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MIMO block spread OFDMA system for next generation mobile communications

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MIMO Block Spread OFDMA System for Next Generation Mobile Communications

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Statement of Originality

I, Yiwei Yu, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Master of Engineering - Research, in the School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

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Acronyms

1G First-generation

2G Second-generation

3G Third-generation

4G Fourth-generation

AWGN Additive white Gaussian noise

BER Bit error rate

BPSK Binary phase shift keying

BS-OFDM Block spread OFDM

BS-OFDMA Block spread orthogonal frequency division multiple access

CDMA Code division multiple access

CP Cyclic prefix

DFE Decision feedback equalizer

DFT Discrete Fourier transform

DMB Digital multi media broadcasting

DVB Digital video broadcasting

DVB-C DVB-cable

DVB-H DVB-handheld

DVB-S DVB-satellite television and satellite Internet

DVB-T DVB-terrestrial

EC Eurppean Commission

FFT Fast Fourier transform

FWA Fixed wireless access

GSM Global system for mobile communications

HAP High altitude platforms

ICI Inter-carrier interference

IFFT Inverse fast Fourier transform

ISDB Integrated services ditial broadcasting

ISDB-C ISDB-cable

ISDB-S ISDB-satellite television

ISI Intersymbol interference

M2M Machine-to-machine

MAC Media access control

MAGIC Mobile multimedia; Anytime, anywhere, anyone; Global mobility support; Integrated wireless solution; and Customized personal service

MC-CDMA Multicarrier CDMA

MC-DS-CDMA multicarrier direct sequence CDMA

MIMO Multi-input and multi-out

MISO Multiple input and single output

MLSE Maximum likelihood sequence estimator

MMSE Minimum mean square error

M-PSK M phase shift keying

M-QAM M quadrature amplitude modulation

NLOS non-line-of-sight

OFDM Orthogonal frequency division multiplexing

OOB Out of band

PAN Personal area network

PAPR Peak to average power ratio

PHY Physical layer

PN Pesudo-noise

P/S Parallel to serial

QoS Quality of service

QPSK Quadrature phase shift keying

SNR Signal to noise ratio

S/P Serial to parallel

SS Spread spectrum

STBC Space-time block coding

STC-MIMO Space-time coded MIMO

STTC Space-time trellis coding

TCM Trellis-coded modulation

TD-SCDMA Time division synchronous CDMA

UMTS Universal Mobile Telecommunication system

WCDMA Wideband CDMA

W-CPN Wireless customer premise network

WiMAX Worldwide interoperability for microwave access

W-LAN Wireless local area network

WLL Wireless local loop

ZF Zero-forcing

Abstract

Wireless communications are developing at a booming speed, with plenty of research emerging on the next generation wireless communications. This thesis presents an advanced system for the next generation wireless communications. The proposed system is called block spread OFDMA combined with STC-MIMO (STC-MIMO BS-OFDMA). The system is based on OFDM, which is able to deliver high data rates in highly dispersive channels and is thereby considered as a good candidate of modulation techniques for 4G. The block spreading technique and STC-MIMO scheme are used to provide the system with frequency and spatial diversity, therefore significantly improving system performance.

In this system, there are two stages to combine block spreading and STC-MIMO with OFDMA. Firstly, a novel block spreading approach is applied to effectively achieve frequency diversity in the OFDMA system without any explicit precoding process. The STC-MIMO using Alamouti code is then incorporated on block basis and performs in space and frequency. Accordingly, the signal model and architectures of the proposed system are presented. Two receiver architectures are designed for different STC-MIMO schemes: the receiver with one antenna and receiver with two antennas.

Simulations are carried out to demonstrate the expected performance improvement. The BER performance comparisons indicate that the proposed system can achieve significant performance improvement. The research project also investigates the system performance when different parameters are used. Our results show that using a larger block spreading size and more receive antennas can further improve system performance because of higher order of diversity advantages. In terms of linear equalizations, the MMSE equalization achieves better performance than the ZF equalization.

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