

# IEEE 802.11b 간섭하에서 IEEE 802.15.4의 채널 감지 방법에 따른 성능 분석

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## Performance Analysis of Channel Sensing Mechanisms in IEEE 802.15.4 under IEEE 802.11b Interference

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### Abstract

In this paper, the performances of the IEEE 802.15.4 under the IEEE 802.11b interference are compared under two kinds of channel sensing mechanisms: carrier sense (CS) and energy detection (ED). For each channel sensing mechanism, the average transmission delay, and the throughput are used as performance measures.

### I. Introduction

Recently, IEEE 802.15.4, a low rate wireless personal area network, has been standardized [1][2]. To provide the global availability, the IEEE 802.15.4 devices use the 2.4GHz industrial, scientific and medical (ISM) unlicensed band. Because this ISM band is commonly used for the low cost radio devices such as IEEE 802.11b WLAN [3], an unrestricted access to the ISM band exposes the IEEE 802.15.4 devices to a high level of interference. Because the IEEE 802.11b was standardized earlier and applied already, the newly deployed IEEE 802.15.4 devices can experience the interference from the IEEE 802.11b WLAN. Therefore, the performances of the IEEE 802.15.4 under the interference of the IEEE 802.11b need

to be evaluated.

In this paper, the performances of the IEEE 802.15.4 under the IEEE 802.11b interference are compared under two kinds of channel sensing mechanisms: carrier detection and energy detection. For each channel sensing mechanism, the average transmission delay, and the throughput are used as performance measures.

### II. Analysis

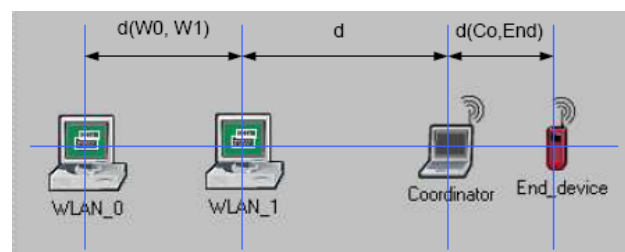


Fig. 1 Coexistence scenario

Each network consists of two nodes. WLAN 0 and WLAN 1 form a WLAN network with  $d(W_0, W_1)$  apart. WLAN 1 transmits IEEE 802.11b data packets to WLAN 0 and WLAN 0 responds with ACK packets. An IEEE 802.15.4 network consists of Coordinator and End device with  $d(Co, End)$  apart.

End device transmits IEEE 802.15.4 packets to Coordinator, and Coordinator may respond with ACK packets. A distance between the IEEE 802.15.4 and the WLAN network is a variable,  $d$ .

In a slotted CSMA-CA, the CCA shall start on a backoff period boundary and performs twice, i.e., CCA1 and CCA0. In this paper, the CCA mode 1, energy detection (ED), and mode 2, carrier sense (CS), are focused on.

For simulation, the slotted CSMA/CA of the IEEE 802.15.4 model is developed using OPNET. The WLAN uses the complementary code keying (CCK) modulation with 11 Mbps. The payload sizes of IEEE 802.11b and 802.15.4 are 1500 and 105 bytes long, respectively. The transmission power of the IEEE 802.15.4 and 802.11b are 1 and 30 mW, respectively. The center frequency of IEEE 802.15.4 and 802.11b are 2410 and 2412 MHz, respectively.

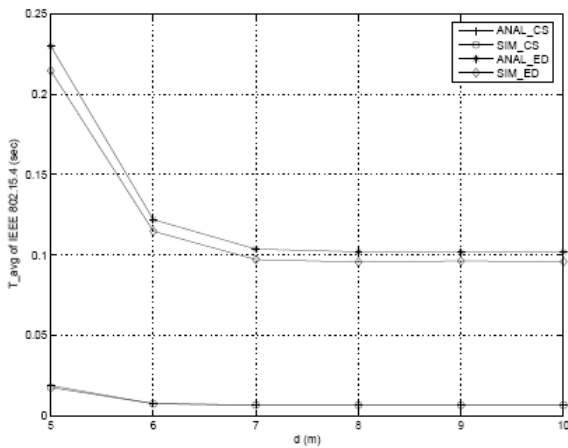


Fig. 2 Average transmission delay

Fig. 2 shows the average transmission delay of the IEEE 802.15.4 under IEEE 802.11b interference. Because of the busy channel by the IEEE 802.11b signals, the average transmission delays of the IEEE 802.15.4 with the ED are larger than those with the CS. The average transmission delay with the ED is at least 11 times larger than that with the CS. Fig. 3 shows the throughput of the IEEE 802.15.4 under IEEE 802.11b interference.

**IV . Conclusion and Future Work**

In this paper, the impact of channel sensing method to the

performances of IEEE 802.15.4 under the IEEE 802.11b interference is evaluated. The average transmission delay, and the throughput are used for analysis. Naturally, the throughput of the energy detection (ED) method is at most 10 Kbps, 6.5% of the carrier sensing method. The average transmission delay of the ED mode is 15 times that of the CS mode. In the ED mode, the IEEE 802.15.4 end device deters the transmissions because of the IEEE 802.11b transmissions, which is not true in the CS mode. These results are reasonable because the CS method is greedier than the ED mode. However, the ED mode is more energy effective, which means the life time of IEEE 802.15.4 network is about 4.7 times longer than the CS mode. This paper can show the criteria for the selection of channel sensing method for an application using IEEE 802.15.4 under IEEE 802.11b interference.

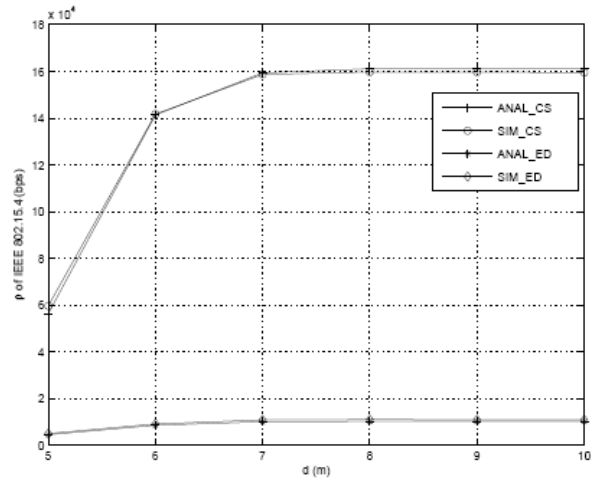


Fig. 3 Throughput

**References**

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- [2] Zigbee specification v1.0, <http://www.zigbee.org/>, 2005
- [3] IEEE Std.802.11, IEEE Standard for Wireless LAN Medium Access Control(MAC) and Physical Layer(PHY) Specification, 1997