Implementation and Field Test for Smart Hybrid Mobile Broadcasting System

Yun-Jeong Song, Youngsu Kim, Jeongil Yun, and HyoungSoo Lim

Electronics and Telecommunications Research Institute / Daejeon, Korea {yjsong, kys, sigipus, lim}@etri.re.kr

***** Corresponding Author: Yun-Jeong Song

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***Abstract*:** The era of convergence is being applied to all areas of Information and Communication Technology (ICT). The convergence of broadcasting service and communication service almost occurs on smart devices including smartphone. The smart hybrid Digital Multimedia Broadcasting (DMB) is a typical example of the convergence of broadcasting and wireless communication service. The hybrid mobile broadcasting service can support seamless video, 3D, high quality, and additional data services based on network connection between the broadcasting and wireless network. The gateway and terminal (including apps on the smartphone) take the role of the main components on the hybrid service. This paper presents the service concept, main components structure, the implementation of gateway and terminals, and field test to the urban areas for the mobile hybrid system.

***Keywords*:** Mobile broadcasting, Hybrid DMB, Gateway, Seamless, Smart phone, Field test

1. Introduction

The mobile broadcasting system makes it possible to transmit data including video and audio contents to a plurality of terminals equally and stably over a broadcasting network. Several mobile broadcasting services have been launched zealously, such as Media FLO, DVB-H, T-DMB, and One-seg [1]. T-DMB and One-seg are only operated actively for mobile broadcasting services [2]. Because the T-DMB system is based on the Eureka-147 DAB system, it has the characteristics of the DAB system, such as good mobile reception, power efficient transmission, and low power dissipating receiver [3, 4]. The T-DMB service providers also have been tried several multimedia services, such like TPEG, data, audio services. But, they are difficult to find sufficient revenue from the services.

Nowadays, hybrid services have been introduced on smart devices including smartphones through broadcasting and wireless networks. Smart DMB, which is the target of DMB and multimedia service based on a hybrid network, was launched in May, 2011 in Korea [5, 6]. In Japan, NOTTV has been operated on the mobile multimedia broadcasting service for smart devices, since the service was launched in April, 2012.

The hybrid DMB system can support seamless, 3D, and additional data services. The one of the hybrid services is a seamless service on a hybrid network. Mobile broadcasting services have difficulty in supporting the required service quality in all broadcasting coverage areas. The seamless service can overcome this drawback. That is, the video hybrid broadcasting technology improves the service quality (broadcasting coverage extension) using the characteristics of the simultaneity of broadcasting and the immediate response of communication.

This paper presents the hybrid service concept based on the DMB, gateway and terminals structure, which are the key components for hybrid system, the implementation of gateway and terminal, and the results of a field tests to two urban areas for mobile hybrid system.

This paper is organized as follows. Section II and III a hybrid gateway on the transmission station and verified terminal. Section IV reports the implementation of the gateway server and test terminal with apps on smart device. Section V shows the field test environment and results. Section VI presents the conclusions.

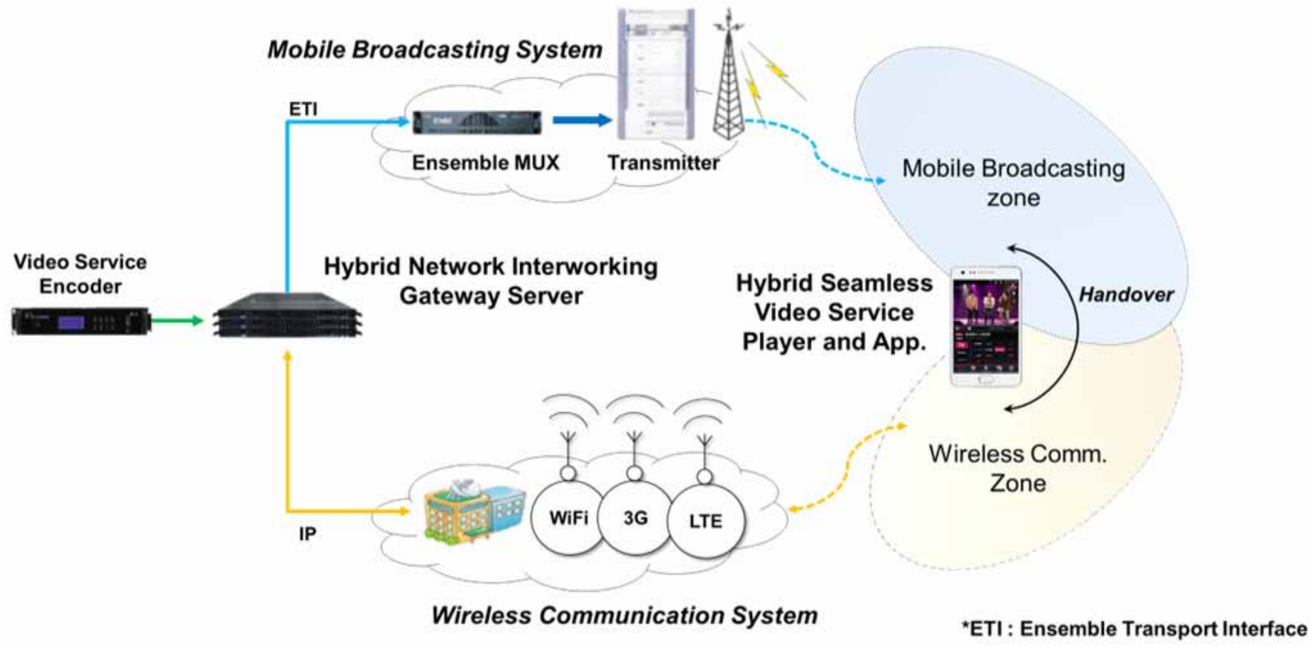


Fig. 1. Hybrid DMB Seamless Service Concept.

2. Hybrid Gateway

The hybrid network interworking service enables the seamless delivery of video for mobile TV viewers moving in and out of a broadcast coverage area. The hybrid seamless mobile broadcasting technology has the effect of extending coverage for mobile broadcasting service virtually with a low traffic load in a wireless communication network. Fig. 1 shows the hybrid DMB seamless service concept. The video interworking service supports a seamless video service on a hybrid network. The user is unaware of the scene changing when video streaming vertical handover occurs between the broadcasting and wireless communication networks.

The hybrid DMB system consists of a hybrid gateway and hybrid terminals with a T-DMB system. The hybrid gateway the role of determining how to send data via a broadcasting network or/and a wireless communication network. The hybrid gateway allows broadcasting of the Ensemble Transport Interface (ETI) for terrestrial mobile broadcasting services, generates an Internet Protocol (IP) stream, and performs access control IP-based streaming on wireless network.

Fig. 2 shows the proposed hybrid DMB gateway structure. The gateway receives the output signal of a video encoder by ETI format and changes the signal to a proper format for DMB transmission. The gateway also re-packages and sends IP stream as the equivalent T-DMB video stream according to the stream request from a hybrid DMB terminal via a wireless network. The ETI frame decoding module de-packetizes the ETI packets to IP packets. As the DMB ETI frame is encoded by the Reed-Solomon (RS) encoder, the out decoder (RS decoder) on the gateway decodes the ETI packets for making the IP packet format stream.

The client access managing module in gateway controls a network connection to the user according to user's stream access request. The stream request signal includes Program Clock Reference (PCR) and time information for finding the starting position of the scene searching index.

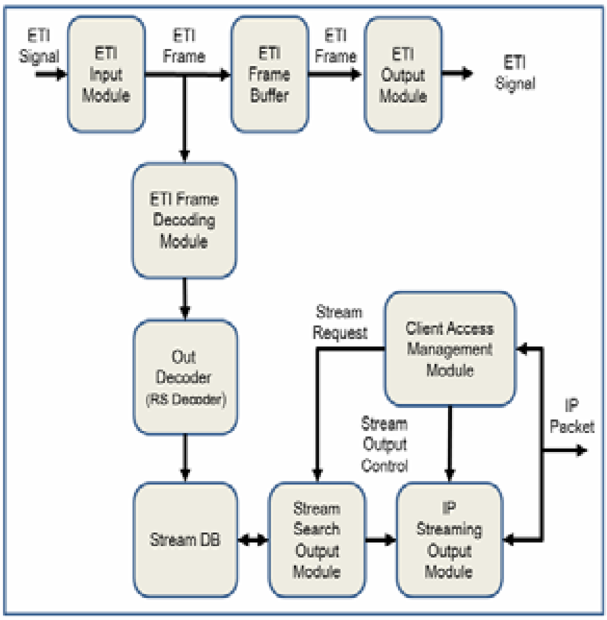


Fig. 2. Hybrid DMB Gateway Structure.

The stream search output module in gateway searches the terminal request scenes on the stream database. The IP streaming output module in gateway packetizes the Transport Stream (TS) packet to an IP packet. At that time, the null packets in the TS stream are eliminated in the IP streaming packet, so the data rate is lower than the TS packet transmission for the same contents.

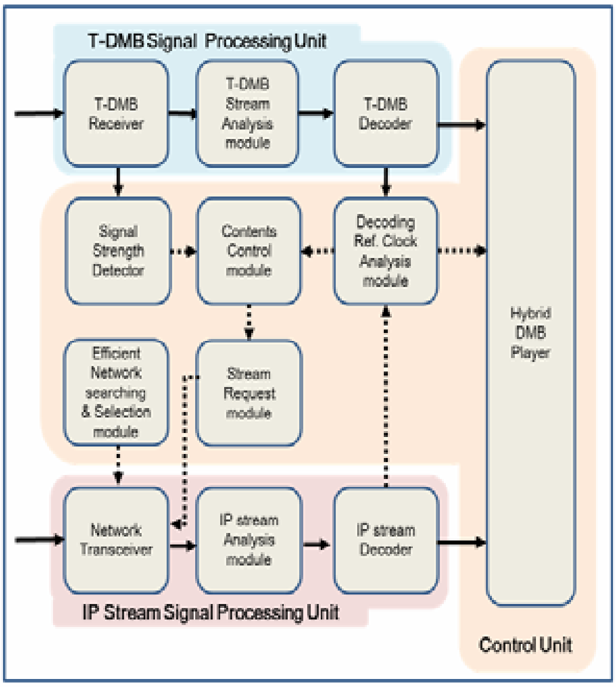


Fig. 3. Hybrid DMB Terminal Structure.

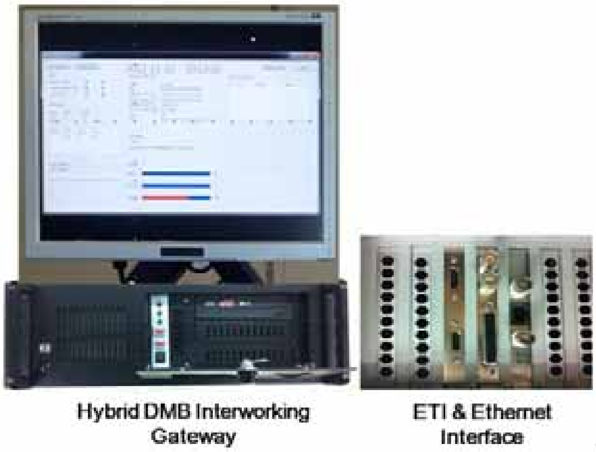
3. Hybrid Terminal

The hybrid terminal is a receiver platform that can provide a seamless service through a hybrid stream delivery based on Smart DMB. The hybrid DMB terminal has a structure, as shown in Fig. 3. The T-DMB signal is received and processed by the T-DMB signal processing unit. The IP stream processing unit receives IP stream over a wireless network, analyzes the received stream at IP stream analysis module, and decodes IP stream at IP stream decoder. The network transceiver in the IP stream processing unit receives IP stream and transmits the request signal to the gateway. The control unit takes the role of signal strength detection, efficient network searching and selection, stream request, contents control, decoding reference timing analysis, etc.

The contents control module on the control unit decides the network handover time using the signal strength and packet amount information on the hybrid T-DMB decoder buffer and sends the decoding reference time to the stream request module.

4. Implementation of Gateway and Terminal

The gateway, the verifying terminal and apps for hybrid smart devices were developed and implemented for a seamless video interworking service. The interworking gateway is a server based on Personal Computer (PC). The gateway is located between the video service encoder and ensemble multiplexer (MUX) for the broadcasting service and for the IP streaming service. Fig. 4 shows the implemented hybrid gateway and a function verifying



(a) Hybrid DMB Gateway

(b) Test Terminal (7inch panel)

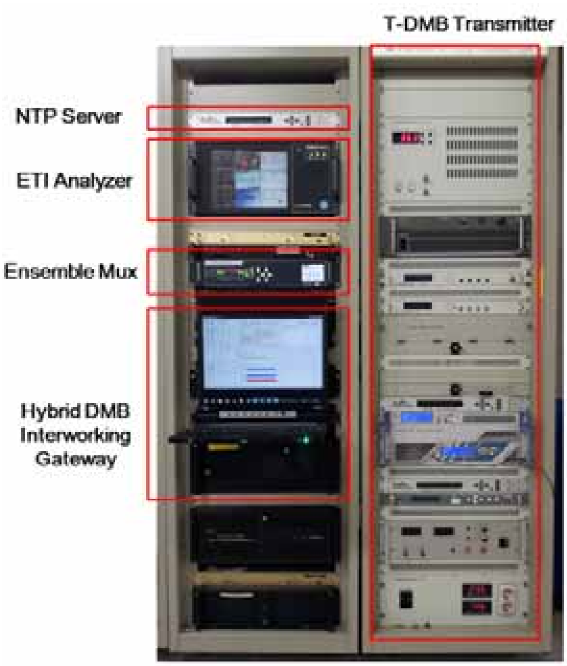
Fig. 4. Hybrid DMB Gateway and Verifying Terminal.

Fig. 5. Hybrid DMB app on a Smart Phone.

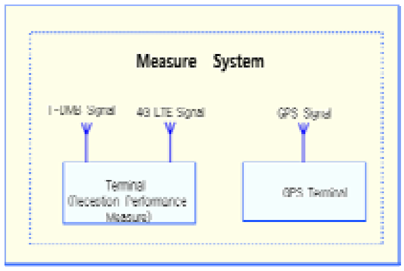
terminal. The upper monitor displays the gateway operating information including the input and output buffer states on Fig. 4(a).

The function verifying terminal can receive DMB signal and Wi-Fi or 4G LTE signals. The handover parameter is mainly terminal decoding buffer status (packet amount) for seamless video interworking service. The terminal requests IP streaming to the related specific scene to the gateway through wireless network when the received packet amount is below the threshold (e.g. 80%) for full supporting quality at hybrid DMB player buffer.

The scene can be changed naturally on a hybrid network. The hybrid DMB app was also implemented on smart phones. Fig. 5 shows the seamless scene changing DMB to IP streaming, when the T-DMB signal is weak on the device and from IP streaming to the DMB service by



(a) Hybrid DMB Transmitter including gateway



(b) Received signal measure e structure

(c) Test Vehicle

(d) Mobile Terminal Installed in Test Vehicle

Fig. 6. Transmitter and Verifying Mobile Terminal with Vehicle.

the recovered DMB signal on smart phone.

5. Field Test and Results

Field tests for hybrid DMB system were performed. The locations of the field test were Daejeon and Seoul Korea. The transmitter consisted of a T-DMB transmitter, which was comprised of an ensemble MUX, exciter, amplifier and Network Time Protocol (NTP) server, and hybrid gateway.

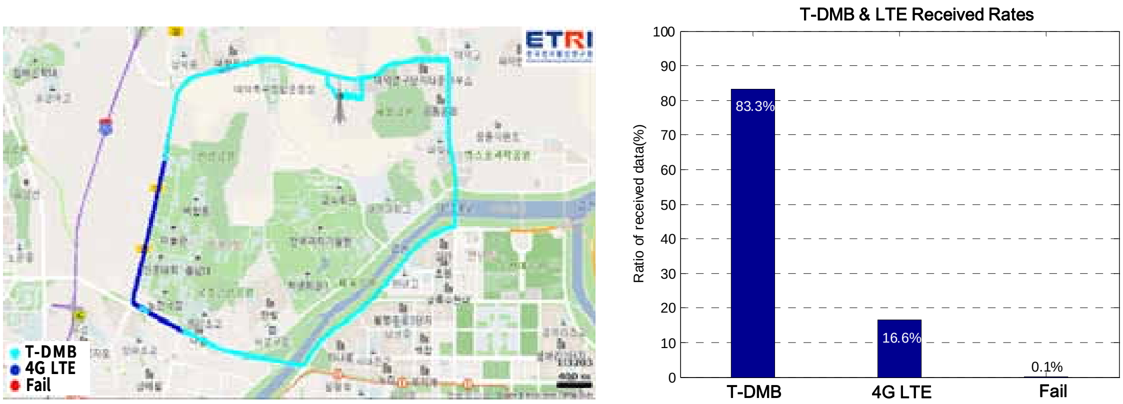
Fig. 6 shows the field test equipment. The transmitter is shown in Fig. 6(a). Fig. 6(b) presents a measure system for gathering data. The measure system receives the T-DMB signal and LTE signal on the verifying terminal and the GPS signal on the GPS terminal. The verifying terminal and test vehicle are in Figs. 6(c) and (d), respectively.

The field test was performed on the mobile test vehicle for the seamless video interworking service. The measurement equipment gathers data of the network type, received signal power, measuring time, and vehicle position on the map (longitude and latitude).

The received signal types are displayed in Figs. 7 and 8, the sky-blue line means a successful received T-DMB signal, the blue line represents the received signal through the LTE network, and the red line represents to fail receiving the video signal on (a) in Figs. 7 and 8.

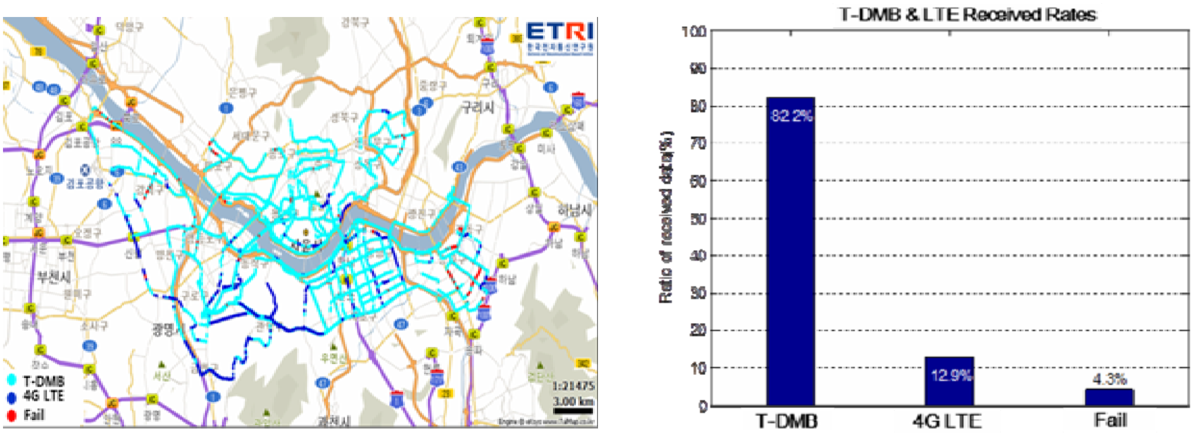
Bar graphs represent the data receiving rates on (b) in Figs. 7 and 8. In the measurement, the T-DMB signal receiving case was 86.3%, the LTE case was 16.6%, and it was0.1% failing to receive the signal in the Daejeon area. In the Seoul area, the T-DMB signal receiving case was 82.2%, the LTE case was 12.9%, and was4.3% for failing to receive the signal. The results showed some differences between the two areas. In Seoul area, there is a larger amount of LTE data traffic than in Daejeon, so the success receiving rates would be lower than in the Daejeon area.

Although there was seamless handover depending on the LTE network status, the results showed successful mobile broadcasting contents handover for a seamless service on the hybrid network.



(a) Displayed received rates on the Map (c) Receiving Rates

Fig. 7. Receiving Network Type according to the measured path (Daejeon).



(a) Displayed received rates on the Map (b) Receiving Rates

Fig. 8. Receiving Network Type according to the measure path (Seoul).

6. Conclusion

This paper presented the implementation and field test results for a mobile hybrid broadcasting system. The target of services was hybrid services on the T-DMB. In particular, the seamless video interworking service was the key service. The structure of the hybrid T-DMB gateway and terminals were added for the service in the T-DMB system. The seamless video interworking service can extend the broadcasting service coverage.

Acknowledgement

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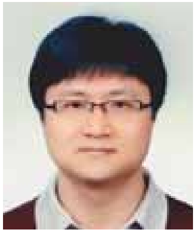
Yun-Jeong Song received the BS and MS degrees from Kyungbook National University, Daegu, Korea, and PhD degrees in electronics engineering from Chungnam National University, Daejeon, Korea in 1987, 1990 and 2004, respectively. Since July of 1990, he has been on principal member of staff, Mobile Broadcasting Research Section, ETRI, Daejeon, Korea. He was a visiting scholar at Cent for Telecommunication Research (CTR) in Columbia University, New York from Oct. '94 to Sep. '95. His research interests are digital mobile broadcasting and high-speed MODEM



Joungil Yun received the B.S. degree from Chonbuk National University, Jeonju, Korea, in 1996, and the M.S. and the Ph.D. degrees from Gwangju Institute of Science and Technology (GIST), Gwangju, Korea, in 1998 and 2005 respectively. Since 2005, he has been with broadcasting system research group in Electronics and Telecommunications Research Institute (ETRI) in Daejeon, Korea. His current research interests include the digital signal processing, digital broadcasting protocols, and digital broadcasting systems.

Youngsu kim received the MS and PhD degrees, all in electronics engineering from Yonsei University, Seoul, Korea in 1986 and 1999. In 1988, he joined Electronics and Telecommunications Research Institute (ETRI), Daejeon, Korea, and he is currently a principal research member of mobile broadcasting research section in ETRI. His current research interests include digital mobile communication and digital broadcasting.

Hyoungsoo Lim received the BS, MS, and PhD degrees in electrical engineering from Pohang University of Science and Technology (POSTECH), Pohang, Korea in 1992, 1994, and 1999, respectively. He was with Radio & Broadcasting Technology Laboratory, Electronics and Telecommunication Research Institute (ETRI), Daejeon, Korea from 1999 to 2000, and DXO Telecom, Inc., Seoul, Korea from 2000 to 2001. He has been with ETRI again since 2002 and is now the Director of the Mobile Broadcasting Research Section. Since 2011, he has also been a professor in the University of Science & Technology (UST), Daejeon, Korea. His major research interests include faster-than-Nyquist transmission, digital broadcasting signal transmission, spread-spectrum, military communications, satellite communications, and wireless LAN/MAN/PAN systems.