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BER Performance of MC-DS-CDMA Systems in the Presence of Timing Jitter

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Abstract

Multi-carrier direct-sequence code division multiple access (MC-DS-CDMA) technique, which is a combination of orthogonal frequency-division multiplexing (OFDM) and code division multiple accesses (CDMA), has been considered as an important technique for the future generation wireless systems due to its bandwidth efficiency, frequency diversity, and immunity to channel dispersion. OFDM has already been employed in many areas, such as digital audio and video broadcasting, wireless local/metropolitan area networks, and asynchronous digital subscriber lines (ADSL). Leveraging the multiple access capability of CDMA, the MC-DS-CDMA technique is an important enhancement to OFDM.

Nevertheless, a major disadvantage of the MC-DS-CDMA systems is their high sensitivity to timing errors between transmitter and receiver due to the use of a large number of carriers and the superposition of signals of multiple users. In this thesis, we study the bit error rate (BER) performance of MC-DS-CDMA system under the effects of timing jitter in additive white Gaussian noise (AWGN) channel and multi-path Rayleigh fading channel, respectively. In particular, we have derived the analytical BER expressions for the MC-DS-CDMA signals in presence of white or colored timing jitters and verified the results via computer simulations.

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List of Abbreviations

MC-DS-CDMA: multi-carrier direct-sequence code division multiple access

OFDM: orthogonal frequency-division multiplexing

CDMA: code division multiple access

ADSL: asynchronous digital subscriber lines

BER: bit error rate

AWGN: additive white Gaussian noise

MCM: multi-carrier modulation

SP: serial-to-parallel

SNR: signal-to-noise ratio

OVSF: orthogonal variable spreading factor

FFT: Fast Fourier Transform

DMT: discrete multi-tone

FDM: frequency division multiplexing

FDMA: frequency division multiplexing access

VLSI: very-large-scale integration

QAM: quadrature amplitude modulation

HDSL: high-bit-rate digital subscriber lines

VHDSL: very high-speed digital subscriber lines

DAB: digital audio broadcasting

FM: frequency modulation

IFFT: inverse Fast Fourier Transform

ISI: inter-symbol interference

D/A: digital to analog

LPF: low-pass filter

RF: radio frequency

ICI: inter-carrier interference

SS: spread spectrum

DSSS: direct sequence spread spectrum

FHSS: frequency hopping spread spectrum

PN: pseudo-noise

FFHSS: fast frequency-hopping spread-spectrum

SFHSS: slow frequency-hopping spread-spectrum

MC-CDMA: multi-carrier orthogonal frequency-division multiplexing

MT-DS-CDMA: multi-tone direct-sequence code division multiple access

FEC: forward error control

4G: fourth-generation

HOVSF: Hadamard orthogonal variable spreading factor

JOVSF: Jacket orthogonal variable spreading factor

SUI: Stanford University Interim