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An IEEE 802.11p-based Wake-up Technique for Improvement in the Reliability of Emergency Alert Service

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Abstract Social disasters, such as the Grenfell Tower [1] incident in the United Kingdom, the Sewol ferry incident in Korea, and serious natural disasters such as tsunamis in Japan, often occur. In order to mitigate the damage from such disasters, it is essential to build a more advanced emergency alert system. The existing mobile broadcasting system is relatively resilient against the destruction of broadcasting infrastructure caused by such disasters, and it provides a high reliability emergency alert service. Examples of these mobile broadcasting systems include terrestrial-digital media broadcasting (T-DMB) [2] in Korea and one segment (One-Seg) [3], [4] in Japan. A wake-up technique that activates a deactivated receiver using the ready mode of a mobile terminal is embedded in One-Seg. However, no wake-up technique is specified in T-DMB [5]. Therefore, this paper proposes a method of improving the reliability of emergency alert services in a mobile multimedia broadcasting system by setting a wake-up signal in null subcarriers of IEEE 802.11p.

Introduction

Fig. 1 The Grenfell Tower fire (2017) [1]

Recently, many disasters, including the Grenfell Tower incident, have occurred, resulting in damage to both people and properties. To overcome this constant damage, many schools and research institutes are conducting studies on T-DMB emergency alert messages, CBS alert messages, electronic signage, and automatic rainfall warnings. A T-DMB emergency alert message, based on a mobile broadcasting system, is resistant to the destruction of broadcasting infrastructure caused by a disaster. As most of the mobile terminals used in Korea include a T-DMB receiver, emergency alert messages can be delivered effectively when a disaster takes place. The standard for transmission of an emergency alert message is defined in T-DMB, which uses a fast information channel (FIC) to transfer an emergency alert message. The FIC is comprised several fast information blocks(FIBs), each of which consists of several fast information groups(FIGs) and cyclic redundancy checks [6] - [10]. The FIGs type number five is used to an emergency alert message when a disaster occurs.

While the One-Seg system [4] in Japan can detect an emergency alert message using the ready mode of a mobile terminal, Korea's T-DMB does not define a method to activate a deactivated T-DMB receiver [5], [6]. If the T-DMB receiver of a mobile terminal is deactivated, an emergency alert message cannot be received, resulting in serious loss of life and vast property damage. As a result, this paper proposes an IEEE 802.11p-based wake-up technique to improve the reception performance of emergency alert services.

System Model

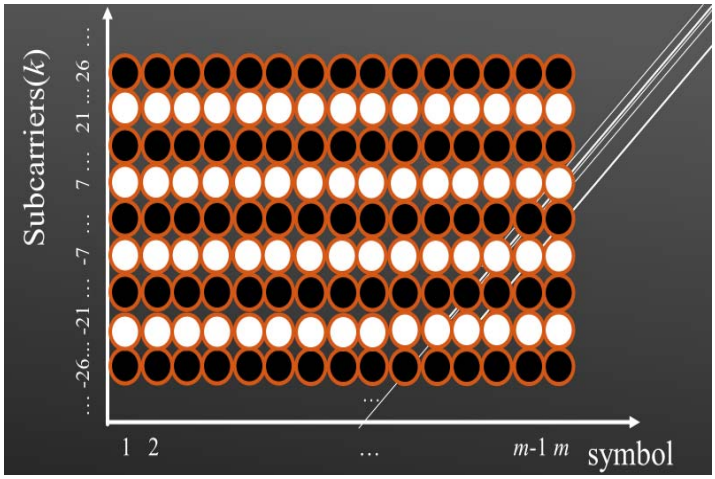

Fig. 2 Structure of IEEE 802.11p frame

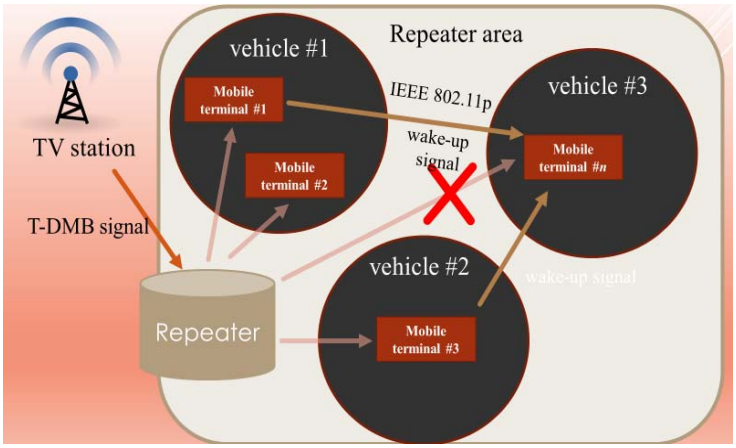

Fig. 3 System Model

Figure 2 illustrated the frame structure of IEEE 802.11p [11] - [13], where an orthogonal frequency-division multiplexing symbol is comprised 64 subcarriers. Of the 64 subcarriers, 12 are allocated to the indexes -32 ~ -27, 0, and 27 ~ 32. Figure 3 shows the system model proposed to improve the performance of an emergency alert system. When a disaster occurs, the main transmitter transmits a T-DMB signal that includes an emergency alert message to the repeaters. A repeater consists of a feedback remover and an equalizer [14]. It transmits the T-DMB signal to all the mobile terminals in its area after removing feedback signals from the input signals entering the repeater. Here, it is assumed that each mobile terminal has an IEEE 802.11p module. If the T-DMB receiver of a mobile terminal is activated, it sets the wake-up signal on the null subcarriers to IEEE 802.11p and transmits the wake-up signal to the mobile terminals in the vicinity. It does so by using the IEEE 802.11p protocol. If the T-DMB receiver of a mobile terminal is deactivated, an emergency alert message is received by activating the T-DMB module through the received wake-up signal.

Simulation Result

The proposed technique assumes an urban environment for the performance evaluation, as shown in Table 1 [15], [16].

Tap Number	Delay[ns]	Average Power[dB]
1	0	0
2	100	-3.5
3	200	-5.1
4	300	-8.0
5	400	-10.9
6	500	-14.0
7	600	-21.5

Table 1. Power Delay Profile of channel model (urban environment).

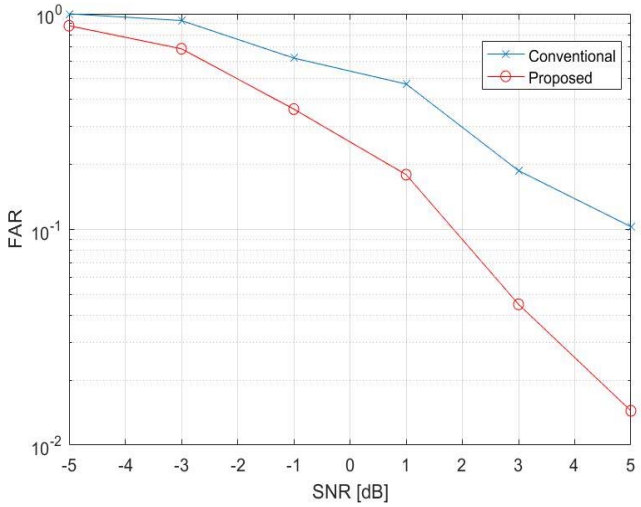

Fig. 4 The FAR performance for the proposed wake-up techniques in T-DMB.

Figure 4 shows the false alarm rate (FAR) performance when the proposed wake-up technique is used. In Figure 4, while the existing method shows a high FAR of 0.1873 when SNR is 3 dB, the proposed technique depicts a low FAR of 0.0450. The proposed technique enhances the reliability of the emergency alert service in a mobile broadcasting system by activating deactivated T-DMB receivers. This activation enables the reception of emergency alert messages.

Conclusion

This paper proposes an IEEE 802.11p-based wake-up technique to improve the reliability of emergency alert services. The proposed technique allows the reception of a T-DMB emergency alert message in a more reliable manner thus contributing to ensuring the safety of people.

Acknowledgement

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