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휴대용 멀티미디어 기기에서의 무선 영상 미러링 서비스를 위한 비압축 영상 전송 시스템의 구현

이상재[◆°], 전영애[*], 최상성[**], 조경록[***]

Implementation of Uncompressed Video Transmission System for Wireless Video Mirroring Service in Portable Multimedia Devices

Sangjae Lee[◆°], Youngae Jeon[*], Sangsung Choi[**], Kyoung-Rok Cho[***]

요약

비압축 영상의 무선 전송은 압축된 영상의 전송과 비교해서 높은 영상 품질과 낮은 지연을 보장한다. 비록 현재의 무선 전송 기술로는 수 Gb/s에 이르는 Full HD급의 영상을 전송하기는 어렵지만 ultra-wideband (UWB)와 같은 몇 가지 종류의 무선 기술은 1 Gb/s의 데이터 전송율을 보장하며 이를 이용하여 휴대용 멀티미디어 기기에서 비압축 영상 전송 서비스를 제공할 수 있다. 본 논문에서는 휴대용 멀티미디어 기기에서의 무선 영상 미러링 서비스를 위한 비압축 영상 전송 시스템을 제안한다. 먼저 단일 또는 다수의 1 Gb/s UWB 기술을 이용한 비압축 영상 전송 성능을 시뮬레이션을 통해 비교하였고 하드웨어로 구현된 비압축 영상 전송 블록과 Gb/s급 무선 MAC 가속기 블록에 대해 설명하였다. 마지막으로 다중 UWB 물리계층을 사용한 HD급 비압축 영상 전송 시스템의 구현 및 시연에 대해 설명하였다.

Key Words : UWB, Uncompressed, Wireless, Video, Transmission

ABSTRACT

Wireless transmission of uncompressed video guarantees higher quality with lower latency than compressed video transmission. Although current wireless technologies cannot fully cover required data rates of about a few Gb/s for full high definition resolution, some wireless technologies such as ultra-wideband (UWB) provide 1 Gb/s data rate which is adequate for uncompressed video transmission in portable devices. In this paper, we propose an uncompressed video transmission system for wireless mirroring services in portable devices. We firstly simulated the performance of uncompressed video transmission using single or multiple 1 Gb/s UWB technology. Then we implemented hardware-based uncompressed video processing block and Gb/s wireless MAC accelerator. Finally, we show the implementation result and the demonstration of uncompressed HD video transmission using multiple 1 Gb/s UWB PHYs.

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◆ 주저자 겸 교신저자 : 한국전자통신연구원, leestrike@etri.re.kr, 정회원
* 한국전자통신연구원, yajeoni@etri.re.kr, 정회원
** 한국전자통신연구원, sschoi@etri.re.kr, 정회원
*** 충북대학교 정보통신공학부, krcho@chungbuk.ac.kr

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Ⅰ. Introduction

For recent few years, people have tried connecting HDTVs with portable multimedia devices such as smart phones or table PCs using uncompressed video mirroring technologies such as High-Definition Multimedia Interface (HDMI). Uncompressed video transmission technologies can offer high video quality, low latency and low cost[1]. Although HDMI has several advantages, current HDMI connection still requires a thick cable. Several wireless video transmission technologies have been emerged to replace wired video connection into wireless one.

Among those newly emerged wireless technologies, ultra-wideband (UWB) technology has been used for high rate wireless personal area networks (WPANs) because UWB itself can offer a very large application bandwidth up to 1 Gb/s[2]. Moreover, UWB technology, which consumes very low power, can be easily adopted to portable devices. Among the various standard activities for UWB technology, the WiMedia medium access control (MAC) and physical layer (PHY) specifications have made a first step for commercialized UWB products such as wireless USB devices.

Thereby, by utilizing the huge bandwidth of the WiMedia PHY and the explicit medium access characteristics of the WiMedia MAC, we may successfully offer uncompressed video mirroring services with guaranteeing quality of service (QoS) as shown in Fig. 1.

In this paper, we propose an uncompressed video transmission system named as "Wireless eXpress" (WiX) for wireless video mirroring services in portable devices. At first, we introduce the architecture of the proposed system. Then we build a simulation model to verify the possibilities of Gb/s wireless uncompressed video transmission. And we explain the delay characteristics of uncompressed video transmission for both single UWB PHY and multiple UWB PHYs using the WiX simulation model. Finally, we show the implementation and demonstration results of the WiX system.

그림 1. 무선 비압축 영상 미러링의 구성 예
Fig. 1. An example configuration of wireless uncompressed video mirroring

Ⅱ. Technical Background

2.1. WiMedia MAC Specification and Related Works

The proposed WiX system consists of uncompressed video processing block, MAC hardware acceleration block and multiple UWB PHYs. The MAC layer of the proposed WiX system is designed based on the WiMedia MAC specification. A timeline of one superframe is divided into 256 fixed length medium access slots (MAS) of 256 us each in duration in the WiMedia MAC specification [3]. We can reserve MASs as two types. One is a contention-based method called as the prioritized contention access (PCA) and the other is an explicit medium access method called as the distributed reservation protocol (DRP). Within DRP reservation periods, no devices can access the medium except the reservation owner and target. In this reason, a DRP reservation method can be used for video streaming applications with guaranteeing QoS. We mainly focus on the usage of DRP reservations for the Gb/s video streaming in the WiX system.

In spite of several advantages of UWB technologies for multimedia transmission, only a

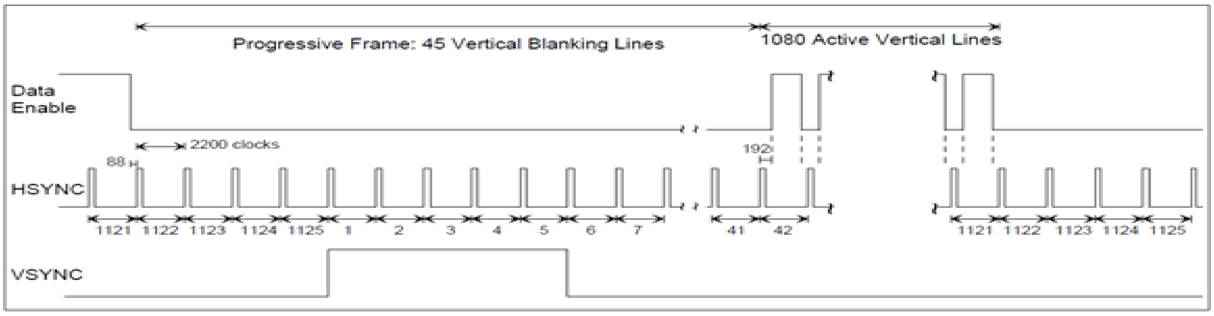

그림 2. 1920x1080p 영상 프레임의 신호 타이밍 예
Fig. 2. An example of video signal timings for 1920x1080p video frame

few studies have been done on the WiMedia MAC. Several researches only focused on the analysis of MAC performance about contention-based PCA reservation policies with or without DRP reservations[4-6]. Kim introduced real-time HD video transmission schemes using UWB and IEEE1394 technologies for multimedia video transmission using DRP reservations, but those schemes only used software-based processing of HD streams[7]. Kuo analyzed the performance of MPEG video transmission using DRP reservations, but only focused on DRP allocation methods, not a queuing problem for multiple HD video streams[8]. Lee implemented a compressed video transmission system using a single 1 Gb/s UWB PHY, not the uncompressed video transmission[9].

For other transmission technologies besides UWB technology, Gilbert introduced 4 Gb/s uncompressed wireless HD A/V transmission chipset using 60 GHz wireless technology, but the basic assumption was the usage of more power up to 10 W which is very large compared with UWB technology [1]. Chung also proposed 1.485 Gb/s video signal transmission system operating at 240 GHz and 300 GHz carrier frequencies, but focused on the radio frequency technology for relaying HD serial digital interface[10].

In this paper, however, we analyze the performance of a hardware-based video data processing for the WiX system to handle uncompressed HD video streams, not the MAC performance itself. Specifically, we focus on the performance evaluation of hardware-based scheduling technique and segmentation and reassembly techniques.

2.2. Uncompressed Video Format

Because many recent multimedia devices offer HDMI as uncompressed video interface, the WiX system adopts HDMI as a video interface. HDMI can support lots of video frame format and the video signal timing is different depending on the video format. Fig. 2 shows example timing for 1920x1080p video frame. By observing the horizontal synchronization (HSYNC) and vertical synchronization (VSYNC) signals, we can catch the start point of one video frame. Each period of one video frame is again separated into video data (active) period and data island (blanking) period. During the active period, active pixel data of an active video line are transmitted. Regarding the maximum bandwidth of 3 Gb/s of the WiX system, we use two high definition (HD) video frame format – 1280x720p@60Hz and 1920x1080i@30Hz.

Ⅲ. Uncompressed Video Transmission System

3.1. System Architecture

In order to transmit uncompressed video data up to a few Gb/s, we process video frames by hardware. We also adopt an acceleration feature for the Gb/s wireless MAC in the proposed system. Fig. 3 illustrates the hardware architecture of the WiX system. The WiX consists of three parts. One is the uncompressed image processing block (NIPB) which contains video frame detection, queuing and aggregation functions for bridging between the HDMI interface and the UWB wireless interface. Another block is the wireless MAC hardware accelerator (MMHA) which can manage multiple UWB PHYs based on WiMedia MAC specification. The MMHA has a role of real-time superframe control and MAS reservation handling, FCS and on-the-fly security functions, and other time critical MAC functions. The other block is the single or multiple UWB PHY interface block.

In more detail, the NIPB detects video frame format by observing the HSYNC and VSYNC signals. The MAC software calculates the maximum bandwidth for the detected video format and reserves MASs depending on the video frame format. The MAS reservation information is used for real time MAS scheduling and saved into the protocol controller in the MMHA. After the MAS reservation, the NIPB saves the active video pixel data of the active video line into the TX Queue.

Then the NIPB aggregates the pixel data of several active video lines in the TX Queue into one wireless packet to transfer the wireless packet to the MMHA. The size of aggregated wireless packets depends on the MAS scheduling information of the MMHA and the channel status. Within the reserved MAS period, the MMHA continuously checks the buffer descriptor information which is updated by the NIPB depending on the status of the TX queue. Each PHY is assigned to its own TX/RX buffer descriptor and the MAC data path. In other words, any retransmission operation of each PHY due to transmission error can be done separately regardless of the status of other PHYs. Finally, the MMHA consists of one protocol control block and three data paths which are connected to each dedicated PHY. The protocol controller in the MMHA checks the reserved MAS information and generates the scheduling information such as superframe control, MAS management, and multi-PHY control.

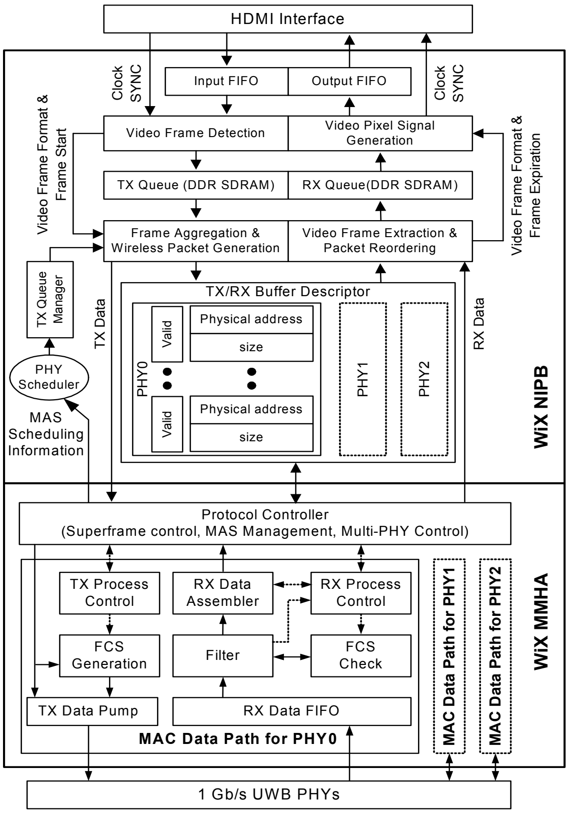

그림 3. 비압축 영상 전송을 위한 WiX 시스템 구조
Fig. 3. WiX system architecture for uncompressed video transmission

As mentioned above, the NIPB aggregates the pixel data of several active video lines into one wireless packet with aggregation headers as shown in Fig. 4. Additional PADs are inserted between video pixel data because of the address alignment for DDR SDRAMs. Each element of the MAC frame and video frame header is defined as follows.

- MAC header is the WiMedia MAC frame header.
- Video header is the video frame header for one fixed size video pixel data block.
- Video data are fixed size video pixel or audio data.
- FCS is the frame check sequence of one wireless packet.
- Resolution indicates the resolution of the video

frame.

- A/V represents the type of audio and video data.
- Aggregation information contains the total number of aggregated video pixel data.
- Frame length is the size of video pixel data.
- Frame number indicates the number of each video frame. This frame number is increased by one at each video frame. For example, there exist 30 video frames during one second for 1920x1080i@30Hz video frame format.
- Data number represents the offset of each video pixel data from the start point of one video frame. Data number is reset to zero at the start of next video frame.

At the receiver side, once wireless packets are received correctly, they are stored to the RX queue in the NIPB. But the arrival sequence is different from the transmission sequence because packet retransmission randomly and independently occurs in each PHY due to frame errors during packet transmission. Therefore, video pixel data should be sequentially arranged using the frame number and data number field in the video header. For example, by using the data number field, we can calculate the offset address from the start point of each video frame and store the video pixel data to the exact location of the video frame queue in the RX queue. Fig. 5 depicts the architecture of the RX queue of the NIPB.

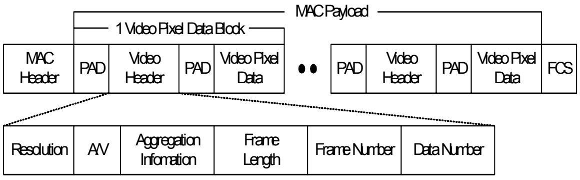

그림 4. 결합된 영상 데이터 전송을 위한 MAC 프레임 구조
Fig. 4. MAC frame format for transmission of aggregated video data

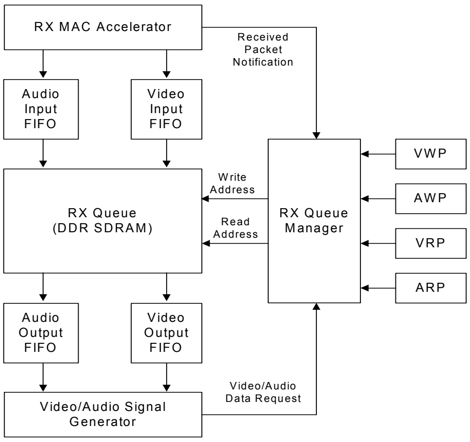

그림 5. NIPB에서의 수신 큐 구조
Fig. 5. RX queue architecture of the NIPB

The RX Queue Manager maintains several pointers for video and audio data blocks such as video write pointer (VWP), audio write pointer (AWP), video read pointer (VRP), and audio read pointer (ARP). If any packet is received at the RX block of the MMHA, the MMHA notifies the packet reception to the RX queue manager in the NIPB. And the Video/Audio signal generator request video/audio data to the RX queue manager.

We need 1024 addresses to store 4096 bytes of one video pixel data block to the DDR SDRAM of the RX queue with 32 bits data bus. Thus, the basic storing block size is 1024x32 bits. We divide the RX queue as 4 sections and each section has 2048 video storing blocks and 154 audio storing blocks. All video and audio pointers are 13 bits width and the most significant 2 bits of each pointer are assigned to 4 sections respectively. Other 11 bits except section bits are the block address and assigned to the location of the basic blocks of the section. Once packets are received from the MMHA, the RX Queue Manager extracts the sections bits and block address from the least significant 2 bits of the frame number and 11 bits of the data number fields in the video header, respectively. The RX Queue Manager stores the video pixel data to the extracted section and block address of the RX queue.

When the Video/Audio Signal Generator request a read operation to the RX Queue Manager, some conditions should be met so that AWP(12:11) >

ARP(12:11) + 1 and VWP(12:11) > VRP(12:11) + 1. And ARP and VRP are increased upon the read request. Moreover, in order to consider packet losses due to transmission errors and prevent abnormal operation during video/audio signal generation, expected header information is stored to the RX queue during the initialization. Finally, we simply samples audio signals at the transmission block of the NIPB and transmit sampled data using the same method as video processing. This method increases the required bandwidth but reduces audio/video synchronization problem.

3.2. Calculation of Usable Bandwidth

In order to define the hardware specification of the WiX system, we should firstly calculate the required bandwidth and the number of reserved MASs. Regarding the WiMedia specification, an actual transmission speed depends on several factors such as frame size, retransmission rate, PHY preambles and tail overhead, inter-frame space, and ACK overhead. We use 1920x1080i@30Hz and 1280x720p@60Hz video frame and 4:2:2 chroma subsampling mode in which 1 video pixel is represented as 16 bits data. For retransmission of wireless packets, we use immediate acknowledgement (immediate-ACK) policy. We assume that the maximum orthogonal frequency division modulation (OFDM) PHY rate is 1024 Mb/s. Then, we can simply calculate the transmission time of single wireless packet which includes one or more video pixel data blocks.

For 1080i@30Hz mode, we need 1920 x 16 x 1080 x 30 = 995.328 Mb/s bandwidth for 1 second for only pure video pixel data. For 720p@60Hz mode, we need 1280 x 16 x 720 x 60 = 884.736 Mb/s bandwidth. Because those video data should be transmitted through wireless channel, we should consider encapsulation and transmission overhead and calculate exact bandwidth requirement.

For transmitting uncompressed video pixel data through wireless channel, we aggregate several active video pixel data of the active video lines and add video header and PADs so that the basic size of each video pixel data becomes 4096 bytes. Although the maximum payload length is 16383 bytes in the WiMedia specification, we aggregate up to 4 video pixel data block regarding the transmission efficiency due to retransmissions.

For example, if we aggregate two video pixel data blocks, the payload length becomes 4096 x 2 = 8192 bytes and the transmission time is calculated as *Payload Length + FCS + PSDU tail overhead* = ⌈(8192 bytes + 4bytes + 6bits)/1920bits⌉ = 35 x 6 symbols where the length of 6 symbols is 1920 bits in the UWB

표 1. Aggregation 개수에 따른 최대 전송 대역의 계산
Table 1. Calculation of Maximum Bandwidth According to the Number of Aggregation.

Number of Aggregation	Payload length for 1 wireless packet (symbols)	Total payload length for 1 superframe (packets)	Maximum bandwidth for 1 channel (Mb/s)	Maximum bandwidth for 3 channels (Gb/s)
1	⌈(1x4096 bytes + 4bytes + 6bits)/1920bits⌉ = 18 x 6 = 108	254 x 819.2 / (108+148) = 812	812 x 4096 x 1 x 8/256/256 = 406	1.218
2	⌈(2x4096 bytes + 4bytes + 6bits)/1920bits⌉ = 35 x 6 = 210	254 x 819.2 / (210+148) = 581	581 x 4096 x 2 x 8/256/256 = 581	1.743
3	⌈(3x4096 bytes + 4bytes + 6bits)/1920bits⌉ = 52 x 6 = 312	254 x 819.2 / (312+148) = 452	452 x 4096 x 3 x 8/256/256 = 678	2.034
4	⌈(4x4096 bytes + 4bytes + 6bits)/1920bits⌉ = 68 x 6 = 408	254 x 819.2 / (408+148) = 374	374 x 4096 x 4 x 8/256/256 = 748	2.244

OFDM PHY. We should add *PLCP preamble length* + *PLCP header length* + *SIFS length* + *ACK length* + *SIFS length* = 148 symbols to the transmission time.

The duration of one MAS is 256 us which is equal to 819.2 symbol duration. If we use only two MASs for beacon transmission, we can use maximum 254 MASs for one superframe. Therefore, we can transmit 254 MASs x 819.2 symbols / (210 + 148) symbols = 581 wireless packets for one superframe and the maximum transmit speed is calculated as 581 packets x 4096 bytes x 2 video pixel data x 8 bits / (256 MAS x 256 us) = 581 Mb/s for one PHY. Because we use three PHYs, we can get 581 Mb/s x 3 PHYs = 1.743 Gb/s bandwidth. We calculate the maximum bandwidth for different aggregation size with 254 reserved MASs like Table 1.

For example, if no aggregation policy is used, only one video pixel data block is included in one wireless packet. In that case, we can transmit up to 1.218 Gb/s with three PHYs. If twe video pixel data blocks are aggregated in one wireless packet, maximum bandwidth is increased to 1.743 Gb/s. Finally, if the aggregation number is 4, the maximum bandwidth is increased to 2.244 Gb/s which is almost 74.8% of the maximum PHY rate. But we cannot aggregate four video pixel data blocks because the payload length exceeds the maximum payload length of 16383 bytes which is the upper limitation of WiMedia packet. In the WiX system, we slightly adjust the size of basic video data for the aggregation of four video pixel data blocks.

Ⅳ. Performance Evaluation and Implementation Results

In order to check the performance of the WiX system, we built a simulation model which was very close to the architecture of the real implementation. Although we implemented the WiX system to transmit HD uncompressed video, we also simulated 720x480p@60Hz format to check the performance when single PHY was used. Because of memory limitations during the simulation, we set the buffer size to 10000 video data blocks and the size of basic video block as 4096 bytes. We also reserved 240 MASs for one superframe. Then we set the initial maximum input traffic load for each video format. For example, we set the maximum traffic load for 1080i@30Hz as 1.1625 Gb/s because we can transmit 1029 pure video pixel data in 1 video frame and 1029 video pixel data x 30 video frames x 4096 bytes / 1 second = 1.0111 Gb/s. We also added 151.388 Mb/s bandwidth of sampled audio data. Thus, the final maximum input traffic load was calculated as 1.1625 Gb/s. The simulation parameters are chosen like Table 2.

표 2. 시뮬레이션 파라미터
Table 2. Simulation Parameters.

Parameter	Value
Basic video data block length	4096
Buffer size	10000 video data block
Maximum input traffic load for 480p	0.4379 Gb/s
Maximum input traffic load for 720p	1.0501 Gb/s
Maximum input traffic load for 1080i	1.1625 Gb/s
Number of allotted MAS	240
Maximum number of aggregation	4

During the simulation, we should consider transmission error which increases required transmission bandwidth. We assume that transmission is retried until retransmission is successfully done. If we assume that r is the probability of retransmission of aggregated frame, then the expectation value of retransmission E is calculated as

$$E = r + r \cdot r + r \cdot r \cdot r + r^4 + r^5 + \cdots = r/(1-r) \quad . (1)$$

Thus, for example, the effective input traffic rate

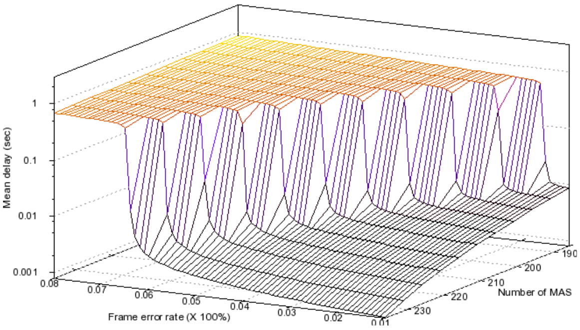

그림 6. FER 및 MAS 개수의 변화에 따른 720x480p에서의 평균 지연
Fig. 6. Mean delay for 720x480p depending on FER and number of MAS

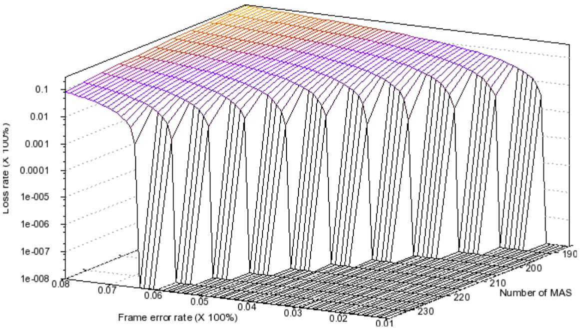

그림 7. FER 및 MAS 개수의 변화에 따른 720x480p에서의 손실율
Fig. 7. Loss rate for 720x480p depending on FER and number of MAS

for 1080i mode is recalculated as shown in Table 3.

We use those values for the simulation once the retransmission probability is given. Finally, all the MAC and PHY parameters are same as the WiMedia MAC and PHY specifications and the PHY rates is set to 1024 Mb/s mode. Fig. 6 shows the simulation result of the increment of the mean delay depending on the changes of both the frame error rate (FER) and the number of reserved MASs for 720x480p@60Hz using single 1 Gb/s PHY. When the number of reserved MASs decreases, the saturation point at which the mean delay rapidly increases becomes lower. From Fig. 7, we can observe that video pixel data are discarded and the frame loss occurs at the saturation point. Before the saturation point, the mean delay is maintained below 10 ms.

For another case, we can transmit 1920x1080i@30Hz video frames using multiple UWB PHYs. Fig. 8 and Fig. 9 illustrate the simulation result of the increment of the mean delay and the loss rate depending on the changes of both the FER, the number of PHYs, the number of reserved MASs, and the number of aggregated video pixel data blocks using multiple 1 Gb/s PHYs.

When the reserved number of MASs is same, it is evident that more usage of PHYs represents a better delay performance. If we use two PHYs and the reserved number of MASs is 200, we can get a better result when we aggregate 4 video blocks than 3 video blocks. On the other hand, if we use two PHYs and the reserved number of MASs is 240, the aggregation of 3 video blocks shows a better result than the aggregation of 4 video blocks. Base on the simulation result, the NIPB dynamically adjusts both the number of reserved MASs and the aggregation policies depending on the channel status and the number of PHYs while maintaining average delay below 10 ms which is an acceptable value for HD video transmissions [11]. As a result, we can calculate the maximum

표 3. 재전송에 따른 입력 트래픽 로드의 증가
Table 3. Increment of Input Traffic Load with Retransmission.

Number of Aggregation	Expected value of retransmission	Effective input traffic load (Gb/s)		
		$r =$ **0.1**	$r =$ **0.14**	$r =$ **0.16**
1	$r/(1-r)$	1.29	1.35	1.38
2	$2r/(1-2r)$	1.45	1.61	1.71
3	$3r/(1-3r)$	1.66	2.00	2.24
4	$4r/(1-4r)$	1.94	2.64	3.23

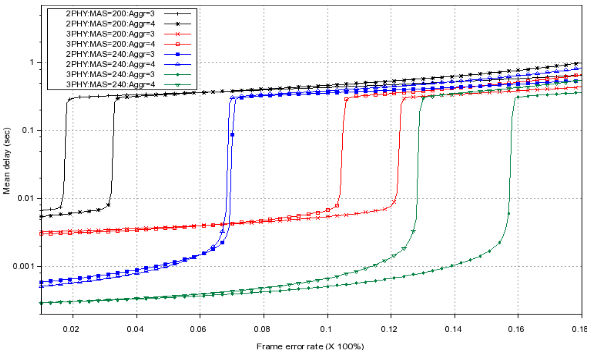

그림 8. 다중 PHY 사용 시 FER의 변화에 따른 1920x1080i에서의 평균 지연
Fig. 8. Mean delay for 1920x1080i depending on FER using multiple PHYs

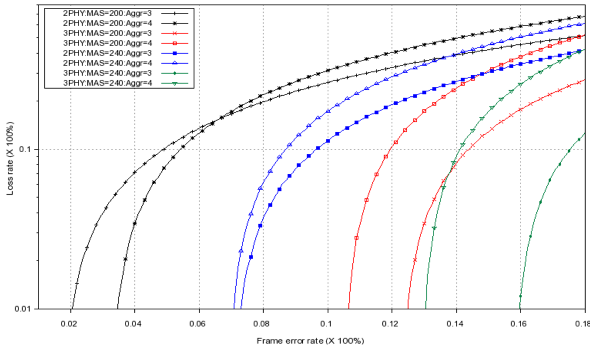

그림 9. 다중 PHY 사용 시 FER의 변화에 따른 1920x1080i에서의 손실율
Fig. 9. Loss rate for 1920x1080i depending on FER using multiple PHYs

throughput below which the packet loss does not occurs.

Finally, we implemented the WiX system using FPGAs and three 1 Gb/s UWB PHYs as shown in Fig. 10. The NIPB and the MMHA were implemented in single FPGA and the 1 Gb/s UWB modem was implemented in another module. Due to the experimental problem, we didn't use RF interface. Instead, modem-to-modem interface is connected through digital-to-analog and analog-to-digital converters.

In order to verify the performance and operation of 1 Gb/s UWB modem, we set the modem rate to 960 Mb/s mode. Then we transmitted test packets of 8000 bytes length and captured the received packet at the receiver FPGA as depicted in Fig. 10. The upper 8 bits of test data in the payload were repeatedly increased in the range of 0 to 255 and the lower 8 bits of test data is repeatedly decreased in the range of 255 to 0. Based on the WiMedia PHY specification, the transmission for preamble and header did not use 960 Mbps mode and required 12 OFDM symbol duration, which was equal to 13.125 us[2]. On the other hand, the transmission of the payload used 960 Mb/s mode and required 36 OFDM symbol duration, which was equal to 67.5 us. As a result, the application bandwidth was calculated as 8000 bytes x 8 bits / 67.5 us = 948.15 Mb/s, which was acceptable bandwidth for the demonstration. From the experiment, we confirmed that received packets were successfully decoded at all UWB modems. We thus fixed the modem rate as 960 Mb/s mode in the demonstration.

The demonstration of uncompressed HD video transmission using the WiX system is illustrated in Fig. 11. We used a smart phone for the HDMI source which offers HDMI mirroring service. In more detail, the smart phone is connected to the HDMI port of the transmission system of the NIPB and MMHA which is connected to three 1 Gb/s UWB modems. And we also used a commercial HDTV which offers HDMI interface for the HDMI client. The video format was set to 1920x1080i@30Hz. Each UWB modem was connected to the counterpart modem through analog interface. We monitored transmitted analog

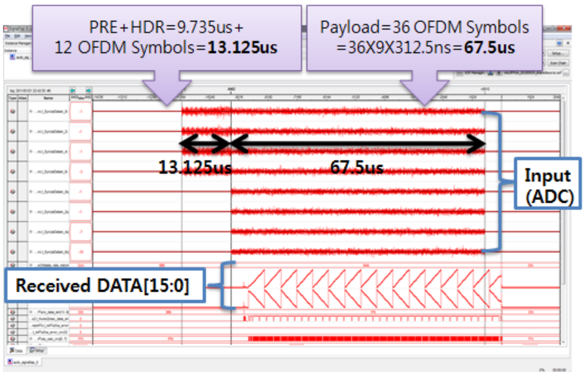

그림 10. 960 Mb/s 모드를 이용한 수신단 물리계층에서의 캡처 파형
Fig. 10. Captured waveform at the receiver PHY using 960 Mb/s mode

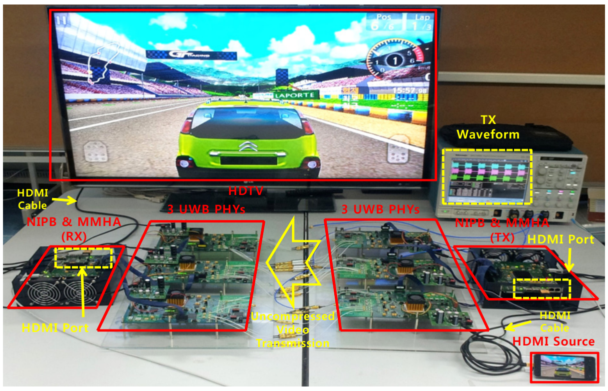

그림 11. 구현된 WiX 시스템 및 비압축 HD 영상 전송 시연
Fig. 11. Implemented WiX system and demonstration of uncompressed HD video transmission

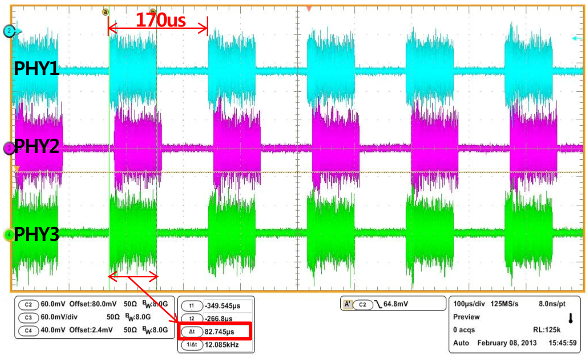

그림 12. 비압축 HD 영상 전송 시연 시의 모든 물리계층의 송신 아날로그 파형
Fig. 12. Transmitted analog waveform of all PHYs during the demonstration of uncompressed HD video transmission

waveform of three channels, appeared in Fig. 12, using an oscilloscope. Because we aggregated 2 video blocks, the payload length of the wireless packet was 8192 bytes and the transmission time of 1 wireless packet including preamble and header was about 82 us, which was very similar to the captured result in Fig. 10. The transmission interval of 1 wireless packet was about 170 us because we should add two *SIFS* duration, reception time of acknowledgement packet, and internal processing time.

The receiver side of the NIPB and MMHA is connected again to three 1 Gb/s modems and also connected to HDTV through a HDMI cable. We reserve 254 MASs and the average frame error rate was maintained below 0.1 %. Because we used retransmission policy, packet losses of video pixel data were almost zero. As a result, 1080i uncompressed video frames were successfully transmitted through the proposed WiX system.

V. Conclusion

Increasing demand for video mirroring services for portable devices can be visualized using uncompressed video transmission technologies. We have proposed a wireless uncompressed video transmission system for video mirroring services which can be used in smart phones or tablet PCs. We built a simulation model for the queuing and scheduling of uncompressed video data. The simulation result showed the possibility of transmitting uncompressed HD video frames for several video formats. We selected the most suitable aggregation policy based on the simulation result. Then we implemented the WiX system using several FPGAs based on the selected aggregation policy and successfully transmitted 1080i uncompressed HD video frames.

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이 상 재 (Sangjae Lee)

1999년 2월 전북대학교 전자공학과 졸업

2001년 2월 전북대학교 전자공학과 석사

2000년~현재 한국전자통신연구원 선임연구원

2010년 9월~현재 충북대학교 정보통신공학부 박사과정

<관심분야> 무선통신 시스템 및 SoC 설계, 무선 MAC 설계

전 영 애 (Youngae Jeon)

1991년 2월 연세대학교 전자공학과 졸업

2001년 2월 충남대학교 정보통신공학과 석사

1991년~현재 한국전자통신연구원 책임연구원

<관심분야> 무선통신 시스템 설계, 무선 LAN, PAN MAC 설계, Home Networking

최 상 성 (Sangsung Choi)

1977년 2월 한양대학교 전자공학과 졸업

1993년 8월 Ohio University Avionics Engineering 석사

1999년 8월 Wyoming University Electrical Engineering 석사

2000년~현재 한국전자통신연구원 책임연구원

<관심분야> 무선통신 시스템 설계, UWB, Home Networking

조 경 록 (Kyoung-Rok Cho)

1977년 경북대학교 전자공학과(공학사)

1989년 일본 동경대학교 전자공학과(공학석사)

1992년 일본 동경대학교 전자공학과(공학박사)

1979년~86년 (주)금성사 TV 연구소 선임 연구원

1999년~2005년 Oregon State University 객원연구원

1992년~현재 충북대학교 정보통신공학부 교수

<관심분야> 통신시스템LSI설계, 저전력 고속회로설계, Platform 기반의 SoC 설계