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DRM/DRM+ 이더넷모드의 다중화분산접속 설계분석☆

Multiplex Distribution Interface Analyzer Using Memory Sharing Techniqyes on Ethernet Mode for DRM/DRM+ Systems

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요 약

본 논문에서는 디지털 라디오 표준인 DRM(Digital Radio Mondiale) 및 DRM+(Digital Radio Mondiale Plus) 시스템을 이더넷모드에서 분석할 수 있는 다중화분산접속(MDI, Multiplex Distribution Interface) 분석기를 설계한다. 제안하는 MDI 분석기는 메모리 공유 기술을 가진 공통 블록 모듈을 사용하여 MDI 패킷들의 부하를 감소시키며, 차세대 디지털 라디오 방송시스템을 위해 수신된 MDI 패킷을 통해 IP(Internet Protocol)와 DRM/DRM+ 시스템의 FAC(Fast Access Channel)/SDC(Service Description Channel) 구성정보를 확인할 수 있다.

☞ 주제어 : DRM, DRM+, 다중화분산접속, 이더넷 모드, 패킷 분석기

ABSTRACT

In this paper, a novel MDI(Multiplex Distribution Interface) analyzer is designed in Ethernet-mode for DRM(Digital Radio Mondiale), and DRM+(Digital Radio Mondiale Plus) systems. The proposed MDI analyzer can reduce the overload of MDI packets by using memory sharing techniques into a common module block. In consequence, it verifies the received MDI packets by composition information of IP(Internet Protocol) and FAC(Fast Access Channel)/SDC(Service Description Channel) in DRM/DRM+ systems for the next generation digital radio broadcasting systems.

☞ keyword : DRM, DRM+, MDI, Ethernet-mode of streams, Packet analyzer

1. Introduction

DRM(Digital Radio Mondiale) denotes a European radio broadcasting standard that can substitute the existing analog AM radio [1]. It can provide much higher audio quality than analog AM with the same bandwidth and less transmission power. Moreover, it can provide high quality data services over large coverage and wide bands [2]. Recently, DRM has been successfully deployed in Europe, Russia, and India for digital radio services [3]. As shown in Table 1, DRM uses OFDM(Orthogonal Frequency Division Multiplexing) for high data rates transmission, which was already adopted into DAB(Digital Audio Broadcasting) and DVB(Digital Video Broadcasting) known as DVB-T2/S2/C2 [3]. In other words, DRM is an OFDM-based digital radio system designed to be compatible with existing AM broadcast band plans [4].

The MDI(Mutiplex Distribution Interface) packets carry DRM Multiplexing data which are important to develop and verify software parts for DRM/DRM+ receivers. However, to the best of our knowledge, any MDI analyzer cannot support DRM/DRM+ receivers simultaneously. Therefore, this paper presents a novel MDI analyzer exploiting memory sharing techniques to decrease the overload of MDI packets. The proposed MDI analyzer can receive and analyze DRM/DRM+ data using Ethernet packets.

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〈Table 1〉 Comparison of digital radios (DAB/DRM/DRM+)

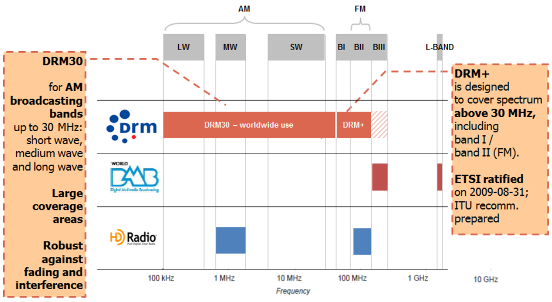
	DAB	DRM	DRM+
Frequency band	Band-I, II, III, IV, L-Band	<30MHz	<174MHz
Occupied BW(KHz)	1536	4.5/5/9/10/18/20	100
Audio coding	MUSICAM -24KHz Mpeg-1 AL II -48KHz Mpeg-2 AL II	AAC/CELP/HXVR +SBR	-AAC/CELP/HXVR +SBR -MPS 5.1/7.1 ch
Used subcarriers	192/384/768/1536	288/256/176/112[5]	-
Subcarrier spacing(Hz)	1/2/4/8 (KHz)	41.67/46.88/68.18/107.14	447.1
Modulation	π/4-DQPSK	4/16/64 QAM	4/16 QAM
Channel coding	Punctured CC R=1/4,3/8,1/2,3/4	-Punctured CC based MLC	-Punctured CC based MLC - RS+CC for packet
Datarate(kbps)	1152(PL3)	20-24(9~10KHz)	35 -190

2. DRM/DRM+ Systems

2.1 Comparison of DRM/DRM+ Receivers

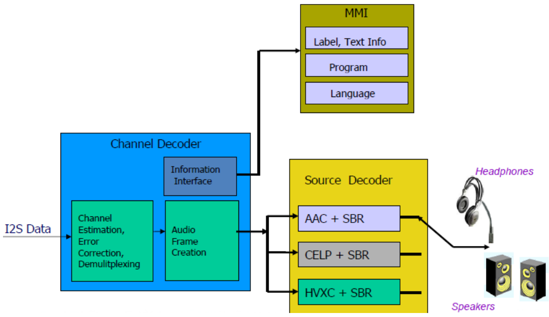
As shown in Fig. 1, the DRM system using OFDM(Orthogonal Frequency Division Multiplexing) system has the advantage that can offer better sound, robust to fading channel, and data service than existing analog AM broadcasting which can be used in various frequency bands of 4.5/5/9/10/18/20kHz.

In Fig. 2, the DRM receiver is supplied to 4 transmission modes to robust the reception signal.



〈Fig. 1〉 Frequency analysis of digital radios

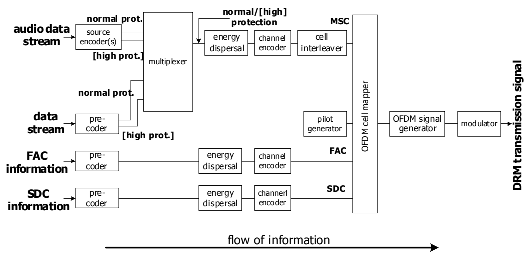
Transmission modes of A to D are supported for digital radio in AM bands below 30 MHz. Transmission mode E, also known as DRM+, provides digital radio service in the 30 to 174 MHz frequency bands[5].



〈Fig. 2〉 DRM receiver building block's analysis

The transmission frame structure consists of FAC(Fast Access Channel) which contains the channel information, and information relevant to service required by the DRM/DRM+receiver in Fig. 3.

And, it has MSC (Main Service Channel) which carries audio and data payload, and SDC(Service Description Channel) which carries the channel coding parameters for MSC, and the multiplex structure of audio & data signals.



〈Fig. 3〉 DRM transmission channel

For frequency bands between 30 to 174 MHz, the only mode E can be selected. Mode E is designed to robust against time and frequency selective fading channel.

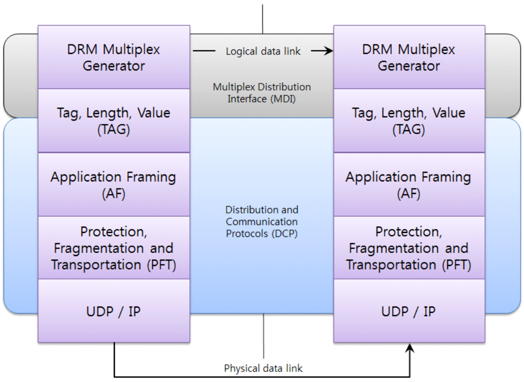
Depending on the modes, the spectrum band can be set to 4.5/5/9/10/18/20 /100 kHz[5].

2.2 MDI Packet of DRM/DRM+

The MDI packet carries DRM multiplexing data from the equipment generating data to the DRM Modulator[6].

The TAG(Tag, Length, Value) items can be carried in a single TAG packet,and which contains the data for the DRM Modulator to produce logical output frame. For robustness modes A to D, as known as DRM, alogical frame contains content for 400ms of broadcasting signal; for DRM+, it contains 100ms of broadcast signal[7].

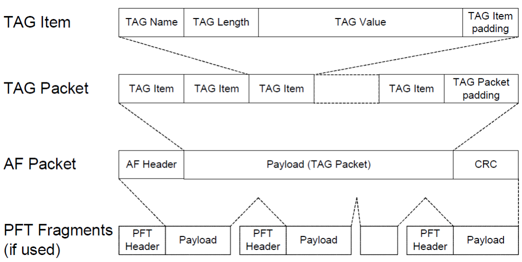
When carrying TAG item standard, a TAG packet is known as an MDI packet. MDI protocol stack is shown in Fig. 4.



(Fig. 4) MDI protocol stack

The TAG layer encapsulates the elementary arbitrary length data items, while the AF(Application Framing) layer combines the elementary data into a related cohensive block data[8].

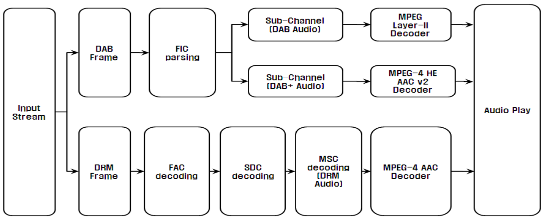
The optional PFT (Protection, Fragmentation, Transportation)layer allows fragmentation of the potentially large AF packets, and adds the possibility of addressing and FEC (Forward Error Correction). The structure of the data at the various layers is shown in Fig. 5[9].



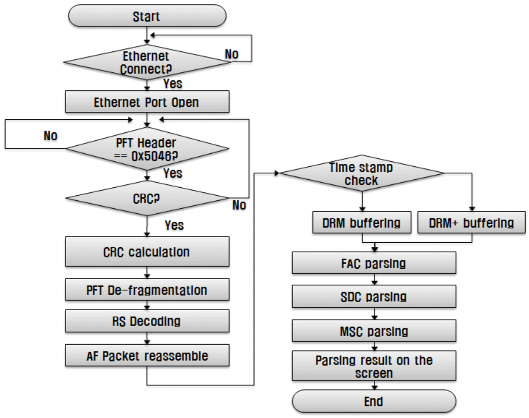
(Fig. 5) Analysis of TAG packet fragments

3. Design of Proposed MDI Analyzer

The input stream of MDI analyzer is realized in DRM receiver depending on ethernet. This stream is transmitted in UDP(User Datagram Protocol) format(PFTpacket). Decoding of PFT packet has four step procedures[10][11].



(Fig. 6) Design of memory-sharing algorthm for DAB/DRM receiver



(Fig. 7) SW design of the proposed MDI analyzer

First, the synchronization of the incoming stream is done using candidate PFT Header(0x5046 or ASCII sync-word "PF").

Second, if transport addressing is enabled, addressed fragments will be were discarded incorrectly.

Third, if either RS(Reed-Solomon code) or simple fragmentation has been used deframent process, thisRS code would be is enabled for error detection, and correction.

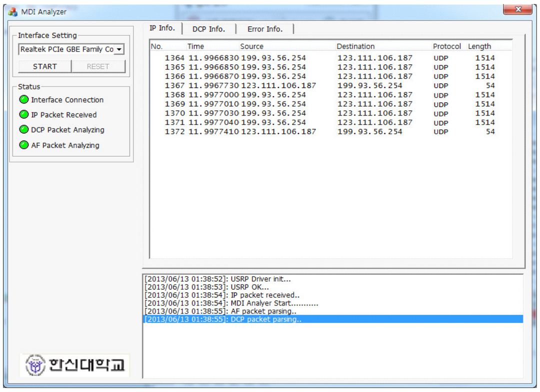
And, finally AF packet will be is reassembled from received PFT packet.

One or more TAG Items are extracted from this AF packets. The FAC, and SDC signal informations of DRM or DRM+ are parsed from the restructed TAG Items which were proposed on the Window based DRM/DRM+ MDI analyzer with ethernet mode.

The processing per each method of decoding and analysis is followed in Fig. 7.

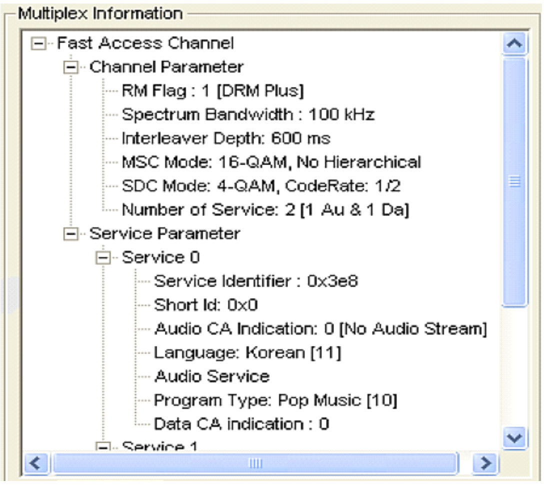
This proposed overload of MDI analyzer has been minimized by memory sharing techniques using a common module block. This system verifies the structure of received MDI packet using the composition information of IP packet, and FAC, SDC information in DRM/DRM+.

This MDI analyzer is based on the Window system, using Visual Studion 2005 MFC as shown in Fig. 8.

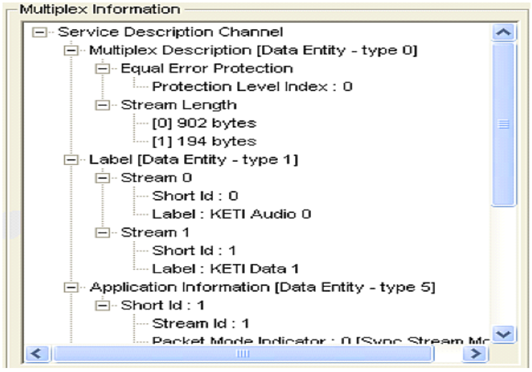


(Fig. 8) Result of MDI analyzer in DRM/DRM+

As shown in Fig. 9, and 10 below, the output of MDI analyzer has the information on FACand SDC of DRM/DRM+ which are building the programs as well as data streams.



(Fig. 9) Analysis of FAC information result for DRM+



(Fig. 10) Analysis ofSDC information result for DRM+

4. Conclusion

This paper realizes MDI packet analyzer for DRM Modualtor with the Window based software. This DRM analyzer is suggested to common function which is successfully analyzed from received IP packet, MDI protocol packet, and the analysis of FAC and SDC informations in DRM/DRM+ contents.

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