Telemedicine with High Quality Moving Image by DVTS between China, Japan and Korea

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Telemedicine with High Quality Moving Image by DVTS between China, Japan and Korea

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Abstract

We have established a medical network between China, Japan and Korea with high-quality moving image with Korea-Japan Cable Network (KJCN), a submarine optical cable between Busan and Fukuoka. Broadcasting real-time surgery and teleconference with medical-quality videos with Digital Video Transport System (DVTS) were useful to learn surgical techniques and other medical procedures beyond the geographical border. In this project, we have conducted 22 events mainly between Korea and Japan in categories of teleconference (8 times), live transmission of medical procedure (7 times), and remote attendance to scientific medical meetings (7 times) until the end of Oct. 2004. On 12th Oct. 2004, we connected to Tsinghua University in Beijing, China, to have a first medical video teleconference with China in 5th Distance Learning and Internet in Association of Rim of University. With these experiences and current achievements, we hope to extend this advanced network system to whole Asia-Pacific countries to share medical skills and knowledge.

1. Introduction

Medical care level in Asia- Pacific area is varied among countries because of a disparity in economic power and differentials in policies, religions and customs. The medical information does not distribute easily beyond the borders, and we usually are not aware of even the existence of the differentials in

medical care. The distribution of medical information with Internet beyond the borders makes medical staffs keenly aware of the differentials, and uncovers the relative advantage and disadvantage in the medical field in each country. By remote inspection into the hospital through internet, medical doctors can confirm the advantage of the new techniques and technology before they induce them into their hospital with a heavy cost. Additionally, in the case of outbreak of emergent infectious disease as SARS, or terrorism with bio/ chemical weapons in Asia-Pacific area, we can grasp the real sense of the strange symptoms from remote area to prevent spreading the disease in the area and to prepare of the care for sufferers. For these purpose, we have been establishing the Asia-Pacific international medical network with medical quality moving image by information technology (1).

2. Materials and methods

The Hyeonhae/ Genkai project was established to use the Korea-Japan Cable Network (KJCN) for development of informatics research and friendship between Korea and Japan in 2001 (2). As a subproject of the Hyeonhae/ Genkai project in medical field, we started to use KJCN for medical teleconference and remote medicine.

Network configuration

Figure 1 Network configuration in the project

As shown in Fig. 1, we used several networks to connect to institutes in the Asia-Pacific countries.

We used QGPOP between APII Genkai NOC and Kyushu University both in Fukuoka, Japan. Two KJCN cables lay submarine between Busan, Korea and Fukuoka/Kitakyushu, Japan. The distance between Busan Landing Station and Fukuoka APII Genkai NOC is about 300 km. We used Korea Advanced Research Network (KOREN) between Busan and Seoul area (Seoul and Gayang) (3). From Busan to Beijing, we used KOREN and China Education and Research Network (CERNET). To the Tokyo station (National Cancer Center office), we used APII from APII Genkai NOC, and to the Honolulu and Cairns, we used the APAN line from Tokyo.

Terminal systems organization

We set up teleconference system and streaming system of recorded video image with bi-direct transmission using Digital Video Transport System (DVTS) on internet protocol on the network described above. DVTS is an open source free ware supported by WIDE project (4).

3. Results

Our career of the Asia-Pacific medical network development

We connected the first network between Hanyang University in Seoul, Korea and Kyushu University Hospital in Fukuoka, Japan on 12th Feb. 2003. We used e-learning system with auto-chatting system and exchanged opinions with paramedical staffs in each side.

The second network was connected between Korean National Cancer Center in Goyang, Seoul and Kyushu University Hospital on 25th Jul. 2003. In this time, we used cipher system (C4-VPN, Focus systems Co.) for internet transmission to protect patient's privacy, because we used a live image of a patient. In the meeting of Asia-Pacific Association of Medical Informatics (APAMI) 2003 in Deague on 21th Oct. 2003, which was cosponsored with CJK-MI2003, we remotely attended the meeting from Kyushu University Hospital through the network and made a remote lecture (Fig. 3).

Figure 2 The APAMI2003 venue in Daegue.

In the meeting of the 17th Asia- Pacific Advanced Network (APAN) in Honolulu on 29th Jan. 2004, we conducted a medical teleconference among three countries with 4 stations (Seoul, Fukuoka, Tokyo, Honolulu) by unicasting from Meinohama iDC in Fukuoka. As the Tokyo station, we connected to Hamanomachi office of National Cancer Center, Tokyo. In this case, we used internet protocol version 6 between Meinohama iDC and Honolulu venue (Fig. 3).

Figure 3 Telemedicine among 3 countries with 4 stations (Seoul, Fukuoka, Tokyo, and Honolulu). The figure is Fukuoka station in the 17th APAN-Honolulu.

On 7th Jul. 2004, we attended remotely to the symposium of Network Organization of Research and Technology in Hokkaido (NORTH) in Sapporo Medical College in Sapporo, Japan from Kyushu University Hospital. Ewha Woman's University Hospital connected to the network on 12th Jul., 2004 and had a teleconference about robotic surgery with Kyushu University Hospital. In the meeting of 63th Japanese Association of Cancer in Fukuoka on 30th Sep. 2004, we got a remote lecture of pathology by Prof. WH Kim in Seoul National University from Korean station (National Cancer Center). In this event, Kyushu University Hospital, which is 3 km apart from the meeting venue, provided the microscopic image of HDTV with MPEG2 compression. Our first telemedicine with China was conducted on 12th Oct. 2004. We connected between Tsinghua University in Beijing, China and Kyushu University Hospital by lines of QGPOP-KJCN-KOREN-CERNET (Fig. 1). We discussed with surgeon from General Hospital of People's Liberation Army, Beijing, about the recent endoscopic surgery in each country.

Figure 4 The first telemedicine between China and Japan in the project. The figure is the Chinese station in Tsinghua University.

We had several other events with Hanyang University Hospital and Korean National Cancer Center except for the events described above, thus, total number of the formal telemedical events in the project is 22 at the end of Oct. 2004 (Fig. 5).

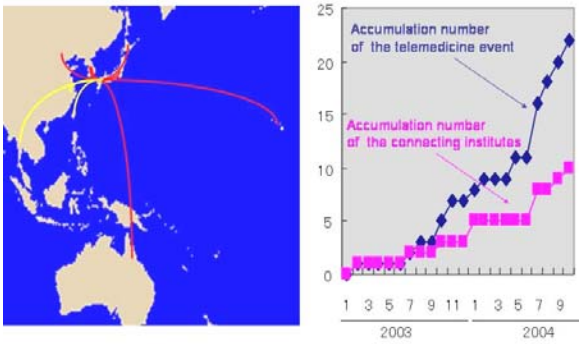

Figure 5 Extension of the medical network in Asia-Pacific area until end of Oct. 2004 (the red line in left figure and the both lines in right figure). We are now planning the first telemedicine with Daejon, Korea (Nov. 2004), Bangkok, Thailand (Jan. 2005), and Taipei, Taiwan (Mar. and Jul. 2005) (the yellow line in left figure).

We had transmitted live image of medical staffs in conference room or meeting venues, the live image of endoscopic surgery/ microscopic surgery/ ERCP procedure/ microscopic pathological image, and recorded digital video of endoscopic surgery/ robotic surgery in the Asia-Pacific medical network. For the teleconference, the image of the attendant was transmitted to both directions through the other line. The attendant discussed each other on the medical

system/ medical procedures (techniques, equipments, etc.) for one hour to eight hours at each conference.

The transmission of moving images with two lines of DVTS over Internet protocol was successfully performed. The patient history and preoperative images were also shown with still-images. The quality of the image was as good as the original digital video. The surgical anatomy was correctly identified and the procedures were well understood. The frame rate of 30 per second was obtained, and the movie was smooth and not sluggish. The sound was clear, however, there was jittering during the entire course by packet loss.

The time delay was less than 0.3 sec between Korea and Japan, and about 0.5 sec between China and Japan, what made no stress for discussion by each endpoint.

4. Discussion

We are extending the medical network with DVTS on internet protocol in Asia-Pacific area. The number of the events and the connecting institutes are increasing rapidly in the past 1.5 years (Fig. 5). From our experience, we have understood that DVTS has several advantages to be used in broad-banded medical network.

1. DVTS is open source free ware and we can download it from Web site (4). We just need to prepare only two PCs with DV port and a commercially available digital video camera before we use it in each end terminal.
2. For medical use purpose, the image should have high quality. DVTS can transmit high quality moving image (SD level).
3. Because of no compression in DVTS processing, it produces only short delay, which is enough short to discuss in natural way. We want to avoid another stress with the language problems in discussion with foreigners.
4. We can make multi-channel with DVTS contents easily. In telemedicine, we like to use information of multiple sources.

On the other hand, DVTS has also disadvantages as below.

1. DVTS needs 30 Mbps as transmission bandwidth to send full frame for a single channel. We have a limitation to extend the network by the available bandwidth in the area.
2. DVTS has a little complicated human interface to be used by the medical staffs. Thus, we have always needed engineering supports.
3. DVTS supports transport of high quality moving image, however, the transmitted sound has not been cared much. Packet loss makes jittering noise.

At the end of Oct. 2004, there has been no major communication/ ethical problem so far.

Because of political boundary, medical communication was difficult among Asia-Pacific area in spite of their close location. By using this new medical network system, we can communicate and exchange medical information over the national border with minimum stresses. In contrast that the knowledge of medical science is uniform and can spread via one-way transmission, information about medical techniques and healthcare concept are often unique in local regions and vary in areas and areas. The present system will help to remove a barrier of medical communications and to standardize them using high quality moving images.

We have established high-quality video transmission system over Internet protocol among Asia-Pacific countries, which is easy to perform, reliable and economical. On the basis of the current results, the minimal requirement for digital video transmission for telemedicine is 30 Mbps with DVTS per channel. This will be a promising and very helpful tool of network for the regional and worldwide remote medicine in the future.

5. Footnotes

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