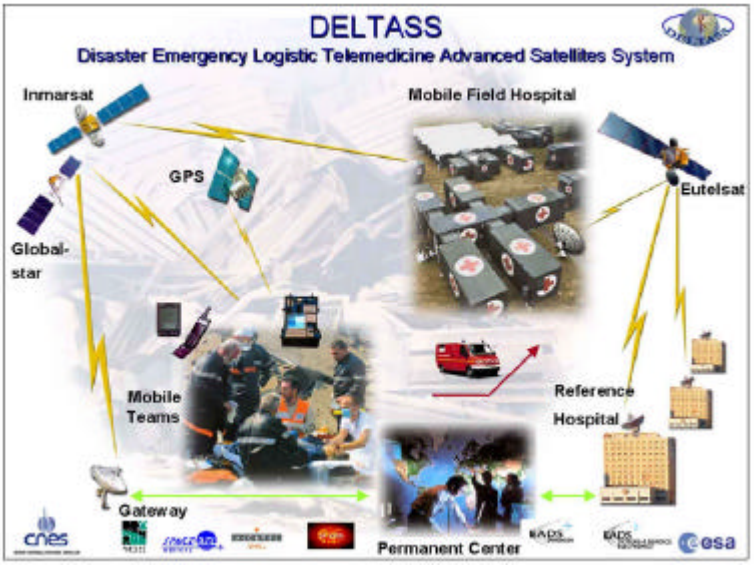

Fig. 2: Satellite-based and terrestrial communication channels in DELTASS

this process. These services consist of off-line and on-line telediagnosis, access to external medical databases, as well as real-time interactive telemedical services such as live teleconsultations, live telesonography, intraoperative virtual reality simulation and interactive telemicrobiology.

In **MEDASHIP** (**Med**ical **A**ssistance for **Ship**s, funded by EU, in cooperation with D'Appolonia (I), CLERT (UK), Eutelsat (F) and NCSR Demokritos (GR)) an integrated system for telemedical consultations on board of cruise liners and merchant ships was set up and is being evaluated. Such a system should allow an improved medical care for patients and crew members, probably in a more cost-effective way. During the pilot phase, the medical centers of the ships are equipped additionally with an ultrasound medical system and an electro-cardiograph (12 channels), interfaced to WoTeSa / WinVicos, as well as a stabilised satellite terminal (VSAT with satellite tracking). In the pre-assigned Reference Hospital (RH) a VSAT-terminal coupled to WoTeSa / WinVicos is used. In the MEDASHIP network every ship can communicate with any RH of the network (mesh-topology). The interactive services being provided include tele-electrocardiography and telesonography. The real costs for this 24-hour telemedical service will be evaluated.

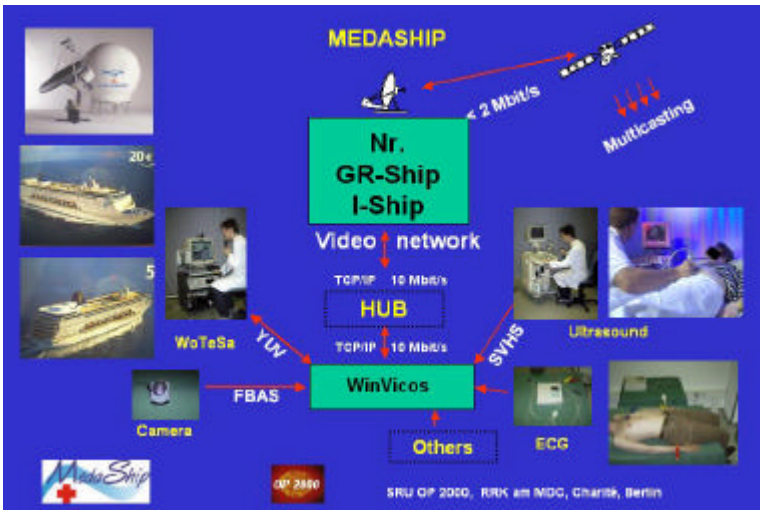

Fig. 3: Connection of medical equipment to WoTeSa/WinVicos in MEDASHIP

Aim of **EMISPHER** (**E**uro-**M**editerranean **I**nternet-**S**atellite **P**latform for **H**ealth, medical **E**ducation and **R**esearch, funded by EU; in cooperation with: Eutelsat (F); Telemedicine Technologies (F), IsMeTT (I), ANDS (AG), EHTEL (B), University of Cyprus (CY), Aïn Shams University and Egyptian Ministry of Health and Population (EG), CICE (F), IMA (F), SEPELM (F), FORTH (GR), Casablanca Medical Faculty (MO), Istanbul Medical Faculty (TU), National Centre for Scientific Research (NCSR) "Demokritos" (GR)) is to establish an equal access for a large number of countries of the Euro-Mediterranean area (France, Italy, Greece, Turkey, Cyprus, Egypt, Algeria and Morocco) to the quality of service which is required for the delivery of on-line services for health care. The EMISPHER network is a hybrid satellite-internet platform.
A network of 10 expert centres (Medical faculties and leading hospitals) will be permanently interconnected and create a **contribution network** of medical centres able to foster the widest cooperation in the long term. These centres will be equipped with bi-directional satellite terminals enabling a permanent mesh connection between the various regional areas of up to

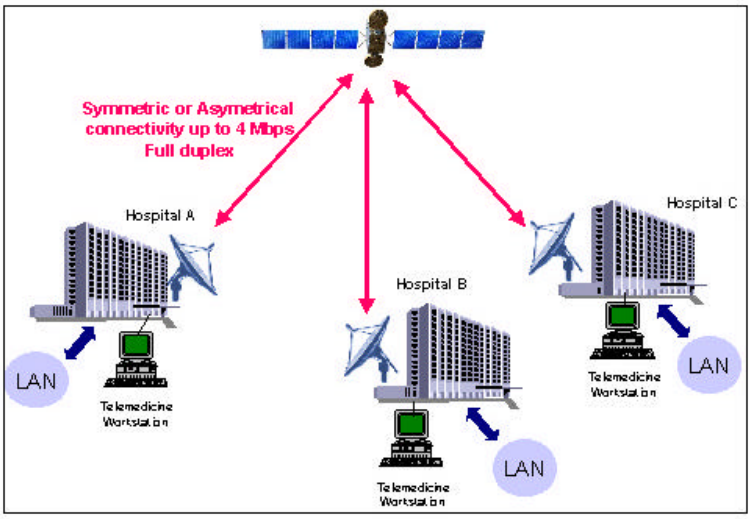

Fig. 4: The EMISPHER network

2 Mbps. These centres will work as "hub" centres for a wider network, built on the existing cooperation in the medical assistance area, constituted of several hundred medical centres (**distribution network**). These centres will be interconnected with down-link-only satellite terminals (512 kbps) enabling the exchange of multimedia patient record elements and the electronic management of the workflow in relation with medically assisted repatriations.
E-learning applications to develop the concept of cross-Mediterranean Virtual Medical University, real-time telemedicine applications for remote expertise and second opinion and shared management of the medical assistance file in case of repatriation of travellers or expatriates will be realized.

Conclusions

The use of distributed medical intelligence contributes decisively to an improvement of health care and to the qualification of medical specialists. By using the interactive video communication software WinVicos telepresence becomes possible serving telementoring, teleteaching and teleeducation.

References

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