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차세대 호텔 멀티미디어 서비스를 위한 시스템 구현

(Implementation of System for Next Generation Hotel Multimedia Services)

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요 약

최근 비즈니스 클래스 호텔은 고객들에게 인터넷 서비스를 제공하는 것이 필수적이다. 따라서 대부분의 호텔은 인터넷 서비스를 위한 설비를 적극적으로 설치하고 있다. 비즈니스맨 또한 호텔 룸에서 자기집 또는 사무실과 같은 수준의 인터넷 서비스를 사용하길 원한다[1][2]. 그러나 현재 호텔에서 CATV 기반의 TV와 VoD (일부분)가 공급되고 있으며, 인터넷 서비스를 위하여 별도의 장비가 설치되어야 한다. 또한 기존의 TV는 2~3년내에 HDTV로 대체될 것이 틀림없다. 본 논문의 목적은 xDSL 기술, VLAN 매핑 기술 및 QoS 기술을 이용하여 차세대 호텔 멀티미디어 서비스 시스템을 구현하는 것이다. 이 시스템은 호텔의 각 룸에 고 품질 비디오 서비스와 인터넷 서비스를 동시에 제공할 수 있으며, 또한 호텔 로비, 회의실, 그리고 커피 샵과 같은 장소에 대하여 무선랜을 이용하여 인터넷 액세스 서비스를 제공해준다. 그러므로 이 시스템은 xDSL 기술을 과금을 위한 VLAN 매핑 기술과 비디오 스트림 전송을 위한 QoS 기술에 접목함으로써 호텔 멀티미디어 서비스 분야에 새로운 시장을 창출해 줄 것이다.

Abstract

These days, it is essential that a business-class hotel provide customers with Internet service. So the most hotels have been installing facilities actively for Internet service. Businessmen also want to use Internet service level to their own office or home in hotel room[1][2]. But now TV and VoD(partial) based-on CATV in hotel is supplied, and the additional network are installed for Internet service. The existing TV also must be replaced to HDTV within 2 or 3 years. The objective of this paper is to implement the next generation hotel multimedia service system using xDSL technology, VLAN mapping technology, and QoS technology. This system can provide each room in hotel with high-quality video service and Internet service simultaneously, and can also supply Internet access service using wireless LAN for the places, such as lobby, conference room, and coffee shop in hotel. Therefore, this system can create the new market in hotel multimedia service field by connecting xDSL technology to VLAN mapping technology for charging and QoS technology for video stream transmission.

Keyword: Hotel, Multimedia, VDSL, Ethernet, WLAN

I. Introduction

In a business class hotel, it is essential to supply Internet service. So in these days, the most hotels have propelled the equipment installation for Internet services. And they have tried to supply the new multimedia services, such as VoD, game, and so on, using these Internet infrastructures[1].

Until Now, most hotels have provided customers with TV/Video services through CATV, and installed the additional equipments for Internet service. More-over, transmission speed for Internet services has been almost 1Mbps, and some hotels have used wirel-ess LAN for Internet services. Most 1Mbps methods

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provide the hotel rooms with Internet services through telephone line using homePNA technology, but can be used in accessing only Internet because of limited transmission speed. Also because of its limited transmission distance, such as 300m or400m, it is difficult to apply the method to large-scale hotels having many buildings thatis scattered about. But it is still known as the method having most competitive power for simple Internet services[1][2].

In these days, it is required to supply Internet and VoD servicesnecessarily for the improvement of competitiveness and gains in a hotel. And the most hotels provide TV/VoD(partial) based-on CATV, and install the additional network for Internet services. Also the existing TV will be changed to HDTV within 2 or 3 years.

Therefore, in the case of developing the total solution for VoD and Internet, which can transfer the video service of DVD quality, it must supply the broadcasting, VoD, and Internet services simultan -eously.

So hotel can reduce the cost of equipment invest -ment, and then can secure the new profitable ser -vices. Also, in the case of hosting large-scale meeting, hotel can broadcast the meeting contents of each meeting room using these equipments, and then have customers see the situation of hotel room. So hotel can increase the number of guest dramatically, and have the effect to increase its reputation as high-quality hotel.

In the case of foreign, the system for only hotel is one based-on HomePNA technology. Most hotels make practical application of the existing Internet equipment. But this system is unfit for providing high-quality VoD service, high-quality TV service, and Internet service together. So new solution must be developed to provide those services in hotel efficiently[2][14].

This paper is to implement the multimedia access system for hotel, which can provideeach room in hotel with both video services of DVD quality and Internet services simultaneously, and also can supply Internet services by installing WLAN (wireless LAN) at a location crowded with people, such as lobby, meeting room, and coffee shop.

This paper consists of 5 chapters. Chapter 2 addresses VDSL basic technology, and the chapter 3 addresses the multimedia services for hotel. In chapter 4, we address the architecture and the charac -teristics for multimedia system. We consider the implementation of the system in chapter 5, and then address the conclusion in chapter 6.

Ⅱ. VDSL Basic Concept

VDSL is one of xDSL technologies similar to ADSL, and has the fastest transmission speed among xDSL technologies. For asymmetric service, it has 1 2~52Mbps transmission speed for downstream, and 1.6~6.4Mbps for upstream, and for symmetric service, it has 13Mbps, 26Mbps transmission speed for bi-direction. As 52Mbps for downstream is faster than T3 dedicated line, it can supply Internet services as well as HDTV (19Mbps) and diverse VoD services[3][6].

· VDSL is the super-speed Internet technology having fastest transmission speed if each home does not have optic cable. But a problem of VDSL is the restriction of transmission distance. ADSL can pro -vide users with services up to 4.5km ~ 5.5km, but the transmission distance of VDSL is up to 1.4km ~ 2.5km. For symmetric service, the maximum transmi -ssion distance is about 1.4km, and for asymmetric service, it is 2.5km. Also for 52Mbps, which is a strong point of VDSL, it has a shortcoming that the transmission distance is reduced to about 300m. This distance has no problems in multiple dwelling environ -ments, such as apartments, small office, and hotel, but has many problems in residential building. Ano -ther shortcoming of VDSL is that as the number of user in a region is increasing, its speed be decreased. But ADSL has the constant speed regardless of the number of user[4][5].

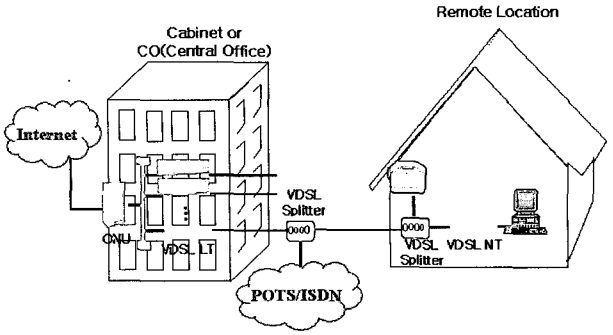

그림 1. VDSL 기술
Fig. 1. VDSL Technology.

Figure 1 shows the method to overcome this techni -cal shortcoming by installing all optic cable up to cabinet in each region. So VDSL can accommodate all regions within radius 300m, and then realize the maximum speed of its own through cabinet connected to optic cable network. Also even if the number of users is growing, the decrease of speed can be solved through the optic cable connected to cabinet and the robust backbone network[3][6].

III. Multimedia Services for Hotel

As the existing solutions for hotel Internet service provide each room with Internet service through the low speed access system of about 1Mbps, it cannot -supply the diverse multimedia services, such as VoD, game[1][2]. These days, as shown in figure 2, there are the attempts to supply VoD service by applying access system based-on xDSL technologies. But Internet traffic and VoD traffic are summed in Ethernet switch, and transferred to the access system through same interface, so it is difficult for video traffic to be transferred without delay.

For system proposed in figure 2, paths for video traffic and Internet traffic are separated. So the sys -tem can prevent the deterioration of transmission quality in Ethernet switch, and also control the trans -mission priorities of Internet traffic and video traffic in the access system differently. Therefore, the video traffic can be transferred without delay. This access system can also assign the independent VLAN tag to each room for charging according to the data amount

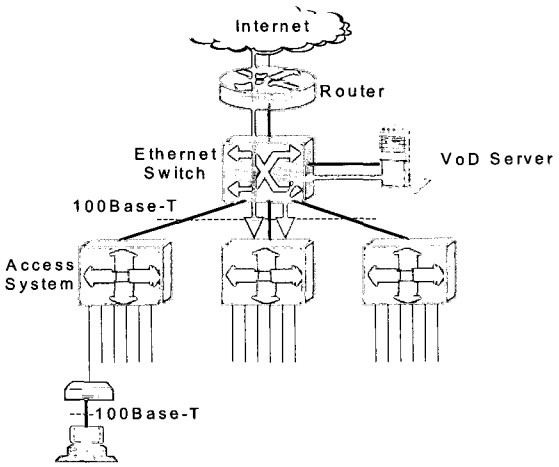

그림 2. 기존의 호텔 인터넷 솔류션
Fig. 2. Existing Hotel Internet Solutions.

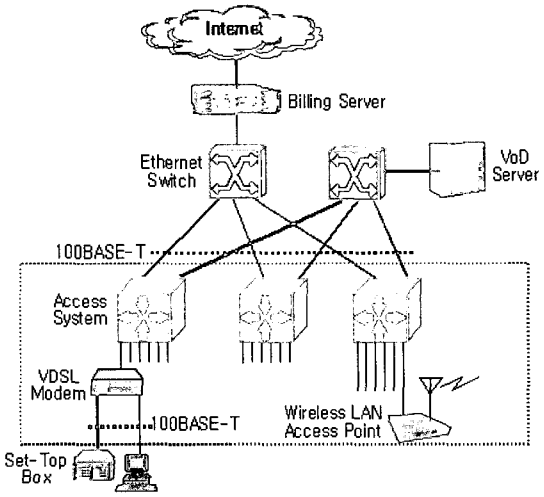

그림 3. 호텔 멀티미디어 시스템 구성
Fig. 3. Hotel Multimedia System Configuration.

used in each room[8].

The method can assign the maximum 4,096 VLAN tags at present, but must assign the maximum 64k VLAN tags for large-scale hotel. As the power feeder of access system supplies the power through phone line for WLAN AP (Access Point) installed at lobby or meeting room, the additional line for power feed is not necessitated. So there is strong point to install WLAN AP easily. VDSL modem is installed in room and can connect PC and set-top box simul -taneously.

Hotel multimedia system includes access system technology, VDSL modem core technology, and VD SL WLAN AP technology.

Access system technology has Ethernet switching function, VDSL interface function, VLAN mapping

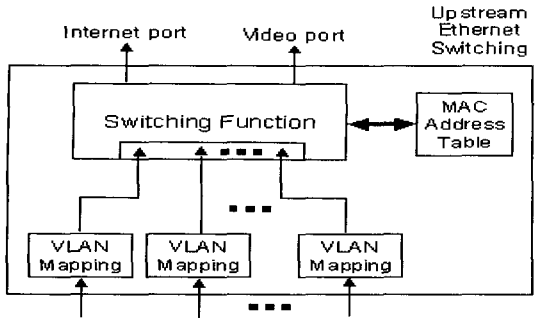

그림 4. 포트 단위 VLAN 매핑 기능
Fig. 4. VLAN mapping function per port.

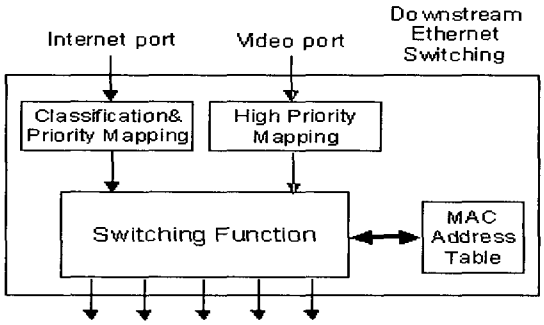

그림 5. QoS 매핑 기능
Fig. 5. QoS Mapping Function.

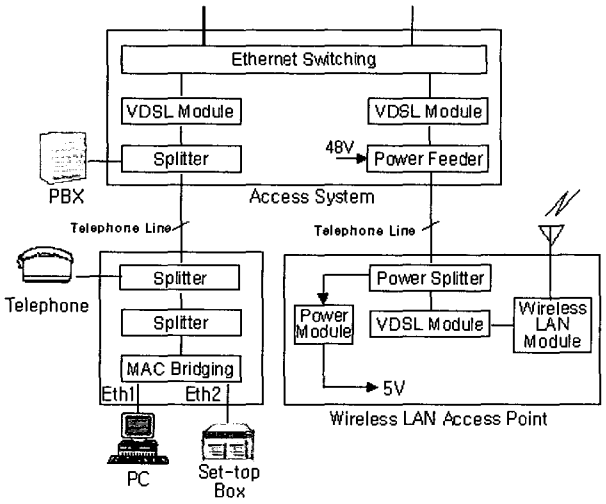

그림 6. VDSL 모뎀 및 WLAN AP
Fig. 6. VDSL Modem and WLAN AP.

function, QoS mapping control function, IP multi -casting using IGMP snooping, and system control and network management function. VLAN mapping function[8] can supply the charging function for each room by measuring the traffic amount per port for upstream traffics. Figure 4 shows this VLAN ma -pping function.

QoS mapping control function[8] is shown in figure 5. This function treats the downstream differentially. downstream traffics are divided into two ports, such as Internet port and video port. video port has hig -hest priority, and then Internet port has many priori -ties. access system technology classifies the down stream traffics into multiple classes, and then assigns a priority to the classified traffic.

VDSL modem core technology has VDSL interface function and Ethernet bridging function. VDSL inter -face functions are the link stabilization function, the automatic speed control function, and the link set-up and speed control function for interworking with the access system.

VDSL WLAN AP technology has IEEE802.11b WLAN interface module and VDSL interface function. IEEE802.11b WLAN interface module is WLAN acc -ess control function and automatic speed control function with distance. VDSL WLAN AP is shown in figure 6[12][13].

Ⅳ. Architecture and Characteristics of System

This system can accommodate 24 VDSL users that can transfer data in about 12 Mbps per user using the existing phone line and has two 10/100/1000Mbps ports for uplink. This system is called Avenue (Advanced VDSL Concentrator with Universal Ether -net port) in this paper.

As Avenue system supplies data and voice servic -es simultaneously, it can supply multimedia services and diverse applications, such as VoD service, video -conference, telemedicine, and home shopping, in the multiunit building and in the enterprise environment.

This system consists of CPU interfacepart, Ether -net switch part, VDSL line interface part, and power part. Figure 7 shows the block diagram of this system. Table 1 shows the configuration of this sys -tem. An AVE_IO consists of 8-port VDSL transcei -vers based on QAM, AFE (Analog Front End) for 8ports, VDSL line driver for each port, and transmi -ssion/receiver filter for each port. As thissystem can accommodate total 3 AVE_IOs, it can have the maximum 24 VDSL ports. AVE_CO consists of Ether -net switch and CPU interface. AVE_PO supplies

표 1. AVENUE 시스템 구성
Table 1. Configuration of AVENUE system.

Function Block Name	Board Name
SCP (System Control Part)	AVE_CO
ESP (Ethernet Switch Part)	
VLP (VDSL Line Interface Part)	AVE_IO
SPP (System Power Part)	AVE_PO

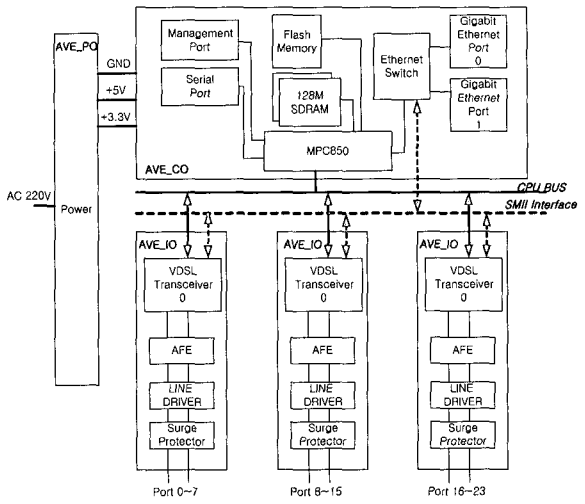

그림 7. AVENUE 시스템 블럭도
Fig. 7. AVENUE System Block Diagram.

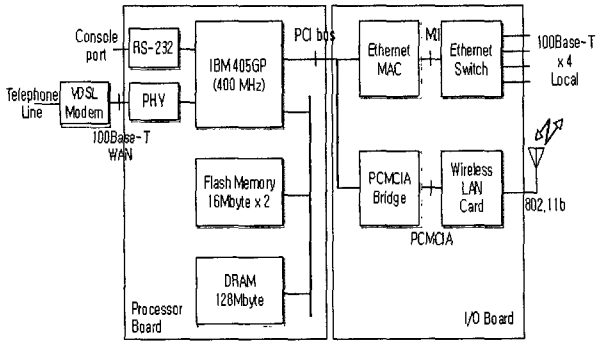

그림. 8. WLAN AP 블럭도
Fig. 8. WLAN AP block diagram.

this system +5v and +3.3V voltage. And Ethernet switch has 2 Gigabit Ethernet ports and 24 Fast Ethernet ports[10][11].

SCP (System Control Part) controls Ethernet switch part and VDSL part through processor. SCP has 10BASE-T interface, serial interface, and SNMP function. ESP (Ethernet Switch Part) supports 24 VDSL ports and 2 Ethernet uplink ports. ESP has the functions, such as maximum 32 MAC addresses, MAC address filtering, port-based VLAN, Tag VLAN based on IEEE802.1Q/P[8], spanning tree[9], and IGMP snooping. VLP (VDSL Line interface Part) have 8 SMII(Serial Medium Independent Interface) interfaces. VLP supports the functions, such as 10/100 Mbps PHY Ethernet interface function (full or half duplex mode, symmetric or symmetric data transmission). SPP (System Power Part) provides this system with DC 5V(4.3A) and 3.3V(12A) through AC 220V input voltage.

Figures 8 shows WLAN AP. This is connected to VDSL modem through WAN interface port. VDSL modem is connected to Avenue system through phone line. So WLAN AP can also supply Internet services at a location crowded with people, such as lobby, meeting room, and coffee shop.

V. Implementation and Consideration

Avenue system consists of three boards, such as AVE_CO, AVE_IO, and AVE_PO.

AVE_CO consists of CPU interface part and Ether -net switch part. CPU interface part has CPU, S -DRAM, and Flash memory. It performs the device control and the management in AVENUE system.

Ethernet switch part has 2 Gigabit Ethernet ports for uplink and 24 VDSL 10/100M ports for VDSL users. It performs the switching function between them. And it is connectedto VDSL ports through SMII, and to Gigabit Ethernet ports through GMII (Gigabit MII). For Gigabit Ethernet interface, MAC interface of each port is connected to PHY through GMII/TBI (Ten Bit Interface), and for 10/100M, through SMII. Ethernet switch performs the packet data transmission/receive to/from PHY by IEEE802.3 specification. MAC supports full/half duplex mode for 10/100M, and only full duplex mode for Gigabit Ethernet port. [10][11]. And it performs the flow control function by IEEE802.3x [7]. It is connected to PHY device through MDIO (Management Data Input Output) interfacesfor link speed and auto-negotiation. Table2 shows the initial setting value of Gigabit Ethernet port.

Figure 9 shows the overall system configuration. VDSL mode in CPE has two RJ-11 ports (Line, Phone) and one Ethernet port. Lineport of RJ-11

표 2. Gigabit 포트 초기화
Table 2. Gigabit port Initialization.

Device Name	PHY Address	Initial setting value
Port 0	00100(04h)	-Internal 1.5V on -Auto-negotiation -Full capacity slave -Crossover enable -125M clock disable -GMI to copper
Port 1	00101(05h)	

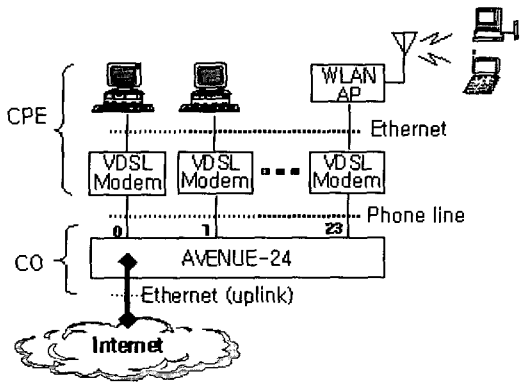

그림 9. 전체 시스템 구성
Fig. 9. Overall system configuration.

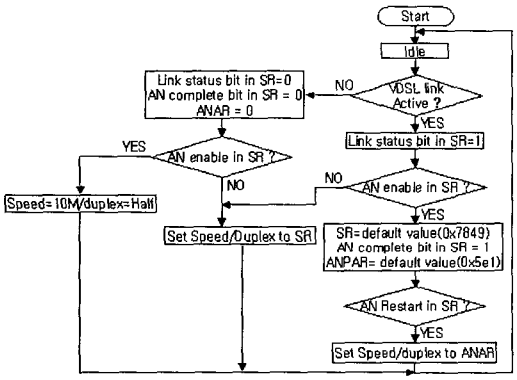

그림 10. 자동 협상 동작 흐름도
Fig. 10. Auto-Negotiation operation flow chart.

ports is connected to VDSL port in AVENUE system (CO) through phone line, and Ethernet port is connected to PC or WLAN AP in CPE through Ethernet line.

This can provide each room in hotel with both video services of DVD quality and Internet services simultaneously, and also can supply Internet services using WLAN at the location crowded with people, such as lobby, meeting room, and coffee shop.

In Figure 9, VDSL link is established between CO (AVENUS-24 system) and CPE (VDSL modem). Ethernet switch in AVENUS-24 system has STA

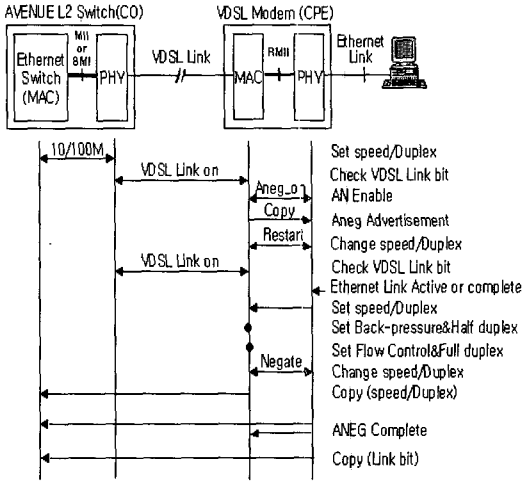

그림 11. MAC 동작 흐름도
Fig. 11. MAC operation flow chart.

(STAtion management) function to gather set-up and status information for each port. STA has manage -ment resisters, and then uses it for AN (Auto -Negotiation) function and PHY control. STA uses MDC (Management Data Clock)/MDIO to control PHY or read the present operation status of PHY. 32 registers for MDIO is necessitated for control, status, and extended.

Figure 10 shows AN function of this system. AN is anoperation which can inform the partner of its own operation method and then detect the operation method of partner.

Many registers are used for AN function. AN operation uses SR (Status Register), ANAR (AN Advertisement Register), and ANLPAR (AN Link Partner ability base page Register) of management registers. ANAR is the register that stores its own ability to advertise, and ANLPAR is the register that receives the ability information of partner and then stores it.

Figure 11 shows MAC operation flow. In figure 10, VDSL modem in CPE is operated in MAC mode. In this case,PHY is bypassed. Its operation is done by register (MAC_CMD). MAC flow is operated accor -ding to VDSL link bit, Ethernet Link bit, and ANEG -ON bit. In figure 11, AVENUS and VDSL mode negotiates the duplex and the speed.

Figure 12 shows VDSL frame format. It consists of header and data. 5 bytes header is not interleaved

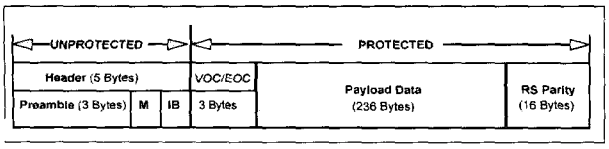

그림 12. VDSL 프레임 형식
Fig. 12. VDSL frame format.

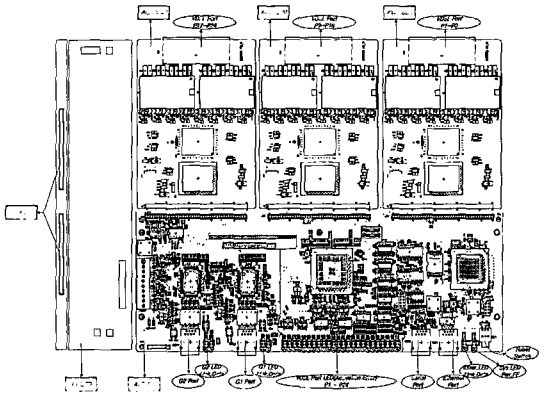

그림 13. AVENUE 시스템 구성
Fig. 13. AVENUE system configurations.

and then is not protected by RS-FEC (Reed Solomon -Forward Error Correction). The protected data is protected by scrambled, interleaved, Reed Solomon. And 3 bytes preamble is located at first position of VDSL frame and used for frame synchronization. Tx and Rx preamble is defined by Modem, and has same value. M (Interleaver Depth) deicide the protection level for the protected part of frame. IB is reserved for Indication Bit. And EOC (Embedded Operation Channel) is connected to outer pin directly and used to clear a channel. EOC also is used to transfer in-band traffic, such as management traffic. VOC (VDSL Operation Channel) is used to transfer control and status information between local and remote devices.

Figure 13 shows the entire board configuration, which has one AVE_CO board, three AVE_IO boards, and one AVE_PO board. This system can indicate the operation status for 10/100 Ethernet ports and Gigabit Ethernet ports, such speed (10/100M), duplex mode (Full/Half), Activity, and warning/error. It also indicates each VDSL port status, such as link status, data transfer status, and error status.

AVE_IO consists of VDSL transceivers for 8 10/100 Ethernet PHYs, AFE for 8 ports, 8 VDSL line drivers, diverse filter for each port, and transformer

표 2. VDSL PHY 초기화
Table 2. VDSL PHY initialization.

Device Name	PHY Address	Initial setting value
VDSL 0	01xxx	Port 0~7 : 000~111(08h~0Fh)
VDSL 1	10xxx	Port 8~15 : 000~111(10h~18h)
VDSL 2	11xxx	Port 16~23 : 000~111(18h~1Fh)

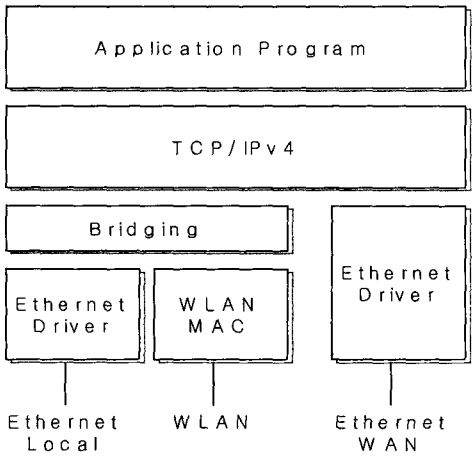

그림 14. WLAN AP 프로토콜 스택
Fig. 14. WLAN AP protocol stack.

for each port. AVE_IO has 8 VDSL ports. Avenue system has 3 AVE_IO boards, and then total 24

VDSL ports. AVE_IO boardis connected to AVE_CO board through 2 X 45 connector. So it is controlled by CPU and connected to Ethernet switch through SMII. The connector for 24 VDSL ports is realized in RJ-45 and is connector to outer splitter. Table3 shows VDSL PHY initial process.

Figure 14 shows the protocol stack of WLAN AP. This is connected to VDSL modem through WAN interface port in remote sites, such as home, office, and hotel lobby.

VDSL modem is connected to Avenue system through phone line. To satisfy this protocol stack, WLAN AP performs following function:

- Device driver for Ethernet interface
- IEEE802.11b wireless LAN MAC driver
- Layer 3 forwarding function between Ethernet ports for WAN interface and for local interface

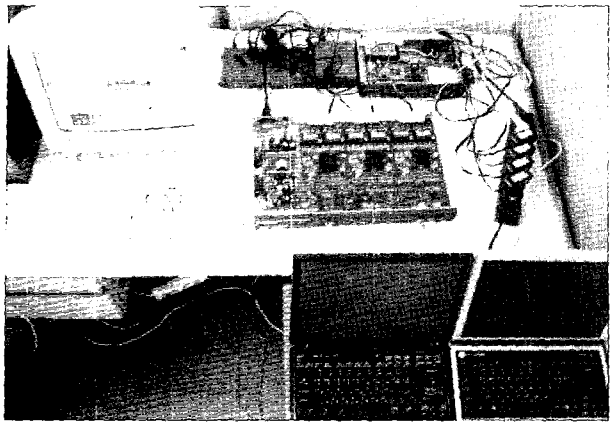

그림 15. 테스트를 위한 시스템 구성
Fig. 15. System Configuration for test.

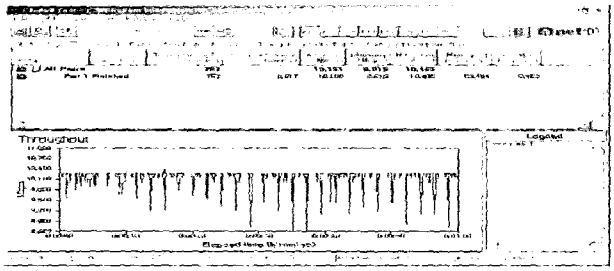

그림 16. 50m에 대한 전송 특성
Fig. 16. Transfer characteristics for 50m.

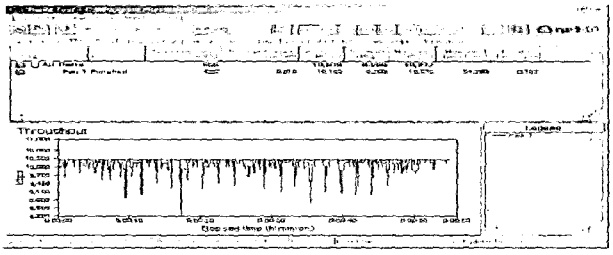

그림 17. 1000m에 대한 전송 특성
Fig. 17. Transfer characteristics for 1000m.

- Layer 2 bridging function between Ethernet ports for local interface
- Layer 2 bridging function between wireless LAN interface and Ethernet ports for local interface

Figure 15 shows the system configuration to test this system. This configuration consists of one access system, 4 VDSL modems, and one WLAN AP. We use CPEV_0.5mm for VDSL link between AVENUE system and VDSL modem. Transmission distances are 50m, 500m, 800m, and 1000m. And we performs the test for branch, hook signal, and ring signal. This system can provide the multimedia services by connecting xDSL technology to VLAN mapping technology for charging and QoS technology for

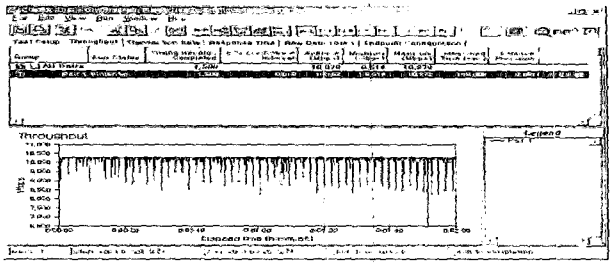

그림 18. 링 신호시 500m에 대한 전송 특성
Fig. 18. Transfer characteristics for 500m with ring signal.

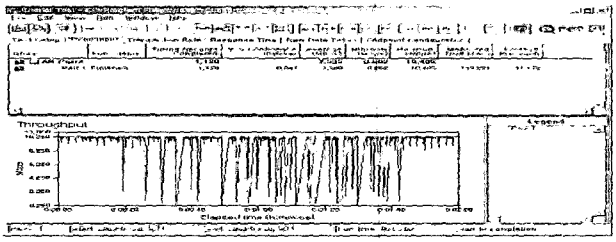

그림 19. 훅 신호시 500m에 대한 전송 특성
Fig. 19. Transfer characteristics for 500m with Hook signal.

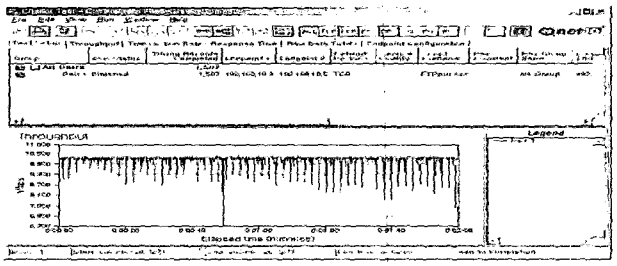

그림 20. 링 신호시 800m에 대한 전송 특성
Fig. 20. Transfer characteristics for 800m with ring signal.

video stream transmission. But it is also important for this system to supply the stable transmission signals. So this test is necessitatedto verify if this system can provide the stable service in the various situations.

Figure 16 and 17 show the transfer characteristics for 50m and 1000m-transmission distance respective -ly. Both show the stable transmission performance over 10Mbps. In large-scale hotels,there are many buildings with many rooms. So the stable transmi -ssion signals are important for diverse transmission distances.

Figure 18 shows the transfer characteristics for 500m-transmissiondistance in environment of ring signal. Under ring signal, it shows also the perfor -mance over about 8Mbps. This can provide users

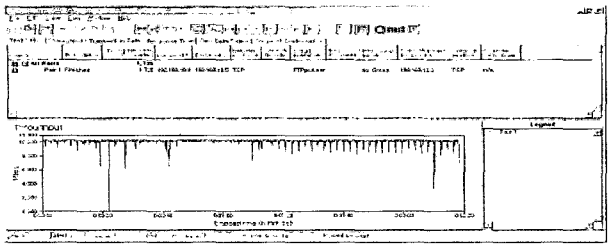

그림 21. 4.5m 브리지 탭을 가진 800m에 대한 전송특성
Fig. 21. Transfer characteristics for 800m with 4.5m -bridged tap.

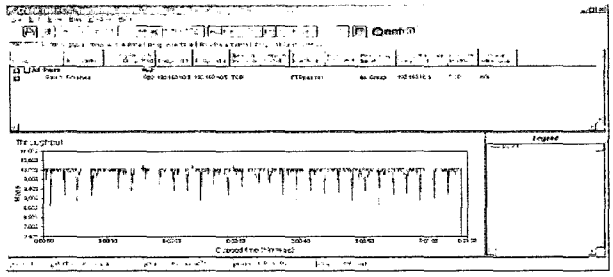

그림 22. 6m 브리지 탭을 가진 800m에 대한 전송특성
Fig. 22. Transfer characteristics for 800m with 6m -bridged tap.

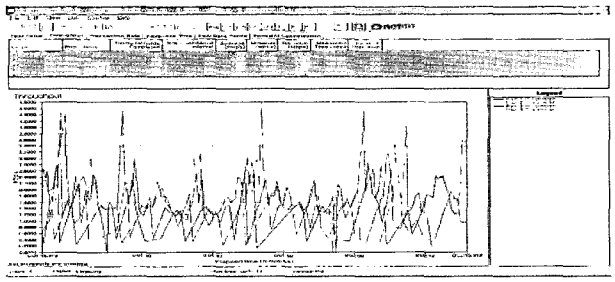

그림 23. WLAN 전송 특성
Fig. 23. WLAN transfer Characteristics.

with stable service through phone line.

Figure 18 shows the transfer characteristics for 500m-transmissiondistance in environment of ring signal. Under ring signal, it shows also the perfor -mance over about 8Mbps. This can provide users with stable service through phone line.

Figure 19 shows the transfer characteristics for 500m-transmission distance in environment of hook signal. Under 2 hook signals per second, it shows also the performance over average 7.5Mbps.This shows that services can be influenced by hook signal.

Figure 20 shows the transfer characteristics for 800m-transmission distance in environment of ring signal. Under ring signal, it shows also the perfor -mance over average 8Mbps. Specifically, it is shown that the hook signal are much more than damaging than the ring signal through figure 19 and 20.

Figure 21 shows the transfer characteristics for 800m-transmission distance in environment of 4.5m-bridged tap. Under 4.5m-branch environment, it shows also the performance over average 9Mbps.

Figure 22 shows the transfer characteristics for 800m-transmission distance in environment of 6m -bridged tap. Specifically, it is shown that the short -bridged taps are much more than damaging than the longer bridged-taps through figure 21.

Figure 23 shows WLAN transfer characteristics. For link configuration, such as PC (Wireless LAN card)<->WLAN (AP port)<->WLAN uplink port<-> VDSL modem<->Avenue system local port<-> Ave -nue system uplink port<->PC (Wired LAN card), this test shows about 4.7Mbps transmission rate. For link configuration, such as PC(wired LAN card)<-> VDSL modem<->Avenue system local port<-> Avenue system uplink port<->PC(Wired LAN card), this test shows about 7.2Mbps transmission rate.

VI. Conclusion

This hotel multimedia service solution adds VLAN mapping technology and QoS transfer technology to xDSL technology that our country takes the lead worldwide. So it is the system that can create the new hotel multimedia market using our excellent technology. This VoD/Internet service system is applied to hotel at first, and then can spread to the mass dwelling region gradually, such as apartment.

This consists of access system technology, VDSL model core technology, and VDSL WLAN AP techno -logy. Access system technology includes VLAN mapping technology per port for the charging in up -stream traffic, QoS mapping technologyfor down -stream traffic, IP multicasting function, and VDSL interface technology. VDSL model core technology includes the link stabilization technology, the auto -matic speed control technology, and the link set-up and speed control technology for interworking with access system. VDSL WLAN AP technology consists

of IEEE802.11b control technology and VDSL inter -face technology.

Therefore, this system can supply the ability to transfer high-speed traffic, the billing function with -out additional login per room, the seamless high -quality transfer for video stream, thebroadcasting service based-on IP, the connection of WLAN AP using phone line, and so on.

In the near future, we will make up for this system in security field, and then will implement the system for commercial product.

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