ADSL-IP 공유기 네트워크 모듈 설계 및 구현

The Design and Implementation of Network Module for Integration of ADSL-IP Sharer

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요 약

인터넷 서비스에 대한 수요의 폭발적인 증가로 인한IP 주소 부족 문제가 대두 되면서 인터넷 통신규약 표준 기관인 IETF 에서는사용자들이 가상의 사설 IP 주소 영역을 지정하여 사용할 수 있는 NAT 및 NAPT기능을 규정하였다. 본 논문에서는 ADSL을 통하여 서비스 되는 하나의 공인 IP주소를 이용하여 여러 대의 PC 및 다수의 인터넷 접속 단말기 사용자가 동시에 인터넷 서비스를 이용할 수 있도록 NAPT기능을 사용하여 ATMOS 기반의 ADSL-IP 공유기 통합용 네트워크 모듈을 설계 및 구현 하였으며 또한 구현된 ADSL-IP 공유기 통합용 네트워크 모듈의 성능 테스트 및 분석을 실시하였다.

Abstract

Since the problem of IP address shortage is caused by the explosive increases of demand for internet service, the IETF has defined the NAT and NAPT that users are able to designate and utilize a private IP address area for their own purposes. In this paper, we have designed and implemented a network module for integration of ADSL-IP Sharer using ATMOS, which uses a global IP address to work through ADSL and NAPT for simultaneous PC accesses to a broadband line. we have tested and analyzed the performance of the proposed network module for integration of ADSL-IP Sharer using ATMOS

☞ Keyword : ADSL , IP Sharer , switching stations

1. Introduction

IETF (Internet Engineering Task Force) has defined the NAT (Network Address Translator) and NAPT (Network Address Port Translator) in which users can allocate private IP ranges and support CIDR (classless inter domain routing) that is more flexible than conventional IP addresses [1].

xDSL(x digital subscriber line) is a technology to make it possible to transmit digital data at very fast rate using cooper line originally intended to deliver voice signal from switching stations to the telephones. There are several versions of xDSL such as A (Asymmetric), H (High bit-rate), S (Symmetric), V (Very high speed) DSL's according to the application goals, technological variations, and speed.

DSL technology was applied to the services of HDSL at early 1990's. After the technical recommendation of ADSL of 1990's ITU-T was proposed, large scale services for ordinary users made into the market and the underlying technology remains one of the dominant ones today[2]. This paper introduces an implementation scheme for a network module of ADSL-IP with NAPT functions to allow multiple users to access internet using only one valid IP address through ADSL network.

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2. Related Works

2.1. ADSL(Asymmetric Digital Subscriber Line)

The ADSL technology that helps send voice and data together at high speed was developed originally to implement VOD services by Bell core at early 1990's. While VOD services fail to set intothe market, the demand for high speed networks kept increasing at late 1990s. Improved version, RADSL (Rate Adaptive DSL) was soon proposed [5].

Rull-Rate ADSL with 1.104MHz frequency range provides speed range between 6Mps at minimum and 640Kpbs at maximum. ATU (ADSL Terminal Unit)-C and ATU-R(Remote) adopted splitter. On the other hand, ADSL with no splitter has advantages of less complexity, less energy consumption, easy installation uses only half the range of Full-rate ADSL and as a result it workson 552KHz frequency rage and produces speed betweenminimal 1.5Mbps and maximal 512 Kbps [2].

ITU-T G.992.1 an G.992.2 defines the specification of Full-Rate ADSL based on T1.413-1998 of ANSI. Annexes A, B, and C specify POTS, ISDN, and TCM-ISDN services and contain regulations for Northern America, Europe, and Japan respectively with localized consideration. Annex E specifies POTS, ISDN and splitter for Japan's case. ADSL now keeps improving leading to higher versions such as 12Mbps ADSL, ADSL2/splitterless ADSL2, ADSL2+, and ADSL2++.

The 12Mbps ADSL was originated from Japanese companies, thus does not come with standard requirements, and it manages to realize 12Mbps by adjusting S=1/2 parameter and gaining 4Mbps improvement. ADSL2/Splitterless ADSL2 was adopted as improved standards of ADSL (G.992.1)

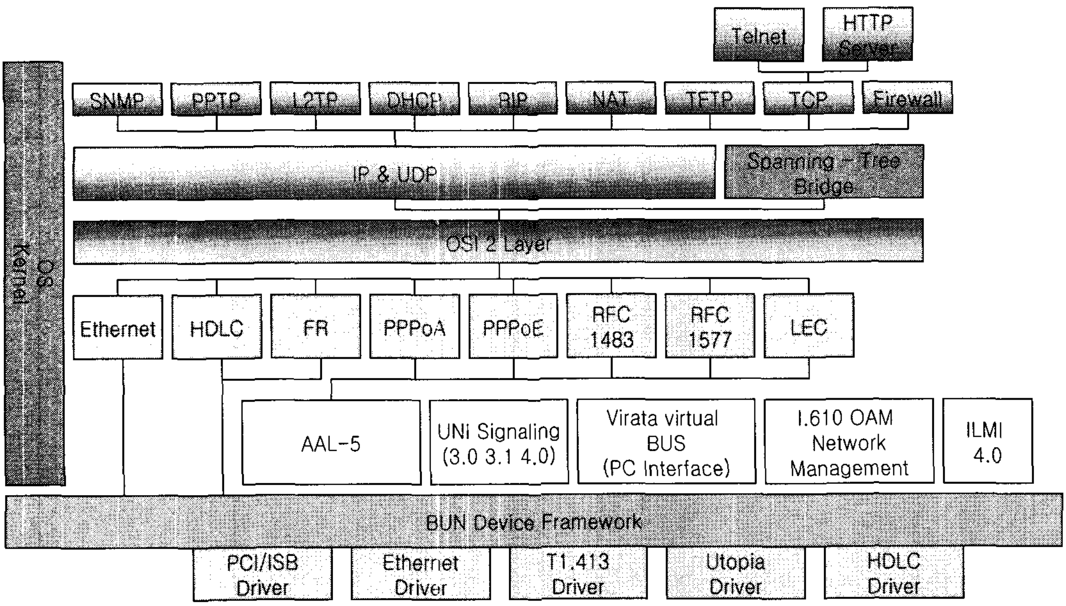

Figure 1. ATMOS Network Module Diagram

and Splitterless ADSL(G.992.2) giving Standards G.992.3 and G.992.4, respectively. ADSL2 was added by new functions including new delivery technology, speed adaptation, diagnostics utility, and stand by mode. It also improved distance factor and supports flexible structure and easier integration of new applications.

ADSL2+ is undergoing a standardization process as a 3rd generation technology of G.dmt.bis. It takes frequency range between 25Khz ~ 2.2MHz, which is a double order of ADSL2 and is expected to provide low bound speed of 24Mbps.

3. ADSL-IP Network Module

3.1 ATMOS Network Module

As figure 1 shows, ATMOS network module provides various functions for general network devices according to the OSI 7 layer model and other standards. The demands and requirements by the service suppliers as well as service consumers arise more frequently due to the fast deployment of high speed internet market.

3.2 Implementation Setting for ADSL-IP

User's local network may have various access environments according to the network characteristics of the service providers.

The ADSL-IP sharer's network module of this paper takes the situation into account and supports RFC 1483 that is a standard for multiple access, PPPoA that is a standardization of PPP protocol in ATM networks, and PPPoE that is a composite of fast but short ranged Ethernet and PPP service [13, 14]. An utility is added to help users to know and deal with the link status and access failure status.

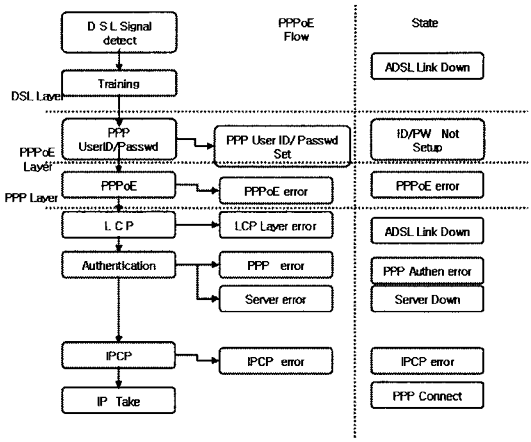

Figure 2. Failure detection flow of PPPoE

In original PPPoE, failures will cause reboot of the system repeatedly, thus users will not know the problems. ADSL-IP sharer is made so that failures in each layer of DSL layer, PPPoE layer, and PPP layer can be dealt directly in the layers as is shown in figure 2.

Figure 3 shows the algorithm to detect failures in PPPoE stage and LCP stage. Failures are detected by excessive retrials occurring more frequently than preset number of times or more time used in the retrials than preset timeout value [16].

Figure 4 shows the MGA process added to make users to use ADSL-IP sharer with ease.

The MGA process is responsible for BUN framework, EmWeb server, and data exchanges with ATMOS network module to realize the multiple access mode that is not supported by conventional ATMOS network module, authorization status of PPP, physical ADSL link status, routing status, and carrier chart. Extra configuration file, mga_cfg, is added to set MGA process parameters in addition to existing configuration files. Figure 3 and 4 illustrate user environment of implemented ADSL-IP sharer.

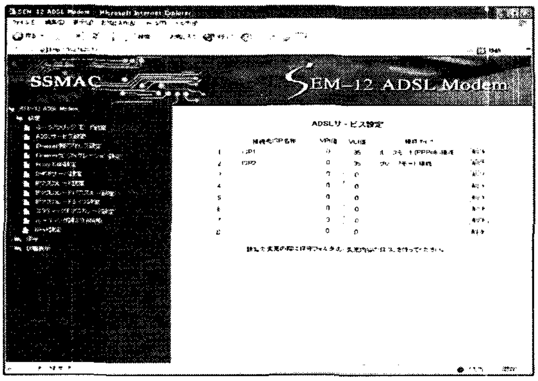

Figure 3. ADSL mode setting과 (table 1) Test items

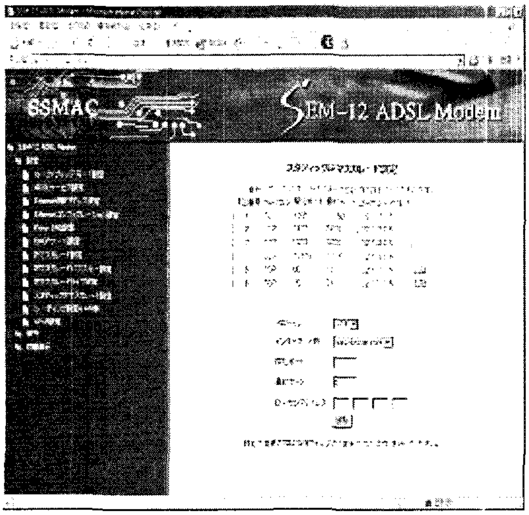

Figure 4. Static IP Masquerade(NAPT) setting

4. Performance Analysis

As table 1 shows, the implemented ADSL-IP sharer is tested in 4 items including IP sharer test, distance dependent link ratio, FTP throughput test, and browser portability.

The implemented system showed satisfactory results with respect to the naïve users requirements in the factors of IP sharer test, FTP throughput test, and browser portability test. Distance dependent link success ratio also met the level required of users,

(table 1) Test items

IP sharer test	Dynamic NAPT	ftp	ok	common web access programs
		web	ok	
		telnet	ok	
		ping	ok	
		tftp	ok	
		smtp	ok	
		MSN Messanger	ok	
	Static NAPT	Web server	ok	virtual server test, arbitrary port access test for game and multimedia services
		ftp server	ok	
		telnet server	ok	
		TCP/UDP 5000	ok	
		TCP/UDP10000	ok	
		TCP/UDP 62000	ok	
		TCP/UDP 64096	ok	
link success ratio depending on different distances			ok	showed deteriorated outcomes compared to other systems

but did not exceed other rival models.

In this chapter, we focus on the issue of upward and downward speeds that are the most critical part of ADSL services. As to the problematic factor of distance dependent link ratio, we have compared with the modem by company A and presents the meaning of implementing ADSL-IP sharer network module. Testing distance dependent link ratio assumes a setting shown in table 2. Line simulator is located between ADSL-IP sharer DSLAM of 12Mbps ADSL service. To simulate ordinary user's environment, we set up copper wires and distances from 0 feet to 24000 feet can be tested by 500 feet units.

(table 2) Setting for testing distance dependent link ratio

ADSL-IP sharer	G.992.1 Annex C
Line Simulator	0 ~ 24000 feet (500feet unit)
DSLAM	FBM-OL, DBM-OL, Auto

Table 2 shows the setting for testing link ratio dependent on distances. ADSL-IP sharer took G.992.1 Annex C method to enable ADSL service in Japan's ISDN environment. Line simulator is set to the values from 0 feet to 24000 feet by 500 feet units. DSLAM is to one of three modes : FBM-OL(Far End Cross Talk Bit Map Overlap) mode that is optimized for long distance transmission, DBM-OL(Dual Bit Map Overlap) mode that is fit to the short range distance, and the auto mode that mixes the previous two modes for optimal performances.

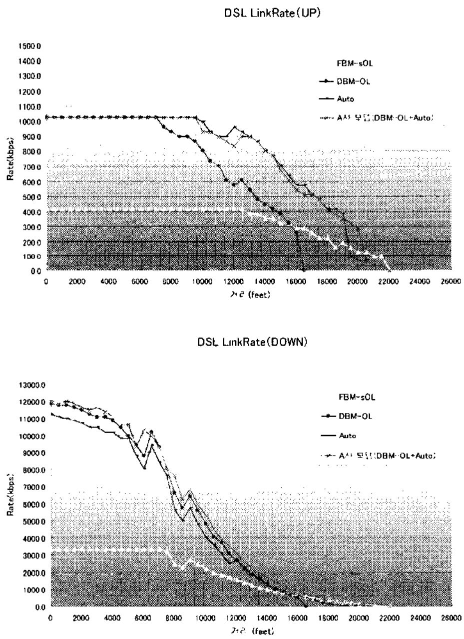

Figure 5. Test results of link ratio in upward/downward distances

As figure 5 shows the graph of test results on distance dependent link ratio, DBM-OL mode in downward up to 8000feet shows performance equivalent to that of company A's modem tested in DBM-OL +auto mode.

As to the long distance testing, the modem of company A could link up to 2000 feet while ours could not make further after 17000 feet. When tuned with FBM-OL that is optimized for long distances, ours can reach as far as 22000 feet just as company A's modem could. When set to auto mode upward, up to 19000 feet the sharer showed same or better results than company A's modem. With more than 19000 feet the ratio rapidly dropped. As to the downward, the link ratio is 1000Kbps below company A's modem overall.

5. Conclusion and Future Work

This paper introduces an implementation scheme for a network module of ADSL IP sharer with NAPT functions to allow multiple users to access internet using only one valid IP address through ADSL network. As a result, DBM-OL and FBM-OL modes obtained satisfactory ratios in long distance and short distance ranges respectively over both upward and downward directions. In auto mode, overall performance is rated worse than that of company A's modem.

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