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A performance effect of the SDMB system on the UWB device

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ABSTRACT

In This paper experimentally evaluates the interference from two kinds of UWB sources, namely a Orthogonal Frequency Division Multiplex UWB source and an Pulse radio UWB source, to a SDMB digital transmission system. The average biterror rate degradations of each system are presented. From these experimental results, we show that in all practical cases UWB system can coexist with the SDMB terminal without causing any dangerous interference about maximum 2m distance also if the SDMB output signal level rise up the 25dB

Key Words : UWB, SDMB, Interference measurement, coexistence, DS-CDMA, OFDM

I. Introduction

Recently, Ultra Wideband (UWB) technology has attracted a lot of interest in the research community and in industry. UWB offers the potential for high data rates, low-power transmissions, low cost, robustness to multi-path fading, and excellent range resolution (geo-location) capabilities. UWB can be used in the design of wireless local and personal area networks providing advanced integrated multimedia services to nomadic users within hot-spot area[1].

UWB signals are generated using sub-nanosecond pulses thus spreading energy over very large frequency band. An UWB radio signal occupies a bandwidth is greater than 25% of a center frequency or more than 1.5GHz. Clearly, this bandwidth is much greater than the bandwidth used by any current technology for communication. Due to the very large bandwidth, no spectrum can be allocated to UWB exclusively thus UWB band overlaps with many other narrowband systems. Therefore to guarantee existing systems from UWB emissions the FCC restricted the UWB operating bands in the 3.1-10.6 GHz frequency range and regulated UWB power emission by defining frequency-power masks for each specific UWB application/device. The assessment of interference caused by UWB devices is of fundamental importance to guarantee not conflicting coexistence and to gain acceptance of UWB technology worldwide. Some results on the coexistence between UWB and existing mobile wireless systems operating in the 3-5GHz band have been already presented in the literature and in regulatory forums[2].

The FCC rulings proposed a radiated power limit from UWB devices of －41.25 dBm/MHz from 3.1 to 10.6 GHz[3]. While the European Commission appears to be adopting a similarly proactive stance towards UWB, the radio regulatory body CEPT is adopting a more cautious approach.(Figure.1) In comparison with the GPS and other indoor communications techniques the effects of wireless UWB systems on SDMB services has not been well covered in the literature. This is probably not surprising. Most current wireless system fall below 2GHz and thus are not in the frequency band in which it is anticipated that most UWB communication systems will use.

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The SDMB is a new concept wireless service for giving high-quality mobile broadcasting system, which is accomplished by comprising both system E in DAB regulation of ITU-R BO.1130-4 and technology for video transmission. The strengths of Satellite-DMB service, the convergence of broadcasting and communication technologies, are mobility and portability that allow accessing the service at anytime, anyplace[4].

Some experiments have been performed. For example, in[5] the effect of a prototype UWB communication system meeting FCC requirements on a wireless mobile system was examined. But the SDMB & UWB interference test was not carried out.

In this paper, interference effects have been studied to the SDMB system for MB-OFDM & Pulse radio UWB source. Section 2 gives the experiment equipment descriptions. Sec. 3 shows the interference measurement system configuration and how to measurement method. Sec. 4 examines the experiment result and conclusions are followed in Sec.5.

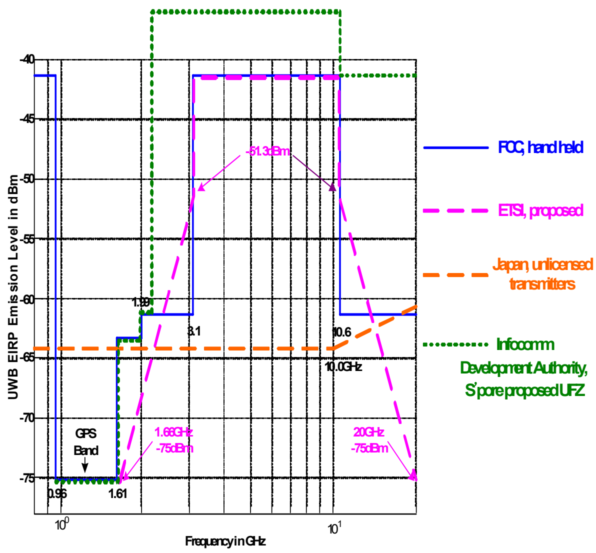

Fig. 1. Proposed Emission Masks

Ⅱ. Experiment system descriptions

2.1. Victim System

The victim used in this study was a SDMB of TU Media communication service-company. The receiver carrier frequency is 2.6425GHz. The SDMB Terminal was connected with a RF cable for measuring the BER testing and test cable for obtaining the diagnostic information using commercial DM software.

Table 1. SDMB characteristics

Audio coding	MPEG-2 AAC+
Video coding	H.264
Modulation	CDMA
Error correction	RS+ Convolution
Transmission ratio	9.44~16.552Mbps
Channel bandwidth	25 MHz

2.2. UWB characteristics

The Pulse & OFDM UWB transmitter employed in this experiment uses parameter values of Table.2, Table.3 and Pulse UWB spectral characteristics as shown in Fig. 2, which is manufactured by Time Domain Corp (PulseON200TM). OFDM UWB spectral characteristics as shown in Fig. 3, which is manufactured by Wisair Corp. In this measurement set-up, UWB transmitter is almost satisfied with FCC Part.15 emission regulation for practical usage but the OFDM UWB Power is below about –5 dB compare with the Pulse UWB Power in 2.6425GHz SDMB service bandwidth[3].

Table 2. Pulse UWB Characteristics

Pulse Repetition Frequency(PRF)	9.6MHz
Center Frequency(Radiated)	4.7GHz
Bandwidth(10dB radiated)	3.2GHz
EIRP	-41.25dBm

Table 3. OFDM UWB Characteristics

Pulse Repetition Frequency(PRF)	9.6MHz
Center Frequency(Radiated)	Variable(3 ch.)
Bandwidth(10dB radiated)	528MHz
EIRP	-41.25dBm

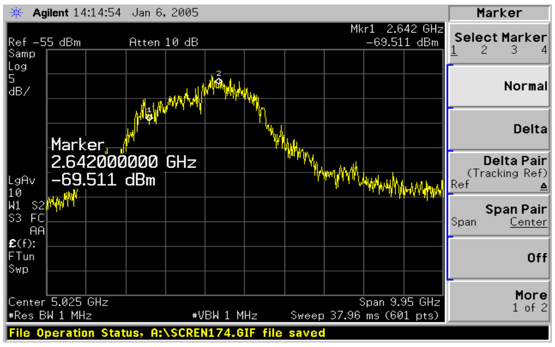

Fig. 2. Pulse UWB Signal Spectrum

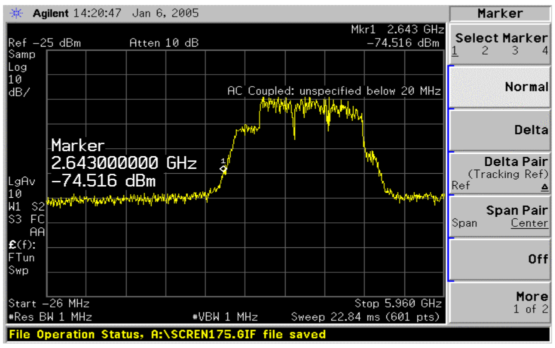

Fig. 3. OFDM UWB Signal Spectrum

Ⅲ. Interference measurement configuration

This paper presents experimental results of the coexistence tests with these two different systems. The main goal of this work is to determine how to the performance of SDMB is degraded in the existence of UWB device in the neighborhood

The measurement configuration employed in this experiment is described in Fig. 4. The SDMB Terminal was received direct signal from the Satellite with 2.6425GHz. It was connected to a notebook PC for the BER check. The Output signal of the UWB Signal generator is interface amplifier (Agilent 83020A) & attenuator (Agilent 8494B/8496B) for generating the precision output UWB power also UWB Signal generator is controlled by the Notebook PC.

This setup enabled us to eliminate the effects of signal fading, which is not the subject of this study. Transmission via space or power lines was completely negligible.

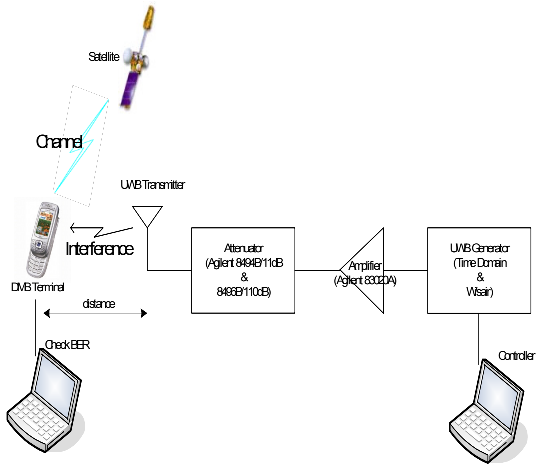

Fig. 4. Conceptual diagram of interference measurement set-up

Fig. 5. Measurement set-up of interference between SDMB and UWB

Ⅳ. Experimental results and discussion

4.1. Direct received SDMB signal from the Satellite

Wireless service can communicate below the 1 x 10-4 BER According to this experiment result,

It is -95dBm/MHz which is the direct received SDMB signal level from the Satellite, Under this condition, the SDMB service has not UWB interference effects more than 0.6m(fig.6) distance from the MB-OFDM UWB transmitter and more than 1.7m(fig.7) distance from the Pulse UWB source Also, SDMB service has not UWB interference effects less than 2 dB(fig.8) power attenuation from the Pulse UWB source (0dB = -61.3dBm/MHz, Fixed distance : 1.5m).

4.1.1. Distance variable

(SDMB receive level : -95dBm/MHz)

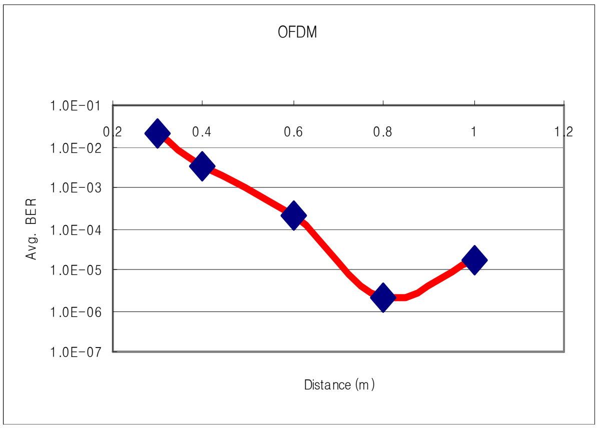

Fig. 6. MB-OFDM UWB Source

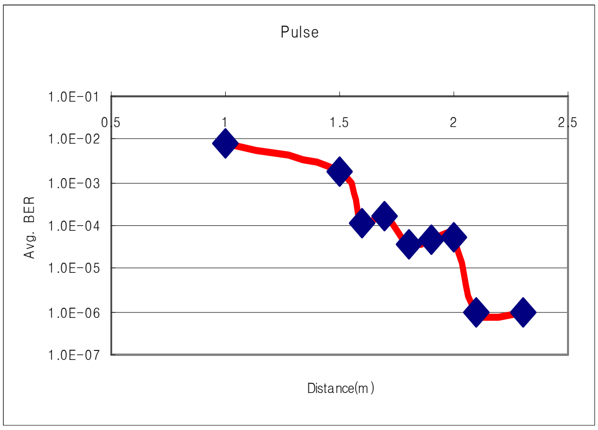

Fig. 7. Pulse UWB Source

4.1.2. UWB source power variable

(Fixed distance : 1.5m)

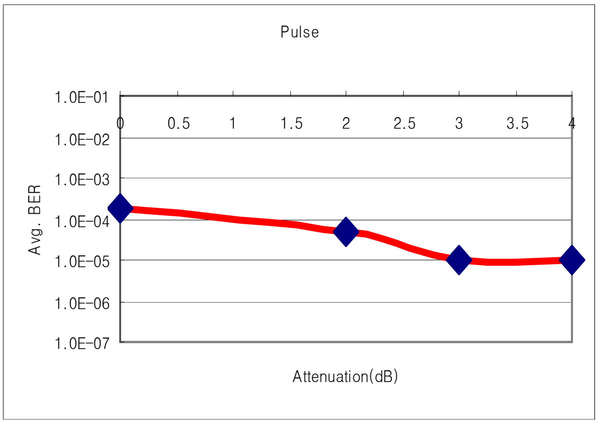

Fig. 8. Pulse UWB Source

4.2. SDMB signal from the Gap-Filler

(Gap-Filler : terrestrial SDMB repeater)

The received SDMB signal level from the Gap-Filler (terrestrial SDMB repeater) is -70dBm/MHz. Under this condition, the SDMB service has not UWB interference effects more than 0.2m(fig.9) distance from the Pulse UWB source Also, SDMB service has not UWB interference effects less than 3 dB(fig.10) power attenuation from the Pulse UWB source (Fixed distance : 0.01m). and less than 12 dB(fig.11) power attenuation from the MB-OFDM UWB source(0dB = -61.3dBm/MHz, Fixed distance : 0.2m).

4.2.1. Distance variable

(SDMB receive level : -70dBm/MHz)

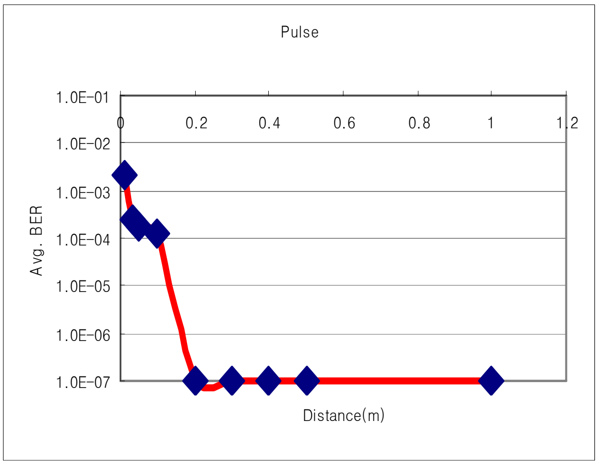

Fig. 9. Pulse UWB Source

4.2.2. UWB source power variable

(Fixed distance : 0.01m)

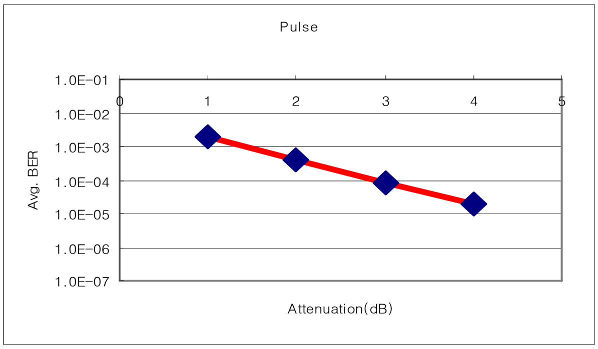

Fig. 10. Pulse UWB Source

(Fixed distance : 0.2m)

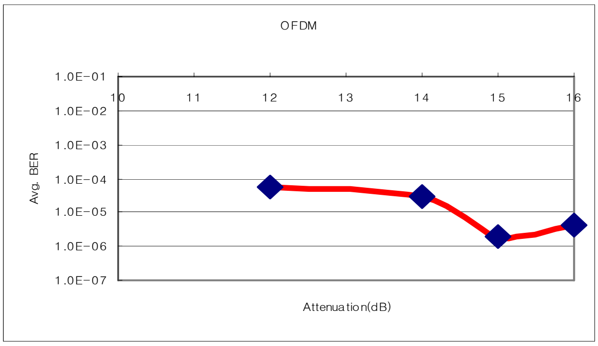

Fig. 11. MB-OFDM UWB Source

V. Conclusion

In this paper we study the coexistence issues between an UWB-based system and a Satellite Digital Multimedia Broadcasting system for the worst case with the weak signal area. In case of the direct satellite receive DMB signal, the measured allowable distance is 0.5m(MB-OFDM UWB source) and 2m(Pulse UWB source) also the measured allowable power attenuation is less than 2 dB (Pulse UWB source : 1.5m distance) note that −5dB the power difference.

In case of the Gap-Filler receiving DMB signal, the measured allowable distance is 0.2m(Pulse UWB source) also the measured allowable power attenuation is not effect less than 3 dB power attenuation from the Pulse UWB source (Fixed distance : 0.01m). and less than 12 dB power attenuation from the MB-OFDM UWB source (Fixed distance : 0.02m).

The effects of other type sources such as DS-CDMA and UWB source aggregate effects will be studied in the future.

If the SDMB output signal level rise up the 25dB (terrestrial SDMB repeater signal), We show that UWB source of the supporting FCC spectrum mask can coexist with the SDMB terminal without causing any dangerous interference.

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