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Medical Care from Space: Telemedicine

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‘Telemedicine’ can be defined in various ways, but the underlying concept is based on the simple fact that, thanks to modern telecommunications links, diagnostic and therapeutic medical information can be passed between patient and doctor without either of them having to travel. Initially and for quite a long period, voice communication, via telephone or radio, was used to solicit the opinion of a doctor in the case of an emergency, but the potential of Telemedicine was boosted dramatically by the widespread introduction of modern information and communication technology (ICT) into the healthcare sector. Today we are at the point where the boundary separating Telemedicine and medical ICT is somewhat blurred. The prospect of using satellite communications technologies and associated connectivity services to support even wider application of the benefits of Telemedicine was the reason why ESA began actively pursuing activities in this challenging domain back in 1996.

Activities to Date

The opportunity for ESA to promote satellite communication in the field of Telemedicine with pre-operational systems first arose in 1996 when, in support of the humanitarian mission in the former Yugoslavia, a consortium of space industry and two major Italian hospitals asked the Agency to provide support in setting up a satellite-based pilot communication system between hospitals in Italy and a field hospital in Sarajevo. At that time, a videoconferencing system, developed a few years earlier in the context of the Agency's Olympus Utilisation Programme

diagnosis). Thanks to the availability of satellite broadband connections (384 kbit/s to 2 Mbit/s), the system proved effective in providing video links with acceptable quality and speed to transfer medical images. Medical peripherals such as an X-ray scanner and cameras in the operating theatre were connected to the system, opening new ways to exploit the Telemedicine setup and to provide remote assistance.

In parallel with the tele-consultation activity, a group of doctors from the University of Sarajevo started to use the system as a learning platform, presenting

initial installation, the network of hospitals is still routinely using the system every week.

The Contribution of ARTES

With the launch of the Multimedia Element of ESA's ARTES programme – Advanced Research in Telecommunications Systems, dedicated to promoting and enhancing the competitive position of European and Canadian industry and operators in the field of satellite-based multimedia – Telemedicine quickly became a hot topic for that part of the programme dedicated to the development and



The field hospital in Sarajevo which hosted the ESA Telemedicine Facility from 1996 to 1999

with associated Local Area Network connections, was installed. The possibility to exploit the expertise of medical specialists located hundreds of kilometres away helped to reduce the feeling of professional isolation experienced by the doctors in the field hospital, particularly when faced with medical problems that were new to them.

The Telemedicine system hosted at the Sarajevo field hospital was mainly used to support tele-consultations concerning both military and civilian patients, both on-line (e.g. live video conferences) and off-line (e.g. by sending medical images for later

and discussing clinical cases such as vitreo-retinal surgery techniques and pathology microscope images with medical teachers located in the hospitals on the Italian side.

After the initial running-in period, the system was progressively enhanced and new functions added in response to the explicit needs of the medical community. Two additional satellite terminals and the associated Telemedicine systems were added to the satellite network, one in Pec and one in Tirana. This method of working has been readily accepted, to the point where today, more than six years after the

validation of innovative applications and services.

Between 1997 and 2002, 20 different projects have been undertaken within the ARTES programme to explore and promote the different facets of Telemedicine via satellite, taking a pragmatic approach (see accompanying table). These projects have been targeted at developing the hardware, software and content elements required by the specific Telemedicine applications and then using the resulting system in a pilot utilisation phase with real users and under truly operational conditions.

Telemedicine-related Projects initiated through ESA's ARTES Programme

(with participating countries in brackets)

- Broadband, Highly Interactive Applications: DELTASS - 3D Simulation component (F, D)
- Distributed Environment for Medical Simulation: MULTIMED (UK)
- Emergency Consultation: SECOM (UK), IEMN (CDN), MIST (CDN), DELTASS - Mobile Field Hospital and Search & Rescue component (F, D), TELANY - Emergency component (I, N), I-DISCARE (F, I, N)
- Tele-Consultation: SHARED (I), EUROMEDNET (I), RCST (CDN)
- Clinical Research: WEBGMS (I)
- Access to Patient Multimedia Data Base: HERMES (I), TELANY - Medtronic component (I, N)
- Continuing Medical Education: EMN (CH, D), SANTTSUR (UK), MAYFLOWER (I,N), SM@RT (I), SKYMED (I), HPS In-Surgery and In-Home (UK)



Project DELTASS: the portable terminal used by the Search & Rescue (SAR) teams to fill in the electronic patient record card. The link with the coordination centre is via the Globalstar satellite system



Project SKYMED: the multimedia interface used for the on-line distribution of a course on ambulatory surgery. The signal is transmitted via satellite using the Internet Protocol and DVB-S (Digital Video Broadcasting – Satellite) technology

The inherent global capabilities of satellites make them the most suitable tool for communication applications involving high mobility, emergency and disaster situations, broadband access from underserved areas, multicasting and dissemination of multimedia contents, high capacity and fast deployment for temporary use. For some of these applications, satellites are the only solution. A summary of the particular relevance of satellite communication for the different areas of Telemedicine is given in the accompanying table.

Towards Sustainable Telemedicine

An important aspect addressed by the Telemedicine activities hosted within the ARTES programme is the sustainability of the various operations after completion of the contract with ESA. In this respect, from the very early phase of the programme it was evident that these exploratory activities with new satellite-based applications and services could have ended up merely as demonstrations of new technologies, unable to progress beyond

‘showcase’ status. This risk is particularly relevant in the field of Telemedicine, where a number of operational, organisational and regulatory aspects have a strong influence on what has to eventually become accepted practice within a given healthcare system.

To prepare the different projects to deal with such a risk, strong emphasis was put on ranking the proposed opportunities on the basis of their strategic merits. In a very early phase, therefore, the projects were forced to face the question of how the initiative would be sustained following the completion of the contract with ESA. In pursuing this challenging objective, all of the Telemedicine-related projects have foreseen from the outset strong participation by the user community, as a representation of the target customer base to which the system will be exposed in the pilot utilisation phase.

Of course, a number of critical factors are still to be resolved before Telemedicine can be deemed a consolidated opportunity, of which three seem to play a major role. The first is the lack of coordinated and

solid regulation at international level concerning Telemedicine services. The second is the fact that costs incurred for accessing Telemedicine services are not eligible for reimbursement by the national healthcare systems (with very few exceptions, such as Norway). The third is the lack of a clear process of certification for distance-learning systems, to validate the credits required by the Continuing Medical Education programmes, which are becoming mandatory in many countries.

It is only matter of time before these questions will be sorted out, by which time the mechanism, the technologies and the services for Telemedicine must be in place. This is why ESA’s role is both crucial and timely in providing the opportunity for such ventures through its ARTES programme.

Some Lessons Already Learned

Although each ARTES project explores a particular strategic opportunity in Telemedicine, a number of recurring critical features would seem to characterise the current situation of Telemedicine as a whole. They can be summarised in terms

of the following lessons learned:

- Telemedicine is still at an early stage of maturity. The process of gathering the user requirements has in many cases to be assisted by a process of awareness-building devoted to preparing the user community for making the most of the Telemedicine opportunity.
- Telemedicine brings changes in the organisational environment of any healthcare system. As these systems are often already very complicated, Telemedicine can be successfully introduced only if conceived and proposed in a proper context, and not imposed on the basis of a technological push.
- In essence, Telemedicine is primarily an information flow between healthcare professionals. As such, it should not try to impose new communication paths, but rather enhance and empower the existing ones.

The Next Step

Telemedicine is an innovative field of application where satellite communications can play an important role, and where associated technology, applications and services can quickly be turned into concrete benefits for mankind. In this respect, the several activities launched within ESA and the European Union have already contributed to the process of bringing Telemedicine from demonstration to operational reality. Such realities have not only to coexist with, but also to become part of the ‘traditional’ healthcare system.

The integration of Telemedicine into the working environment of healthcare professionals can only be pursued through an intensive process of awareness building among the user community and the stakeholders in the healthcare system. The projects launched so far have provided a

valuable contribution in this direction and have allowed us to identify and explore new technical solutions and applications with the clear potential to become part of the future Telemedicine practices.

ESA Telecom is continuing to play an active role in encouraging and promoting the use of satellites for Telemedicine. A Symposium at ESRIN in May 2003 will bring together communications specialists and healthcare professionals to review the current status of satellite-based Telemedicine services and technologies in monitoring, diagnosis, therapy and medical education, and to identify possible guidelines that should be taken into account in defining future programmatic actions for the further development of Telemedicine via satellite.



Satcom Aspects	High Mobility Communications in Emergency and Disaster Situations	Broadband Access from Underserved Areas	Multicasting/ Dissemination of Multimedia Contents	High Capacity/Fast Deployment for Temporary Use
Telemedicine Areas				
Broadband, Highly Interactive Applications		+	+	++
Distributed Environment for Medical Simulation			++	++
Emergency Consultation	++	+		+
Teleconsultation		++		++
Clinical Research			+	
Access to Patient Multimedia DataBases	+	++		
Continuing Medical Education		+	++	

Relevance of satellite communications in different areas of Telemedicine: + important, ++ decisive