

## Performance Evaluation of DRM+ System in Laboratory Trials

Myung-Sun Baek, Sora Park, Yonghoon Lee, Geon Kim, Bo-mi Lim, Yun-Jeong Song,

\*Chae-Hun Im, Yong-Tae Lee

Electronics and Telecommunications Research Institute (ETRI)

\*Telecommunications Technology Association (TTA)

[sabman@etri.re.kr](mailto:sabman@etri.re.kr), [ytleee@etri.re.kr](mailto:ytleee@etri.re.kr)

### Abstract

The DRM+ is the newest digital radio standard for in-band environment. Although various state of the art technologies are adopted, the performance evaluation information is not sufficient. It is hard that many countries and stations considering the DRM+ as their digital radio standard check the performance of DRM+. To evaluate the performance of the DRM+ system, this paper depicts the laboratory trial results of DRM+ standard. In the laboratory trial, the rack type DRM+ test bed is built. To reflect the practical broadcasting environment, various tests are executed. Many countries and stations can efficiently use these test results, which are considering converting their analog radio broadcasting to digital broadcasting.

### 1. Introduction

In most countries, the transition of analog television broadcasting to a digital broadcasting with its improved picture and sound quality has been widely executed. The radio broadcasting has been stayed in analog technology. Therefore, although recent advances in digital communications and compression algorithms have made more efficient and more robust transmission schemes possible, radio broadcast systems have not fully utilized these advances to their benefit. Recently, many digital radio broadcasting techniques and standards have been proposed and many countries consider converting their analog radio broadcasting to digital broadcasting. The representative digital radio broadcasting methods are digital audio broadcasting (DAB), DAB+, terrestrial digital multimedia broadcasting (T-DMB) audio, HD Radio and digital radio mondiale plus [1].

Among the digital radio broadcasting standards, DRM+ is the latest standard for FM band radio broadcasting. The DRM+ system adopts the efficient transmission techniques and the state of the art audio codec. However, the system does not have sufficient test results and the number of commercial devices is not much. For last two years (2009~2010), ETRI executed the digital radio broadcasting performance test to consider digitization of Korean radio broadcasting. In the test, the DRM+ system was included and the system performance was evaluated. In this paper, we present the laboratory test results of DRM+ system. For the test, DRM+ transmission rack and reference receiver are built.

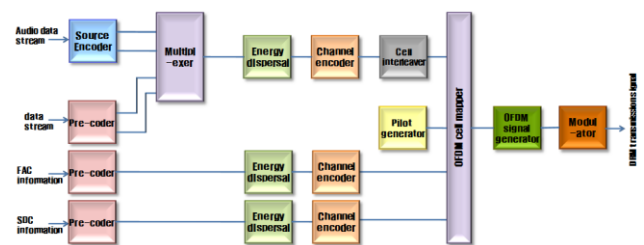


Fig. 1 Block diagram of DRM+ system

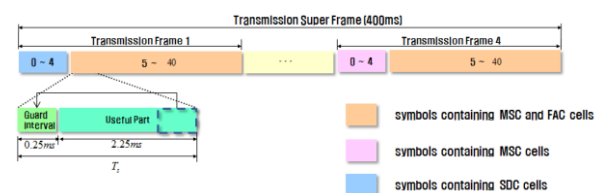


Fig. 2 Frame structure of DRM+ signal.

### 2. DRM+ System Model

Fig. 1 shows block diagram of the DRM+ transmitter. As the figure, the DRM+ system uses coded orthogonal frequency division multiplexing (COFDM) modulation and interleaved convolutional code. The main service channel (MSC) has the service data including audio and data service, and the fast access channel (FAC) is included the parameter about channel information. The service description channel (SDC) provides the decoding method and multiplexing information of MSC. For the baseband modulation, both QPSK and 16-QAM can be used. The DRM+ is designed for the broadcasting bands up to

120MHz, and the signal bandwidth of DRM+ system is 100kHz. Since the bandwidth of DRM+ is 100kHz, the DRM+ signal can be transmitted through the frequency space between FM signals.

Fig. 2 describes the frame structure of DRM+ signal. As the figure, the SDC is transmitted for the first part of the frame and then, FAC and MSC are transmitted. Among the frame, most signals are the feature combining FAC and MSC. The one frame has 100ms frame time, and one super frame consists of four frames. Each frame has 40 OFDM symbols. The time duration of OFDM symbol is 2.5ms, and the guard interval (GI) is built with cyclic prefix (CP).

### 3. Laboratory Test Environment and Results

To execute the laboratory trial of DRM+ system, rack type transmitter and board type reference receiver are designed. In the laboratory test, various test items are evaluated which are dynamic range, received signal performance in both additive white Gaussian noise (AWGN) and fading channel, audio quality, single frequency network (SFN) performance, and so on. In this section, we present the received signal performance in both AWGN and fading channel. In the fading channel, mobile reception environment with 60km/h is considered. In this test the center frequency of the DRM+ signal is 98.7MHz. The test bed for the received signal performance is depicted in Fig. 3. The DRM+ signal of DRM+ transmitter is inserted to the fading simulator which distorts the input signal according to the channel parameter, and then the AWGN signal is added to the output of the fading simulator. By controlling the two attenuators, various SNR values are adopted.

Fig. 4 depicts the DRM+ performance in AWGN channel according to variation of protection ratio. The DRM+ supports various protection ratios using punctured convolutional code. Users can choose the proper protection ratio considering the broadcasting environment. The BER performances are decreased as increasing the protection ratio values. In DRM+ standard, threshold of audibility (ToA) is set to  $BER=10^{-4}$ . The system can satisfy the ToA at under the signal-to-noise ratio (SNR) = 4.5dB. The BER performance in fading channel is described in Fig. 5. In this result, the ToA can be satisfied at under SNR=13dB. The whole BER tendency in the fading channel is similar to the BER performance in AWGN.

### 4. Conclusions

In this paper, laboratory test results of DRM+ system are depicted. The SNR values satisfying the ToA are described in various channel models and protection ratios. The results can help many countries and stations which consider the DRM+ standard as their digital radio broadcasting.

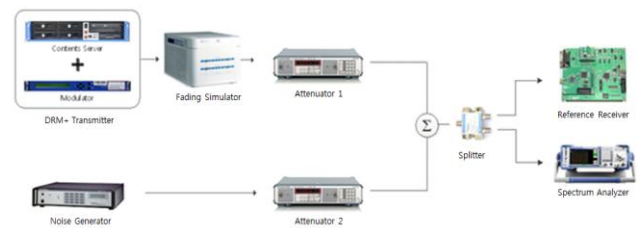


Fig. 3 Test bed for the laboratory test.

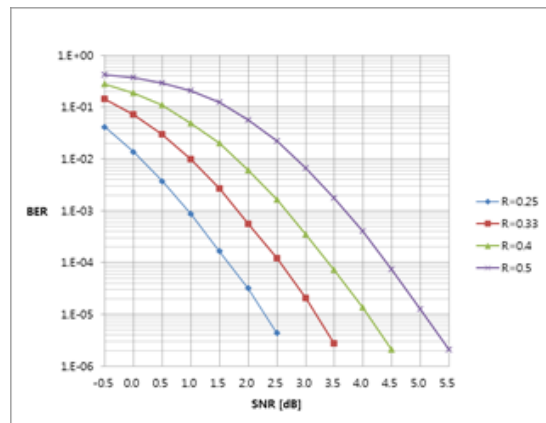


Fig. 4 BER performance of DRM+ system in AWGN channel

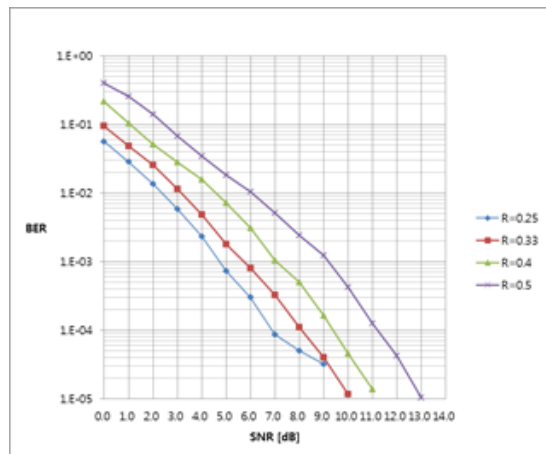


Fig. 5. BER performance of DRM+ in fading channel (urban 60km/H profile).

### Acknowledgement

This research was supported by the KCC(Korea Communications Commission), Korea, under the R&D program supervised by the KCA(Korea Communications Agency) (KCA-2011-11912-02002)

### Reference

[1] ETSU ES 201 980 V2.2.1, "Digital radio mondiale (DRM) system specification," ETSI, August 2009.