

Study on Algorithm for Additive Data Service in ATSC DTV

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Abstract— In this paper, we analyze the performance of transmitter identification (TxID) technique for advanced television system committee digital television (ATSC DTV) signals. In the ATSC DTV systems, signals are transmitted through the multiple frequency network (MFN) so that the frequency resource is used inefficiently. The TxID technique is employed to implement the single frequency network (SFN) which is proposed for solving a frequency inefficiency problem of the MFN. The system performance is evaluated in accordance with several numbers of water marking levels and transmitter number.

Keywords— advanced television system committee digital television, transmitter identification, additive data service

I. INTRODUCTION

The latest trend of broadcasting systems are not fixed broadcasting and low definition but high mobility and high definition multimedia information reception. Moreover, full duplex transmission positioning and relay station for high spectrum efficiency are at issue because of broadcasting and telecommunication convergence technology [1].

Terrestrial DTV system have a limitation which is non-efficiency in frequency resource use of view by transmitting through multiple frequency network (MFN) using each different frequency in each of coverage when between transmitters transmits broadcast signals [2].

Transmitter identification (TxID) technique is a technique to implement single frequency network (SFN) issued to overcome disadvantage of channel allocation with lack of frequency [3]. The TxID scheme has the advantage of location awareness in mobile communication environment. This technique uses spreading code and the distance between the peaks of received signals. The watermarking technique for TxID is possible only by spread code and the performance is absolutely depended on correlation character of the spread code [4]. Now, issues of development of core technology of terrestrial DTV technique of ATSC form were technique to maximize quality of service (QoS) of DTV transmission technique which is demanded in wireless channel environment of single channel network to maximize frequency use efficiency and solution for H/W complexity at receiver.

Recently, however, service to purpose transmission of an adaptive data service using modulation/demodulation method of spread code of watermarking of TxID is increasing. Technique research which is to do positioning using ATSC TxID technique based advantage of special frequency called terrestrial radio is being highlighted.

In this paper, we propose algorithm for additive data service with watermarking code. The performance is evaluated in terms of symbol error rate (SER).

This paper is organized as follows. In Section II, the watermarking scheme for ATSC is described. In Section III, we explain the watermarking method for additive data service. Simulation results are presented in Section IV. Finally, conclusions are drawn in Section V.

II. WATERMARKING SCHEME FOR ATSC DTV

In the proposed watermarking methods for identification and additive data service, a spreading sequence is added to the DTV signal before transmission in Fig. 1. They transmitted through channel. In this point watermarking data is important that it is to transmit a form of low amplitude value which does not almost affect DTV transmit signal. The watermarking data acts interference to existing DTV signal. If watermarking amplitude increases, the watermarking data detection performance is improved. However, the performance of existing DTV signal is decrease and power consumption. At the receiver, peak to peak is calculated through correlation using reference code before the signal demodulation process. Consequently, we obtained information data for TxID and additive data.

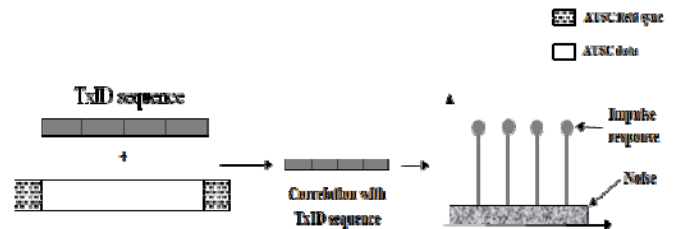


Figure 1. ATSC DTV signal with watermarking technique.

Fig. 2 shows the DTV signal frame structure. The watermarking data is inserted according to DTV frame length.

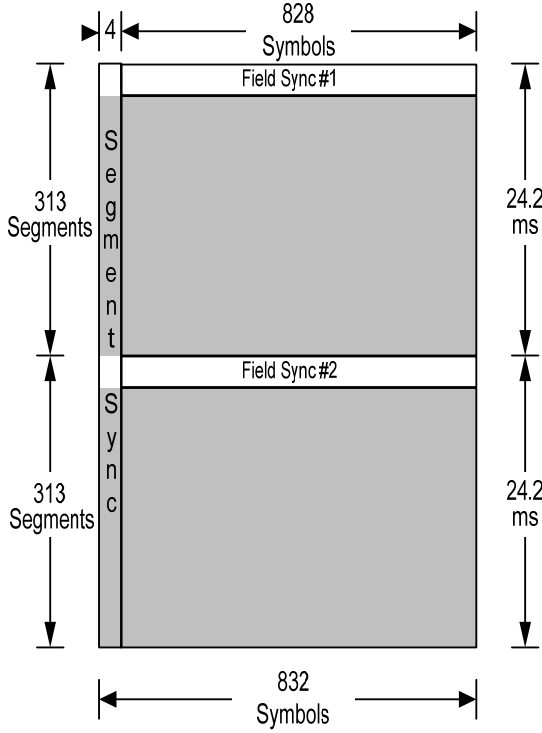


Figure 2. Structure of ATSC DTV data frame. (8VSB)

Denote the DTV signals for the i -th transmitter before and after the inserted of the spreading code sequence $s_i(n)$ as $x_i(n)$ and $x'_i(n)$. The watermarking process is as following [3]:

$$x'_i(n) = x_i(n) + \rho s_i(n), \quad (1)$$

where n is the index for discrete signals, ρ is a gain coefficient to control the insert amplitude of the spreading sequence.

The received signal from the i -th transmitter r_i that after through the channel h_i can be given by function:

$$r_i(n) = x'_i(n) \otimes h_i + w_i(n), \quad (2)$$

where $w_i(n)$ is the white Gaussian noise for the i -th transmitter during the channel propagation. The received signal $r(n)$ can be formulated as:

$$r(n) = \sum_{i=1}^N [x'_i(n) \otimes h_i + w_i(n)], \quad (3)$$

where N is the total number of the transmitters. The existence of the several transmitters is unknown without any further identification process. Information of TxID and signal strength of each specific transmitter at the reception site can be achieved by calculating a correlation function [5].

III. WATERMARKING METHOD FOR ADDITIVE DATA SERVICE

Proposed transmission scheme which transmits additive data is rising with phase or amplitude in the conventional TxID system. From this system, we can transmit additive data without any effect to the transmission. Fig. 3 shows transmission of additive information data that applies phase modulation to spread code in the TxID system.

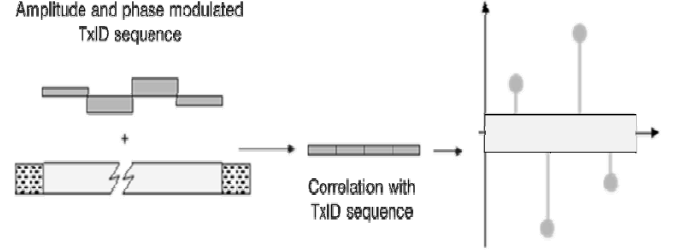


Figure 3. TxID and data transmission system with amplitude and phase modulation.

Also, we can use amplitude modulation to improve data rate of additive information from TxID system. Data modulation and transmission system with amplitude and phase modulation are possible that it can make additive data service. Conventional TxID system for additive data service applied amplitude and phase modulation to spread code for TxID [4].

IV. SIMULATION RESULTS

In this section, the performance of the proposed system is evaluated through simulation. Simulation parameter is given by Table 1. We assume that channel is AWGN, spreading code is Kasami used. The interference source is watermarking signal at SER simulation, and 8VSB signal at DER simulation.

Table 1. Simulation Parameters

Parameters	Value
Modulation	8VSB
Code	Kasami
Channel	AWGN(noise)
Interference	SER : Watermarking signal DER : 8VSB signal

A. SER Performance of Various Watermarking Level

If average value of watermarking level is high, data transmission performance is improved. But study about data transmission using spread code for TxID have to progress within no influence because 8VSB data is applied to 8VSB transmission system of ATSC. SER of 8VSB signal applied various watermarking level to solve it is as follow.

In simulation results, we can get SER performance 15dB simulation result when 8VSB signal have no interference in AWGN environment when the greatest amplitude watermarking from 8VSB signal is transmitted, SER performance is 17dB. Therefore we know that there is performance difference with watermarking or without.

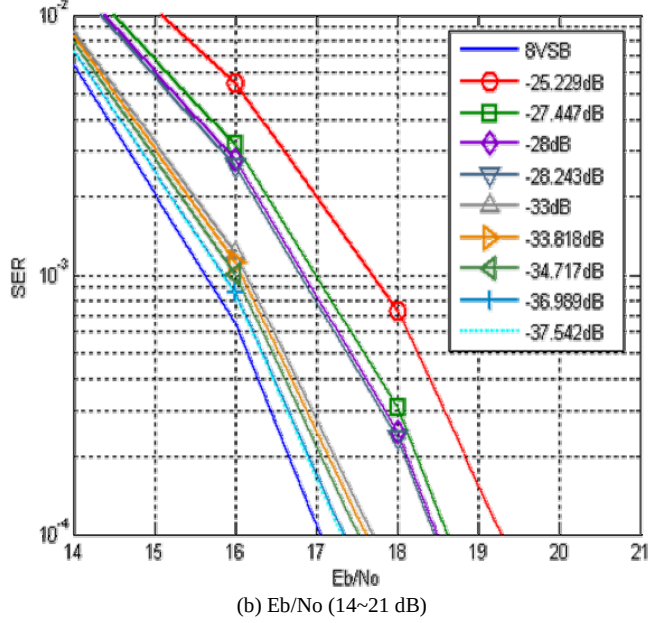
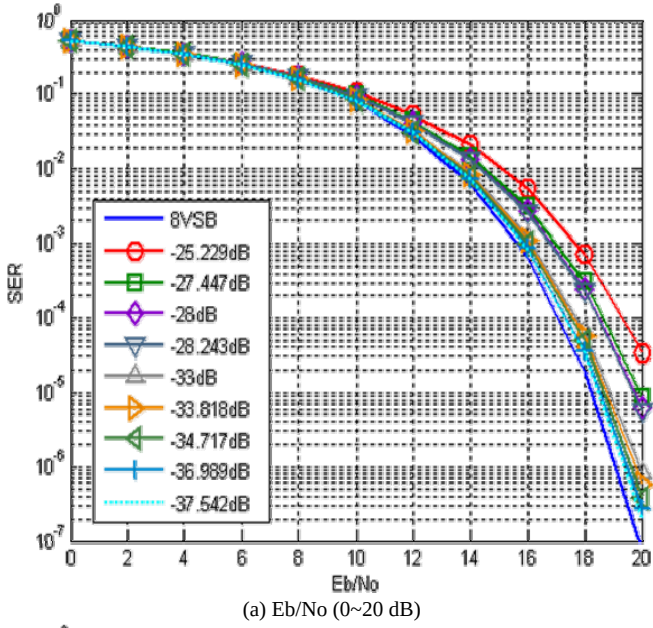


Figure 4. SER performance of watermarked 8VSB signal.

B. DER Performance with Number of Transmitter

The result is DER performance of each watermarking level with transmitter's changes, considering averaging four times, in environment non-existing multi-path. In simulation results, we can confirm better performance the more watermarking level increase and cognize transmitter when we use watermarking. And if number of transmitter increases, DER performance is fallen because interference between each signal increases.

V. CONCLUSIONS

In this paper, we analysed the performance of TxID technique for DTV signals. In the ATSC DTV systems, signals are transmitted through the MFN so that the frequency resource is used inefficiently.

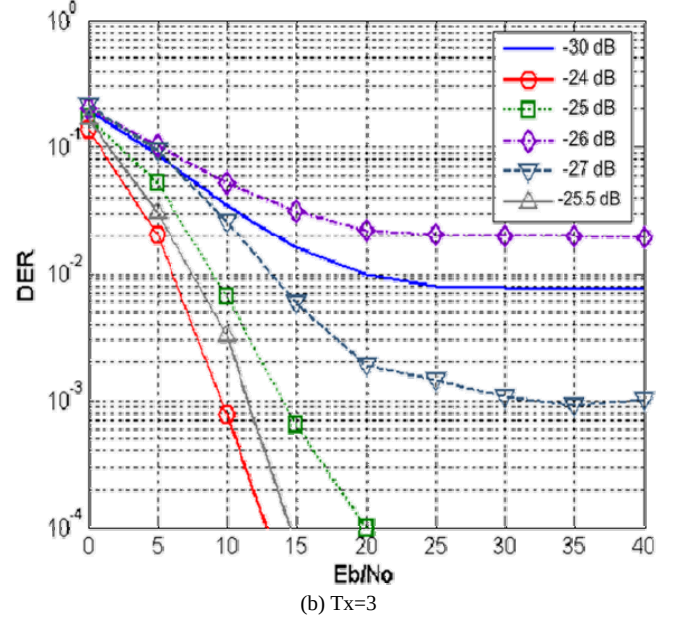
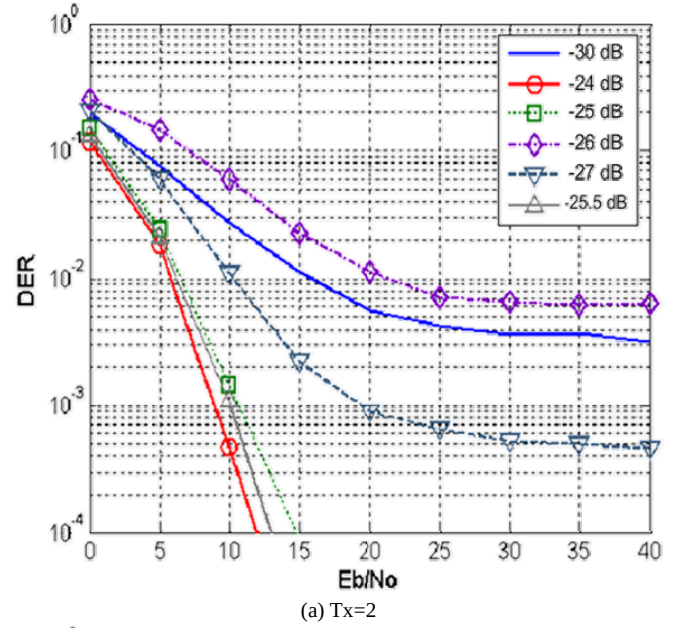


Figure 5. DER performance with number of transmitter. (Tx=2, 3)

The TxID technique is employed to implement the SFN which is proposed for solving a frequency inefficiency problem of the MFN. At the transmitter, data streams to be transmitted are watermarked with a PN code, which is assigned to the transmitter, and transmitted. At the receiver, each transmitter is distinguished by using auto correlation. Proposed transmission scheme which transmits additive data is rising with phase or amplitude in the conventional TxID system. From this system, we could transmit additive data without any effect to the transmission. The results of the paper can be applied to wireless multimedia digital broadcasting systems.

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