A study on Improvement of Bandwidth Efficiency to FSS Internet with Spoofing and Cash Function

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Abstract—This study performed five methods of tests and measurements to verify the improvement of connection time and bandwidth efficient of FSS (fixed satellite service) TCP/IP network by means of the cash function and the spoofing function. Tests and measurements are performed with; 1. Not to apply the cash and spoofing function 2. Apply the cash function 4. Apply both cash and spoofing function in HUB station and VSAT 5. In a typical commercial terrestrial Internet with LAN. The study results in this paper show that application of the spoofing and cash function greatly improves the bandwidth efficiency to FSS TCP/IP Internet service.

Index Terms—FSS, satellite network, spoofing, cash function, HUB, VSAT, bandwidth

I. INTRODUCTION

This paper describes the results of tests and measurements performed by means of four categories of satellite Internet and one category of terrestrial Internet. The purpose of the test and measurement is to verify the effectiveness of the cash function and the spoofing function in satellite communication. Traditionally INTERNET services in GEO satellite communication system have been provided by unidirectional satellite link (down link) as Fig. 1 to overcome the transmission delay caused by long distance from earth to space and to save the uplink equipment cost etc.

Recently the satellite INTERNET market rapidly has been decreased with the increase of terrestrial xDSL subscriber as Fig. 2 and Fig. 3 We suggest that the main reason is that traditional low speed telephone INTERNET subscriber lines have been changed to the high speed xDSL and then the existing satellite INTERNET subscribers using telephone line to uplink have been changing to use xDSL. On the other hand, the RF component price in the transmitter part gradually have been dropped with spanning of RF equipment market and developing of RF technologies. KT (Korea Telecom) and Information & Telecommunication Institute of Hansei University (HITRI) have carried out this study to verify the effectiveness of two functions for bi-directional satellite Internet. The one is the spoofing function used to reduce the required time for the link establishment. Another one is the cash function used to improve the transmission bandwidth efficiency.

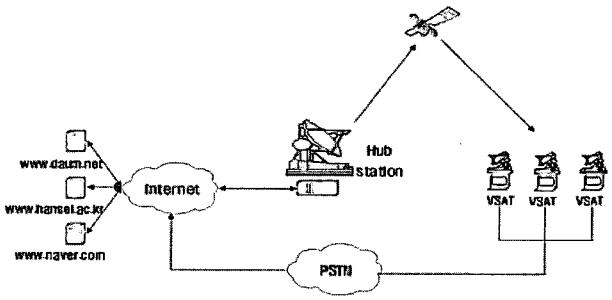

Fig. 1 Typical unidirectional satellite Internet network configuration

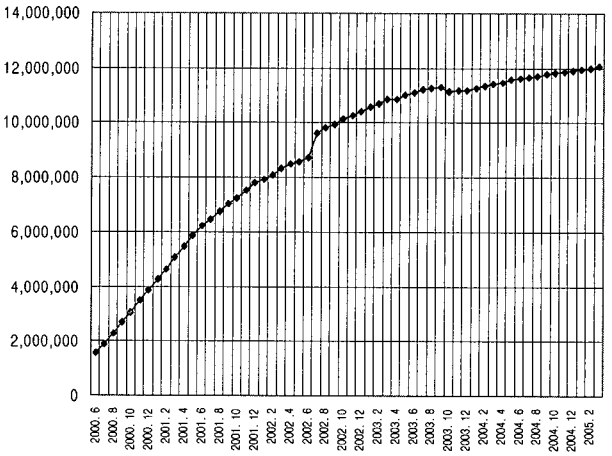

Fig. 2 Trends of terrestrial Internet subscriber

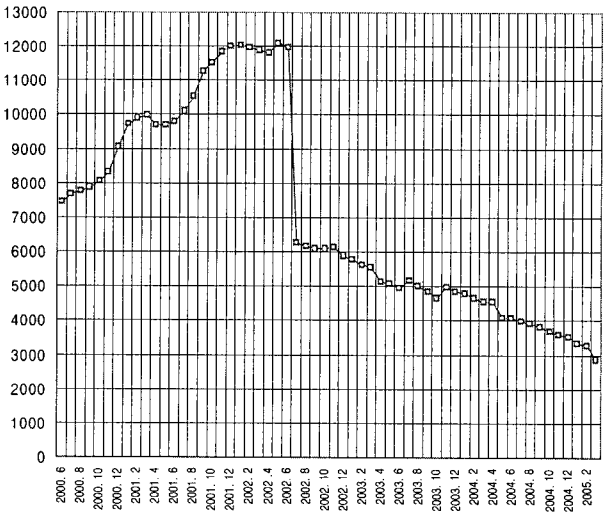

Fig. 3 Trends of satellite Internet subscriber

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II. TESTS AND MEASUREMENTS

A. Test and Measurement system configuration

Table 1~Table 3 shows the related specifications for test and measurement. Table 1 is specifications for terrestrial system, Table 2, for Satellite system and Table 3, for VSAT terminal.

Table 1 Terrestrial system specifications

Hub earth station	1 station 9m antenna	
VSAT terminal station	2 station1 2m antenna	IDU/ODU ACQ : 191.0 PING : 1,686ms PTS : VSAT_141b_uts
HUB-INTERNET connection line	45Mbps	

Table 2 Satellite system specifications

Orbit	GEO 116°E
Satellite name	Mugunghwa-3
Transponder	Bandwidth : 36Mhz. Inbound : 11.040Mhz (480Khz 23group) Outbound : 24.8Mhz
Frequency band	Ku-band
Link bit rate	Inbound : 256Kbps Outbound : 23.58Mbps

Table 3 VSAT terminal station specifications

Clarification	Items		Specification
INTERNET option	Start page		No confirmation
	space		1MB
	LAN connection establishment		NO
	Security level		normal
	Image dithering		delete
	Smooth screen moving		delete
Registry	H_C_U	Max-1	15
		Max-2	15
	H_C_M	Max-1	15
		Max-2	15
Virtual memory	Min		384
	Max		768
	Registry size		64

B. Test network configuration

We used four satellite test networks and one terrestrial test network configurations as Fig 4, Fig 6, Fig 8, Fig 11, and Fig 14. Test and measurement satellite networks are connected to the related Internet website via 100Mbps LAN that is connected to Internet with bit rate 45Mbps dedicate line. The topology of satellite network is star topology. The six Internet websites are selected for test and measurement as following ;

A:www.naver.com, portal site
B:www.google.com, text based site
C:www.hansei.ac.kr university site
D:www.kbstar.co.kr bank site

C. Test and Measurement Results

Test and Measurement performed 3times in 20minutes interval. So total 15times in each test and measurement case tested and measured the traffic and connection time to each websites.

1) Non function satellite network results

Fig. 4 shows the non cash and spoofing function in satellite network configuration. The satellite network is just connected to Internet website via gateway in Hub station. Fig. 5 shows the results of test and measurement for each 4 websites.

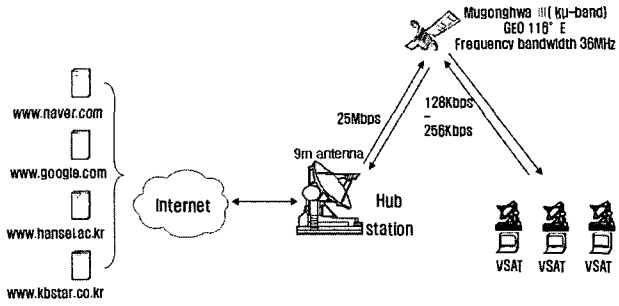
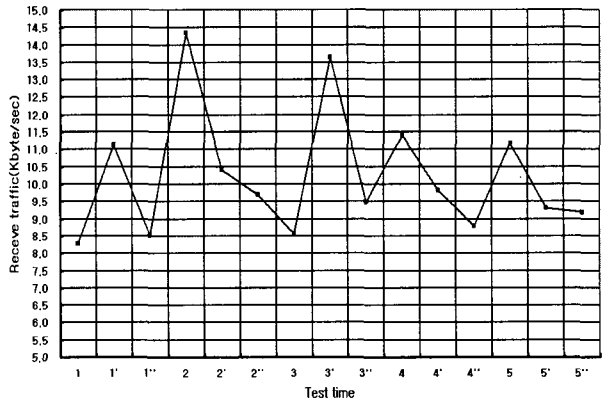
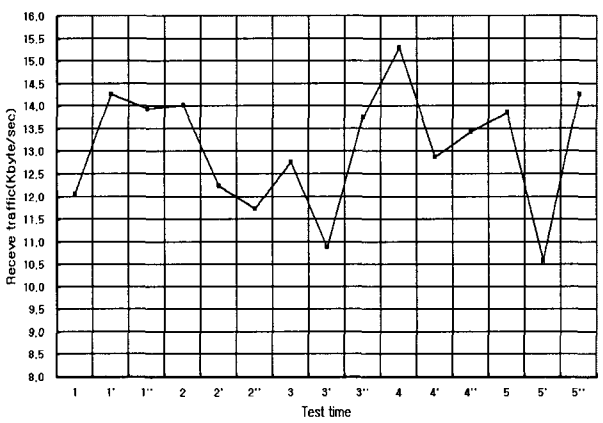


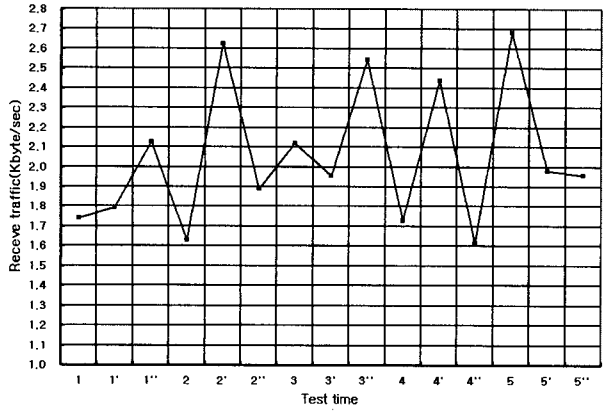
Fig. 4 Non function test satellite network configuration



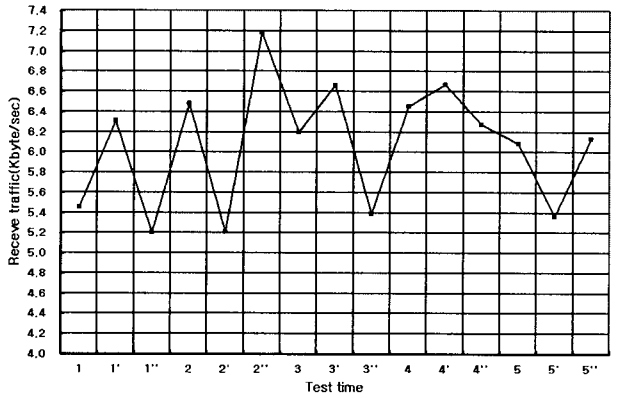
(a) A website



(b) B website



(c) C website



(d) D website

Fig. 5 Measurement Results of each website by nonfunctional

2) Cash function only satellite network results

Fig. 6 shows the cash function only test satellite network configuration. The satellite network is connected to Internet website via the Cashe sever in Hub station. Fig. 7 show the results of test and measurement for each 4 website

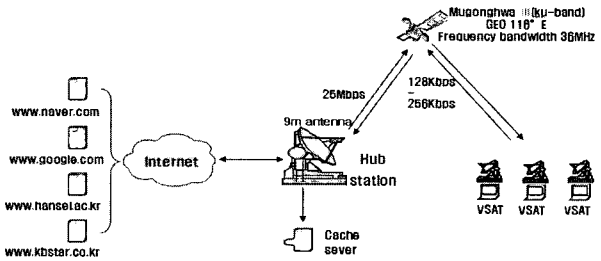
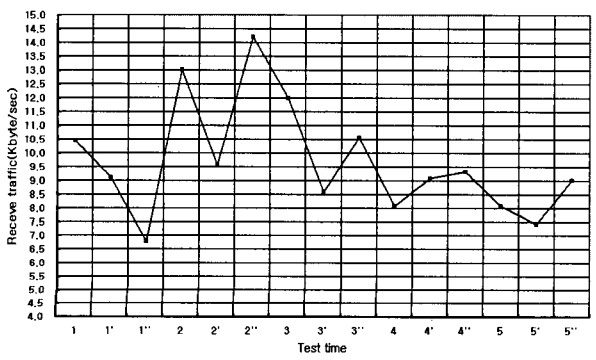
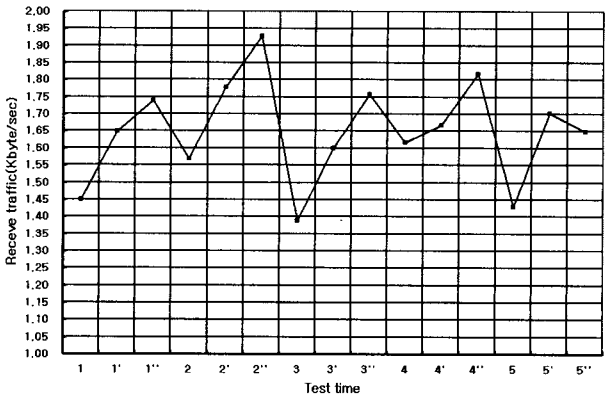


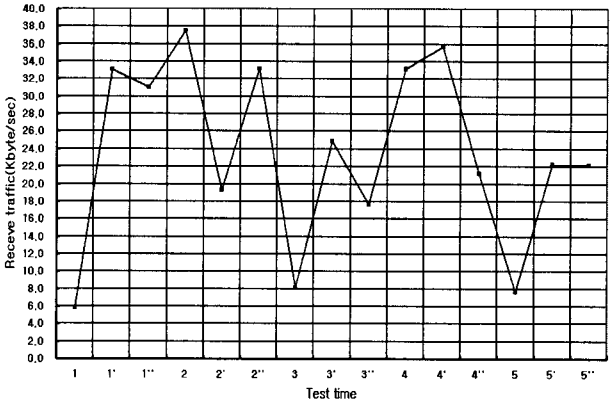
Fig. 6 Cash function only test satellite network configuration



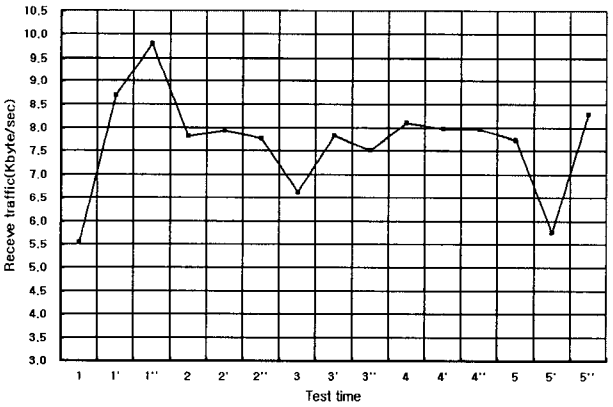
(a) A website



(b) B website



(c) C website



(d) D website

Fig. 7 Measurement Results of each website by Cash function only

3) Spoofing function only satellite network results

Fig. 8 shows the spoofing function only test satellite network configuration. The satellite network is connected to Internet websites via the IP gateway in Hub station. Spoofing function is installed in both IPGW (IP gateway) of HUB station and IDU of VSAT. The principle of TCP spoofing is a router (gateway) near the source sending back acknowledgements for TCP segments in order to give the source the illusion of a short delay path which speeds up the TCP sender's data transmission. The gateway then suppresses the actual acknowledgement stream from the satellite host and sends any missing data. IPGW in HUB station and IDU in VSAT have spoofing function. Fig. 9 shows Handshake with spoofing function.

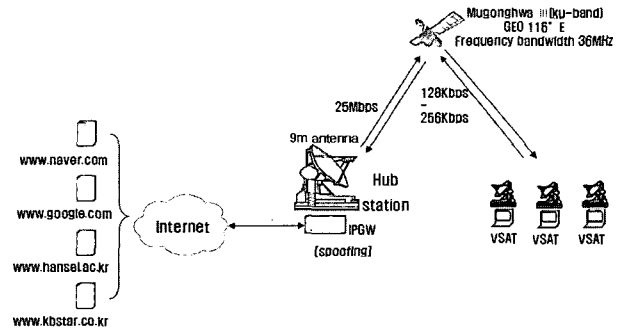


Fig. 8 Spoofing function only test satellite network configuration

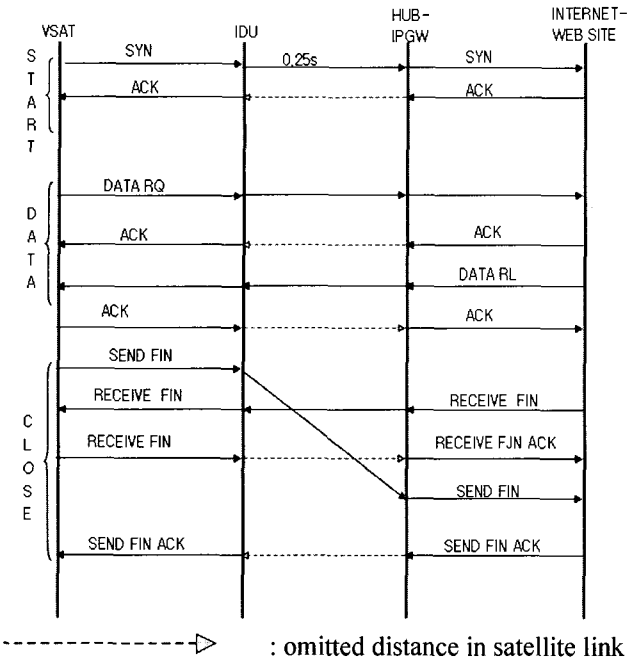
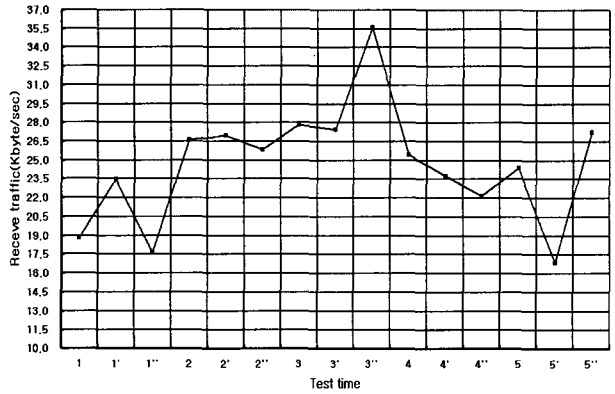


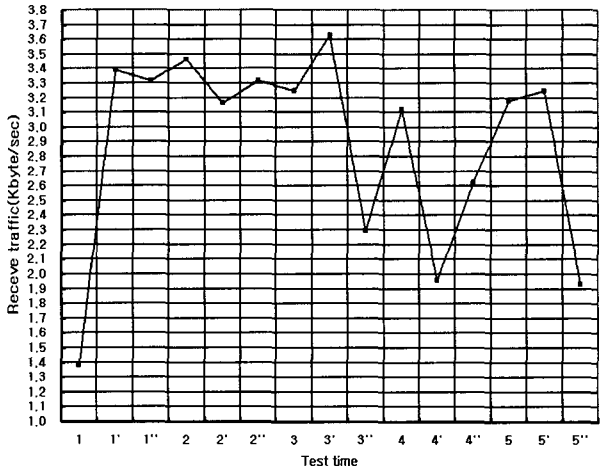
Fig. 9 Handshake with spoofing function

As known from Fig. 9, in case of using spoofing function, mathematically 0.25s x 5times = 1.25ms delay is reduced. The distance between IDU and HUB IPGW is satellite link. Fig. 10 shows the results of test and measurement for each 4 websites

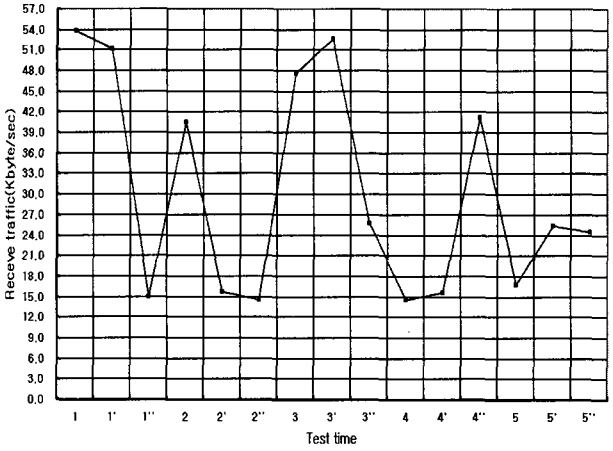
As results of tests and measurements for satellite TCP network having spoofing function, the traffic bit rate increases dramatically in comparison with the other method except the spoofing plus cash function.



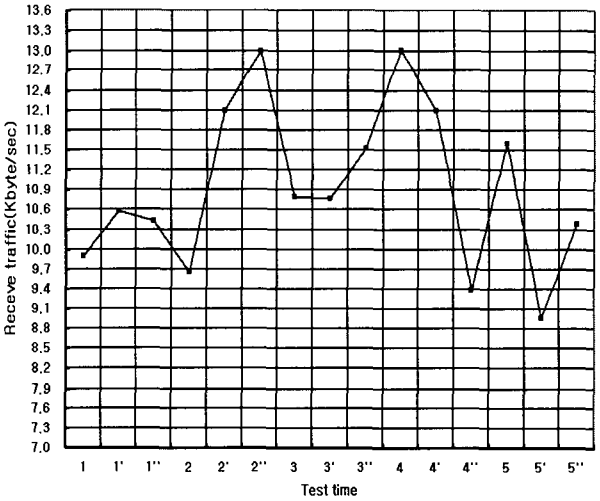
(a) A website



(b) B website



(c) C website



(d) D website

Fig. 10 Measurement Results of each website by spoofing function only.

4) Spoofing plus Cash function satellite network

Fig. 11 shows the satellite network that has the spoofing function in HUB and VSAT station and the cash function in HUB station. The function of Cash server is to save the webpage, FTP and other file which are frequently used by users. When users again access to these webpage, FTP etc within any fixed time after

nearest access to it, first of all, access call will be connected to cash server and then cash server access to related website, FTP etc instead of user. Cash server compares a received data to a saved data, and the difference data between these data only will be sent to user. Therefore cash function can reduce the line cost and use efficiently the bandwidth. The satellite network is just connected to Internet website via gateway in Hub station. Spoofing function is in both IPGW (IP gateway) of HUB station and IDU of VSAT. Cash server is connected to Internet through gateway.

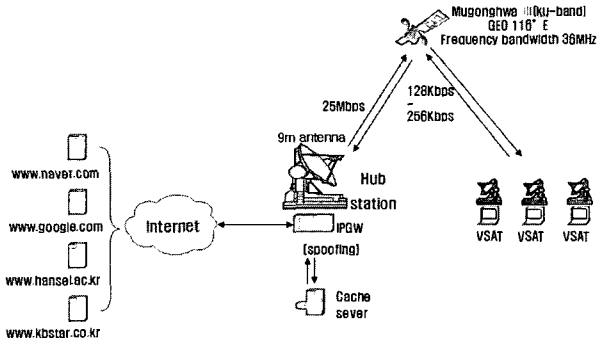


Fig. 11 Spoofing plus Cash function satellite network Configuration

As results of spoofing function for satellite TCP networks, effectiveness of spoofing function is not enough to overcome the satellite transmission delay and improve the performance of satellite TCP networks. Usually the saved data in cash server are periodically deleted to 20minitus interval to protect overflow of data in cash server memory. Fig. 12 shows handshake of the spoofing plus cash function satellite network. To analysis the test and measurement results in each cases, we calculated the received average traffic (Byte/sec) from websites and the measured average website connection time in VSAT terminal. Fig. 16 shows an average traffic in each cases and Fig. 17 shows an average connection time to Websites in each cases.

5) Tests and Measurements to a typical terrestrial Internet

To compare the performance between terrestrial Internet and above tested and measured satellite networks, tests and measurements are carried out to a typical commercial terrestrial Internet. Fig. 14 shows the configuration of terrestrial Internet test and measurement network. In the tests and measurements, we also used the same four Websites as to in case of the above satellite test and measurement network. Fig. 15 shows the results of test and measurement in terrestrial internet.

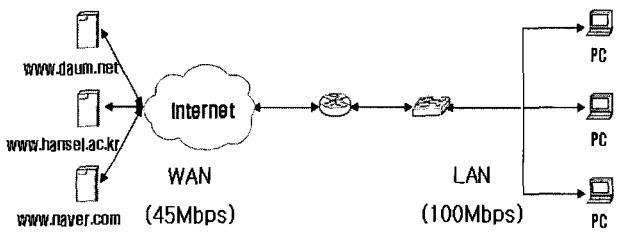


Fig. 12 Terrestrial Internet test Network configuration

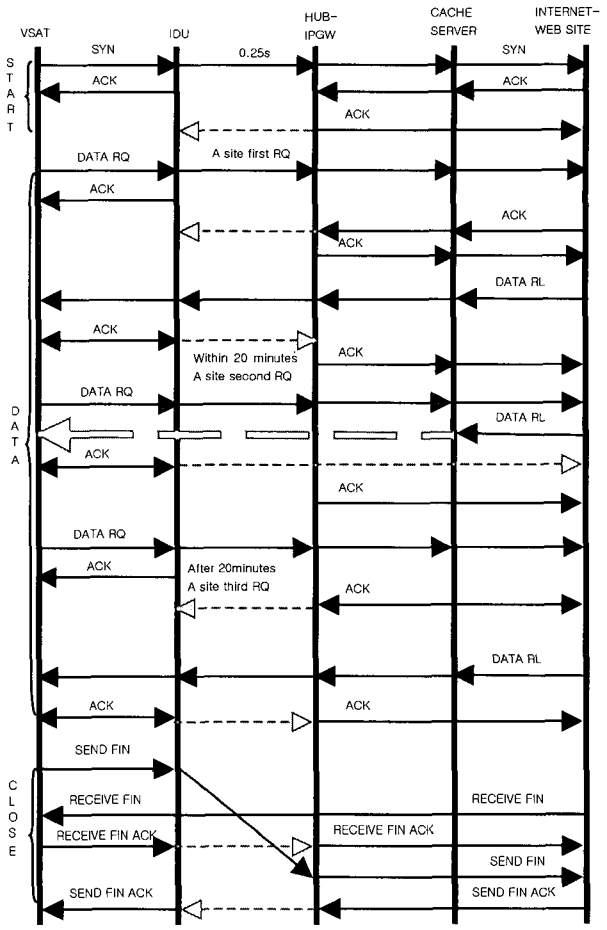
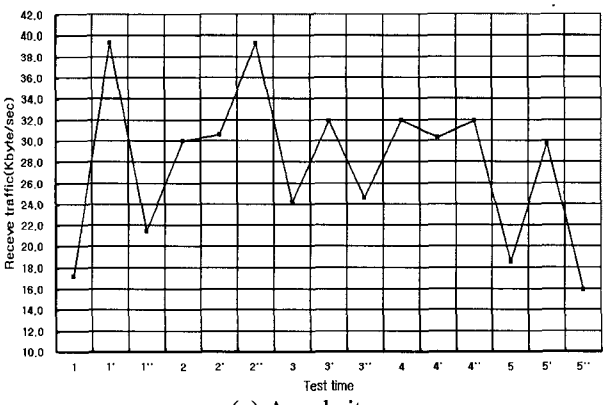
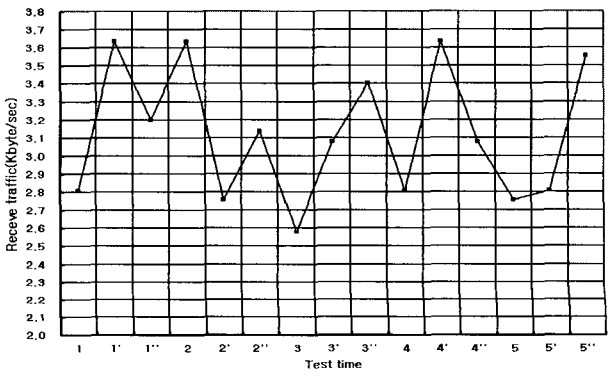


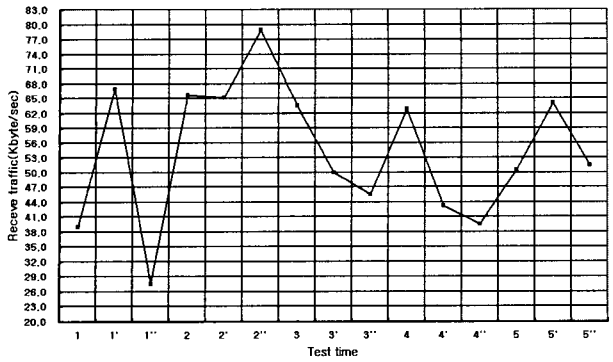
Fig. 13 Handshake of the spoofing plus cash Function satellite network



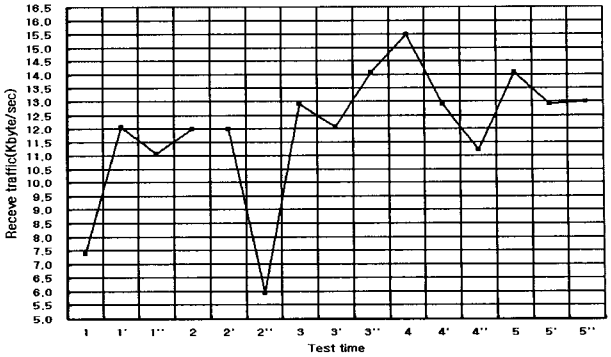
(a) A website



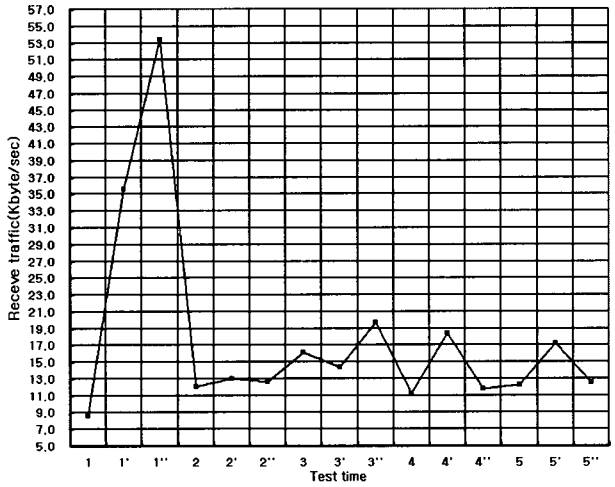
(b) B website



(C) website

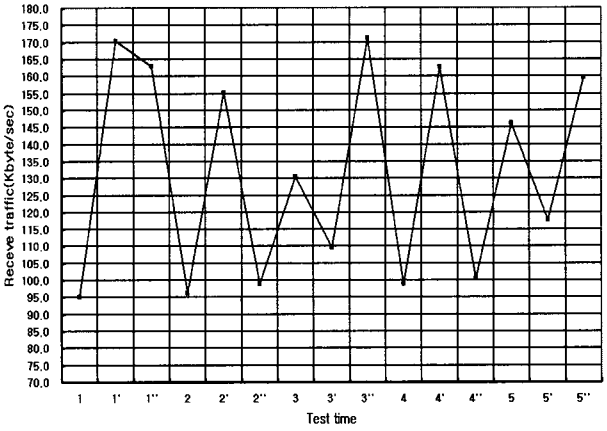


(b) B website

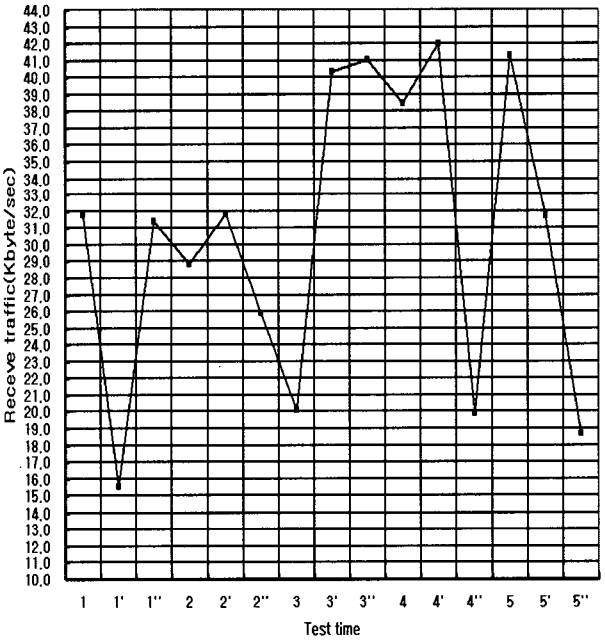


(d) D website

Fig. 14 Results of test and measurement in Spoofing plus Cash function in satellite network



(c) C website

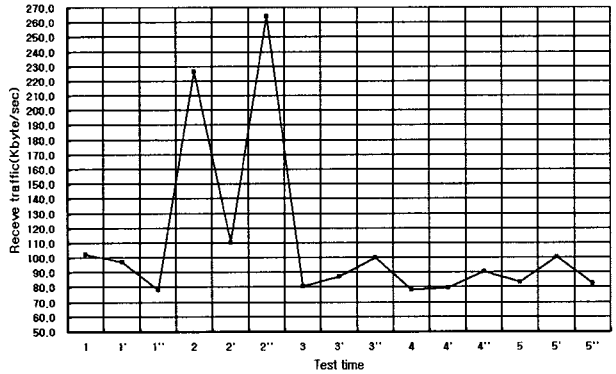


(d) D website

Fig. 15 Results of test and measurement in Terrestrial Network

6) Test and Measurement Result Comparison

To analysis of the test and measurement results by means of comparison of the test and measurement results in each case, we calculated a received average traffic (Byte/sec) from websites and the average Website connection time in VSAT terminal. Fig. 16 shows an average traffic in each cases and Fig. 17 shows an average connection time to Websites in each case. In Fig. 16 and Fig. 17, when Spoofing function and Spoofing plus cash function are applied to the satellite TCP/IP network, the performance for byte rate and connection time are always improved for all website but in the case of Cash function only, both traffic byte rate and connection time are rather lower and higher in both A website and B website.



(a) A website

When cash plus spoofing function is applied, the received traffic in VSAT terminal increased to maximum 4.2times in C-website and minimum 1.5times in B-website.

When cash plus spoofing function is applied, the website connection time in VSAT terminal reduced to maximum 3.9times to C-website and minimum 1.8times to B-website.

In the case of cash function only, the results show that there are no effectiveness in comparison with Non function satellite network in both Moving Picture-based A-website and Text-based B-website However, when the spoofing function only and the cash function plus spoofing function are applied, the effectiveness of both website connection time reduction and received traffic expansion appeared to all websites.

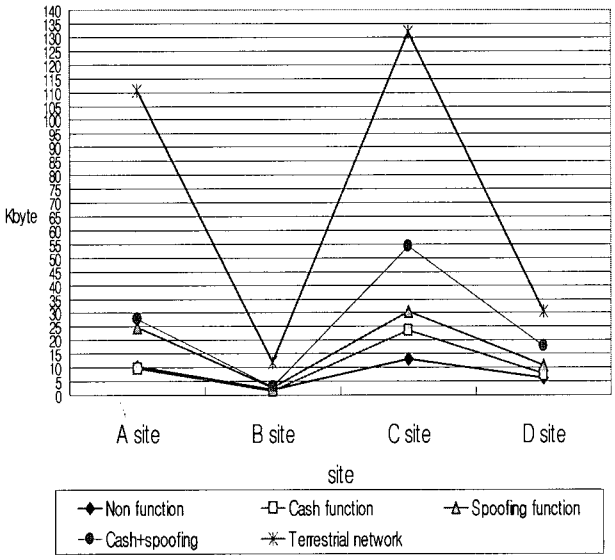


Fig. 16 Comparison of receiving traffic (Kbytes/sec)

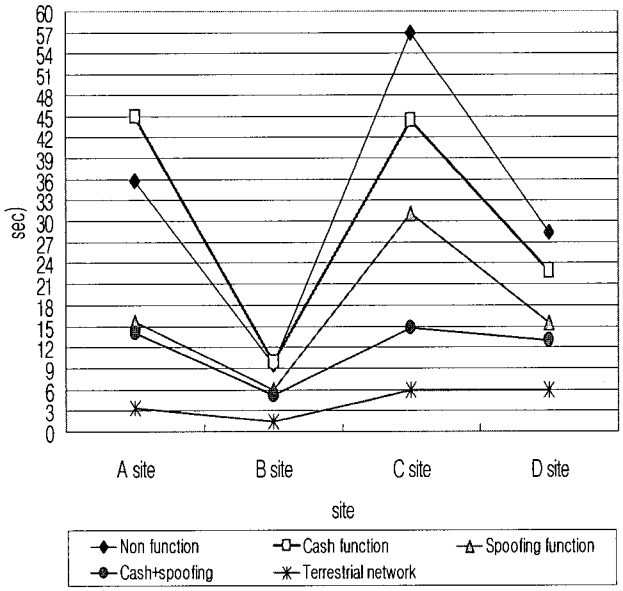


Fig. 17 Comparison of websites connection time(sec)

Table 4. Comparison of Connection Time(Sec)

Classification	A site	B site	C site	D site
Non function	35.7	9.5	56.9	28.4
Cash function	44.9	9.8	44.3	22.9
spoofing function	15.6	5.9	31.1	15.4
Cash + spoofing	14.1	5.2	14.7	13.0
Terrestrial network	3.5	1.4	5.9	6.0

Table 5. Comparison of Receive Traffic (Kbytes/Sec)

Classification	A site	B site	C site	D site
Non function	10.3	2.1	13.1	6.1
Cash function	9.7	1.6	23.5	7.7
spoofing function	24.7	2.9	30.4	10.9
Cash + spoofing	27.8	3.1	54.3	17.9
Terrestrial network	110.8	11.9	131.7	30.6

III. CONCLUSION

We have tested and measured the related five networks to verify the performance improvement of satellite TCP/IP network with cash and spoofing function. When Spoofing function and Spoofing plus cash function are applied to the satellite TCP/IP network, the performance for traffic byte rate and connection time are always improved for all websites. However in case of the Cash function only, the traffic byte rate is rather lower and the connection time is rather longer in A website and B website than in the non function system. This meaning is that the only cash function is not give effectiveness to the moving picture-based website and the only text-based website. When cash plus spoofing function is applied, the received traffic in VSAT terminal increased to maximum 4.2times in C-website and minimum 1.5times in B-website. When cash plus spoofing function is applied, the website connection time in VSAT terminal is reduced to maximum 3.9times to C-website and minimum 1.8times to B-website.

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