Evaluation of the Network Quality at International ATM test-bed - International Network Demonstration at APEC TELMIN 3 -

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Abstract

The 3rd APEC ministerial meeting on the telecommunication and information industry (APEC TELMIN3) was held in Singapore in June, 1998. This demonstration was performed using IP over ATM test-bed between Singapore and Japan. 'Isabel' was selected as the basic interactive video conference tool, and several medical application was also performed in it. The bottle neck of network was detected using network performance bench mark test 'pathchar'. It pointed out the IP layer packet loss of this link. In order to monitor the real-time quality of service of this link at the real performance at TELMIN-3, we used the ICMP echo, that enabled monitoring the decreasing of the Quality of service for the video conference system, with elongation. It was suggested that the icmp packet loss and RTT elongation was useful for prediction of loss.

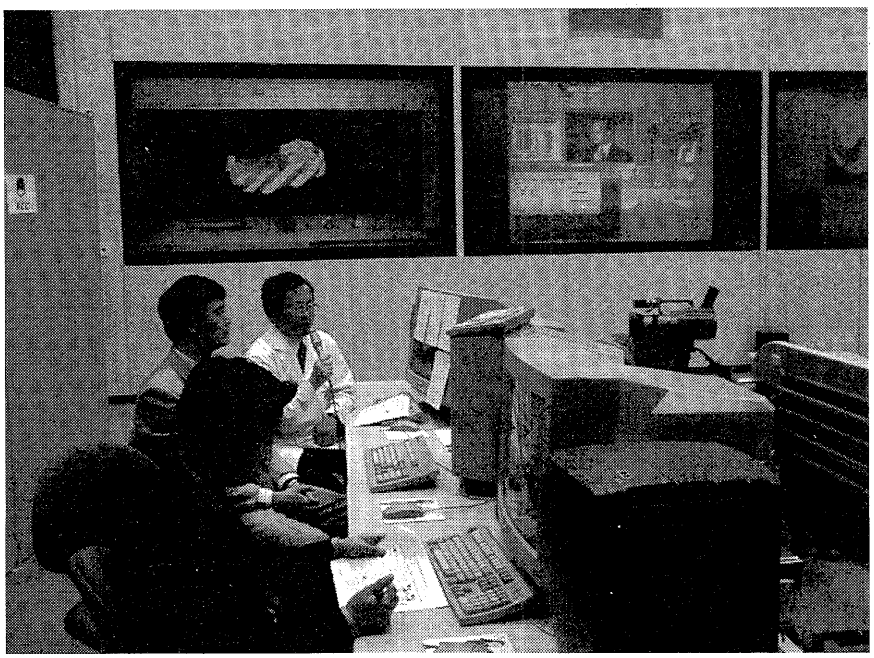


Fig. 1 : Photograph of Demonstration Japan Side(CRL)

Introduction

The 3rd APEC ministerial meeting on the telecommunication and information industry (APEC TELMIN3) was held in Singapore in June, 1998. The APEC committee planned the demonstration program for suggesting and promoting the images of telecommunication and information industry in near future of APEC area at TELMIN-3. The subject for this session was arranged for several field of telecommunication and industry, i.e., tele-education (Canada), tele-medicine (Japan and Singapore), tele-work (social infrastructure, US) and electronic commerce (Japan). The special team was organized. The special team consisted of the Internet networking engineers, staffs for configuration, officers for making scenario and demonstrators. The mission of our team was the demonstration of tele-medicine. This demonstration was fundamentally different from the usual Internet demonstrations, in the meaning of required for reliability of networking. Fortunately our demonstration was succeeded. The fig.1 demonstrates the situation at that time. In this paper, authors report the result examined about the problems of a network at this demonstration.

Materials and Methods

Backgrounds

As it is showed in table 1, the preparation of demonstration was processed. Not only because of the international governmental collaboration, but networking scientists and medical, the negotiation process required the hard negotiations. It was quite different from the usual demonstrations and events, it was proposed the ministerial matter, details of script were not fixed until the real performance.

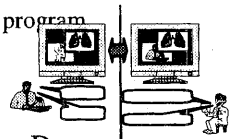
Process of Setting up

The demonstration was planned by the APEC-TEL committee. The purpose of it was to promote the telemedicine in near future. After the long discussion for the selecting the applications from the large amount of medical field, the committee selected the direction of the script on the telemedicine for cancer diagnosis and treatment. The script team was organized for forming the consensus for the details of the technological and medical details. As it is showed in table 1, this process was promoted. In this process, the difficulty of the first step was occurred. In initial term, this international team could not make the face to face meeting.

Table 1: Outline of Preparation

Date	Events Agenda	Place	Members
January	Decision for Theme: telemedicine	APEC	APEC Committee
March	Rough Sketch of Script.	Tokyo	CRL and NCC
April	Face to face meeting for demonstration	Tokyo	CRL, NCC, MPT, NUS, Singapore Gov.
	Machine and software		CRL, NCC, MPT, NUS, Singapore Gov.
	Network configuration		CRL and SINGAREN
	IP over ATM		CRL and SINGAREN
	Script outline		NCC-Japan, NUS
April	Script details	E-Mail	All members
	1st draft of script		
May	Network configuration	Tokyo, Singapore	CRL
	ATM and IP router setting up		
May	1st trial for machine configuration	Tokyo, Singapore	CRL and MPT
	Real time Video conference: Failed		
May	Machine preparation	Tokyo	CRL
June	Machine and Network install.		
	Rehearsal –1	Tokyo, Singapore	Singapore
	Press release	Singapore	

Table 2. Outline of Script at TELMIN-3 Demonstration on Telemedicine.

Video Conference tool	Applicati on	Roles of demonstrator	
ISAVEL		Singapore site	Japan site
		Opening Remark by Japanese Minister (1 min) Introduction by Japanese Senior Official (5 min) Introduction of the participants(2min)	
		Hello, Hello,...	Hello, Hello,...
		How the system could improved health care in the APEC community Typical Case Scenario and Demonstration Background explained by Dr. from singapore (2 min) Tele-consultation between Dr in Singapore and Dr. Japan via J-S link (6 min)	
	VRML and Medical application program	 Dr.	Dr.
		Video tape screening of tele-surgery from Singapore Closing Remark by Japanese Minister (1 min)	

The face to face meeting with Japanese and Singapore team at middle of April contributed the promotion the embodiment this project. In this meeting, the basic objects were determined.

They selected the ISABEL as the video conferencing tool for the interactive communications between Japan and Singapore. At the same time, the medical application program that is written with

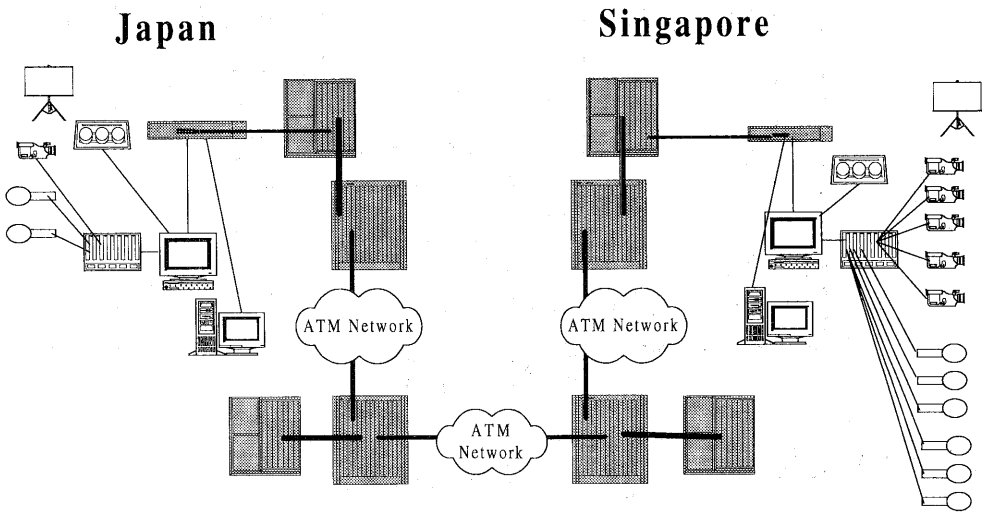


Fig 2. Network Configuration

VRML for the three dimension navigation system for surgical operation. And they also selected the CT automatic detecting program, for the cancer diagnosis. Using these two medical application programs, the outline of script was devised, which appears in Table 2.

Results and Discussions

Network Confiuration

This ATM network is based on the APEC-APII testbed, which is provided by Ministry of Posts and Telecommunications, Japan. Following the selected video conference systems as ISABEL, the network team configured the point to point with IP based connection over ATM network. The network configuration for this demonstration was determined as Fig 2.

Detecting Bottleneck of the Network

At the first establishment of the IP connection, the test with SGI-O2 workstations, using 'ISABEL' was failed. Because of the ISABEL communication windows froze at Japan side. For detecting the bottleneck of network, the performance test was performed using 'pathchar' alpha version written by Van Jacobson at LBL at 1998. The benchmark result is enumerated in table 3. It was suggested that we had 24 percents IP packet loss on that link. We checked from the physical layer as the beginning by the cooperation of telecom carriers on the full route. Because we could measure the packet loss only from the application layer, the measurement only from that layer only suggested the phenomenon –"IP

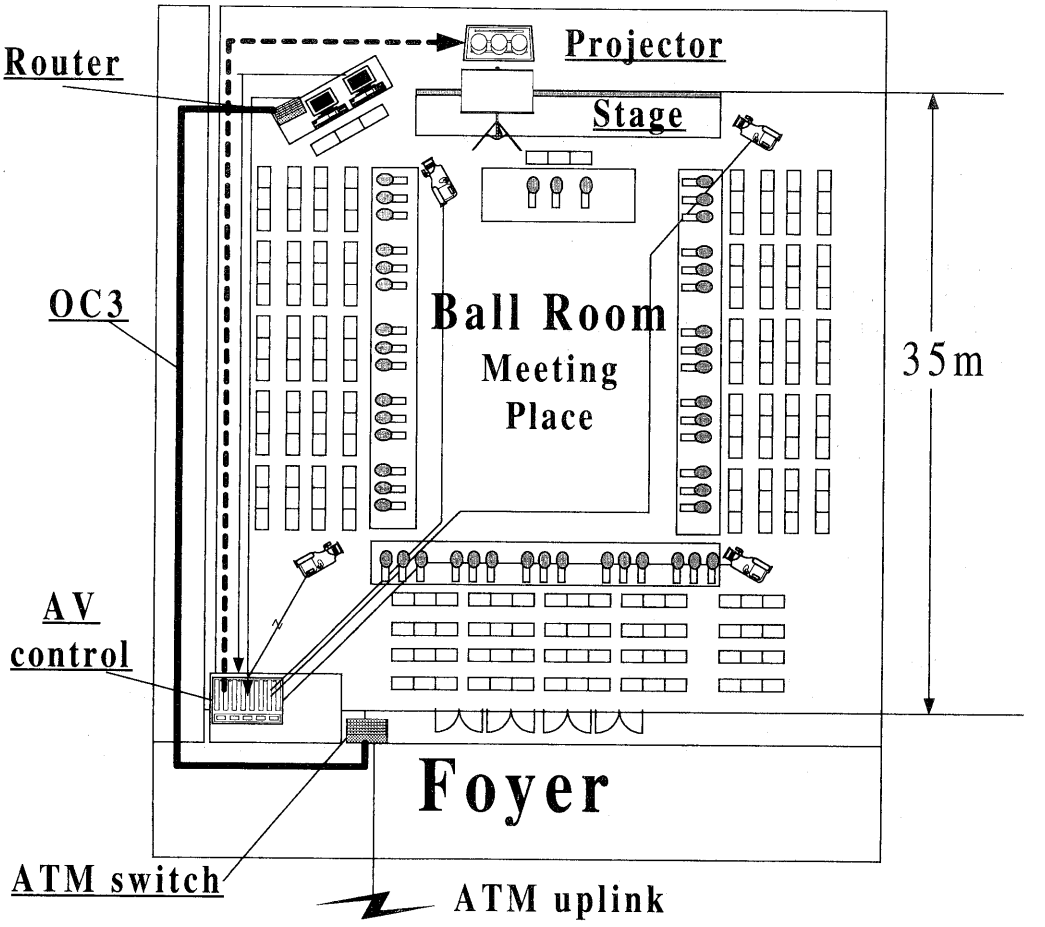
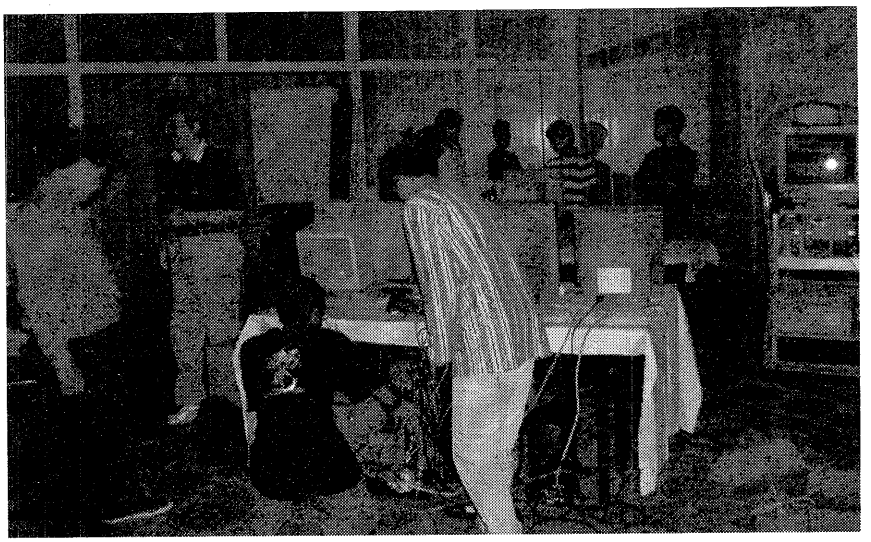
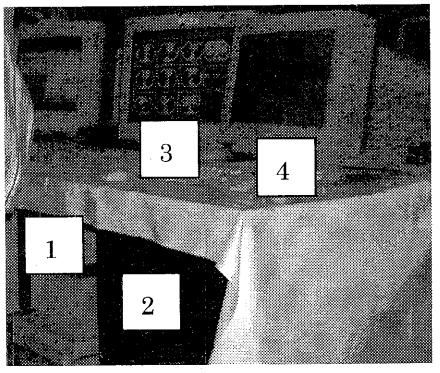


Fig3 : Configuration at the Meeting Place.



4a: Intstallation at the meeting



4b: Set up Condition.

1: UNIX WS for video conference
2: Router
3: Workstation console for ISABEL
4: Console for Medical Application.

Fig 4. Installation at the Meeting

packet loss existed", thus we had to confirm the layer 2 with the "rule out" method. This strategy was the worst. The telecommunication-carrier could not be the causes of these kinds of trouble. However the operators or end-user could measure only from the application layer. Thus, it was the most useful information that the ATM layer information. We had two company telecommunication carriers for this link. As expected, the ATM layer test suggested the ATM cell loss did not exist at this link. The IP operators tried to tune up the router configurations with the heuristic strategy, they could not neglect the packet loss until the real performance. Thus, the network team tried to monitor the ICMP-packet loss with running the 'ping' for the detection of SERIOUS changes of the networks. If the serious change of network link including packet loss might occur, any alternative methods for keeping the continuity of demonstration would take place instead from the demonstration methods with network. It was the warranty for these kind of demonstration matter.

Installation and configuration at the meeting place

The wiring configuration at the meeting place appears in Fig3. The situation of installation at the meeting place appears in Fig. 4. The size of meeting place was 34m x 34m large, there is over two hundred seats for the official delegates from each country. The AV console concentrated the microphone on the seat of each official. They used 4 to 5 (including portable one) NTSC based Video cameras with cables, all of the cables were connected into the AV console. They also inserted the Video image distributing box between each workstation and display. These box sent the all screen images into the AV console as the NTSC signals. The AV operators

Table 3: Measuring Results of IP packet loss of full routes, Japan to Singapore.

No of Hops	Distance(Km)/ materials	RTT(ms)	Objected Throughput(Mbps)	IP Packet Loss(%)
Japanese demo-machine	SGI-O2			
	10m, Ether switch(10BASET)	2.47	7.8	0
CRL router	CISCO 7505			
	30Km, ATM (40Mbps)	5.5	8.4	24
Tokyo	CISCO 7505			
	3300 miles, International ATM link (8Mbps)	81	7	0
Singapore-gateway	CISCO 7505			
	less than 10Km, ATM link	82.6	11	0
Meeting place	CISCO 7505			
	OC3	83.9	10	0
Singapore demo machine	SGI-O2			

switched the images from each camera and sent the concentrated image to the screen on the stage. These audio and video environments were provided by the event-specialist at Singapore.

Real-time QoS monitoring with ICMP

As an initial trial for monitoring the quality of service, the authors proposed the ICMP based system, which is showed in Fig. 5. The result of measurement at the real performance at TELMIN-3 appears in Fig.6. Fig. 6a is the trend of RTT (round trip time) between the measuring machine (PC with FreeBSD 2.5.1.) with following official script at table 2. For the evaluation of IP packet loss, we calculated the cumulative packet loss rate with following formula.

$$cPL(t) = \frac{(nPs(t) - nPr(t))}{nPs(t)} \quad (1)$$

Where cPL is cumulative packet loss ratio at time t. nPs(t) : number of sending packet to distination host. nPr(t) : numbers of receiving packets.

The calculated trend of cumulative packet loss ratio is shown in Fig 6b at the same time trend as 6a. It is suggested that the IP packet loss ratio increased with the streaming traffic due to ISABEL and decreased with the end of streaming data traffic. From this result, this analytical method is useful for the QoS evaluation of IP layer transport.

Conclusions

The 3rd APEC ministerial meeting on the telecommunication and information industry (APEC TELMIN3) telemedicine demonstration was performed using IP over ATM test-bed between Singapore and Japan. Demonstration was performed using the video conference system sending stream-type data transfer. 'pathchar'. pointed out the IP

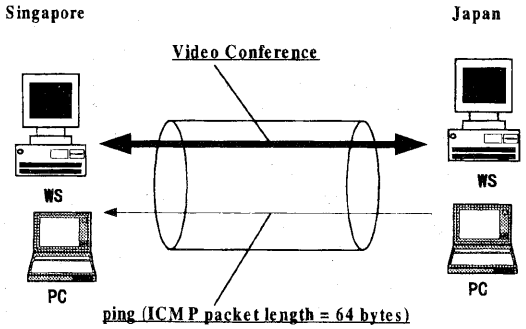
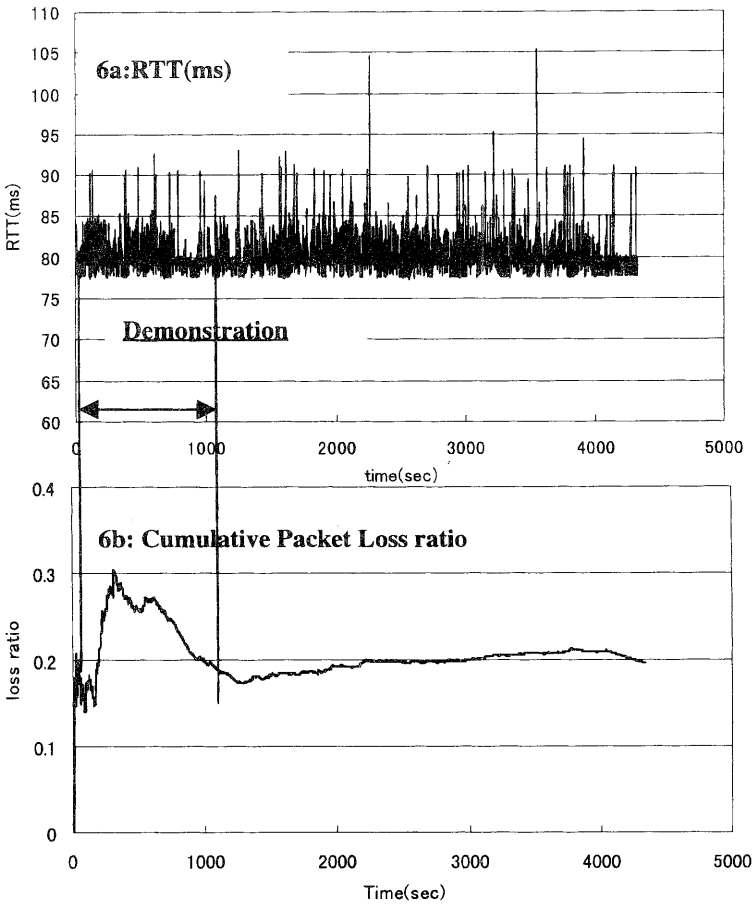


Fig.5: ICMP Based Real time Network Monitoring System at TELMIN-3

Fig 6: Results of Measurement for Qos Evaluation at TETLMIN-3



layer packet loss of this link. In order to monitor the real-time quality of service of this link at the real performance at TELMIN-3, we used the ICMP echo, that enabled monitoring the changing the Quality of service for the video conference system, with elongation. It was suggested that the icmp packet loss and RTT elongation was useful for prediction of loss.

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