شبكة المعلومات الجامعية

بسم اللّه الرحمن الرحيم

SALWA AKL

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

SALWA AKL

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

SALWA AKL

بعض الوثائق الأصلية تالفة

SALWA AKL

بالرسالة صفحات

لم ترد بالأصل

SALWA AKL

A MULTI-CARRIER CDMA MOBILE COMMUNICATIONS SYSTEM EMPLOYING PRE-RAKE AND DIVERSITY

By

Fatma Abd El-Karim Kamel Newagy

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements For the Degree of
MASTER OF SCIENCE
in
ELECTRONICS AND COMMUNICATIONS

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2002

A MULTI-CARRIER CDMA MOBILE COMMUNICATIONS SYSTEM EMPLOYING PRE-RAKE AND DIVERSITY

By

Fatma Abd El-Karim Kamel Newagy

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements For the Degree of
MASTER OF SCIENCE
in
ELECTRONICS AND COMMUNICATIONS

Under the Supervision of

Prof. Dr. Emad K. Al-Hussaini **Dr. Hebatallah M. Mourad**

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2002

A MULTI-CARRIER CDMA MOBILE COMMUNICATIONS SYSTEM EMPLOYING PRE-RAKE AND DIVERSITY

By

Fatma Abd El-Karim Kamel Newagy

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements For the Degree of
MASTER OF SCIENCE
in
ELECTRONICS AND COMMUNICATIONS

Approved by the
Examining Committee:

Prof. Dr. Emad K. Al-Hussaini	Main advisor	E. K. Al-Hussaini
Dr. Hebat-allah M. Mourad	Advisor	Hebat-Allah Mourad
Prof. Dr. Salwa H. El-Ramly	Member	Salwa El Ramly
Prof. Dr. Magdi Fekry	Member	

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2002

Abstract

In this thesis a combination of orthogonal frequency division multiplexing (OFDM) and code division multiple access (CDMA) has been proposed for application in a mobile personal communications system. This is called Multi-carrier (MC) CDMA system. It combines a high spectral efficiency with an immunity to channel dispersion. Furthermore, instead of building a rake receiver in the mobile unit (MU), the base station (BS) can pre-rake the signal before transmission in the downlink using the channel impulse response estimated from the uplink. The mobile unit uses a conventional receiver and still achieves approximately the same performance as in the case of the rake receiver. For further improvements, dual transmitter diversity is employed to combat fading. Theoretical and simulation results are obtained for the system under consideration. Depicted results show appreciable improvements when compared with those previously considered in the literature.

Acknowledgement

The author wishes to express her gratitude to Professor Emad K. Al-Hussaini who supervised this work and gave his valuable advice and assistance during different phases of this work. The author owns him most of the success of this work. Grateful thanks to Dr. Hebatallah M. Mourad for her great assistance and advice during this work. I really want to thank them for their lovely manner and patience in many situations. The author is thankful to her family for their support.

Table of Contents

Symbols & Abbreviations

Symbols

$a_k(t)$	The Pseudo noise (PN) code for user k.
$\beta_{k,\ell}$	The channel gain for path ℓ and user k.
$\beta_{k,m,\ell}$	The channel gain for path ℓ and subcarrier m and user k.
$b_k(t)$	The data stream for user k.
$b_{i,m}$	The input data at time instant i and subcarrier m.
$C_{k,l}(m)$	The discrete aperiodic cross-correlation function between users k, 1.
$h_k(t)$	The complex low-pass impulse response of the channel for user k.
$h_{k,m}(t)$	The complex low-pass impulse response of the channel for user k and subcarrier m.
K	The total number of users.
L	The number of channel paths.
M	The number of subcarriers in multi-carrier systems.
N	The spreading factor of spread spectrum systems.
$n(t)$	Zero mean additive white gaussian noise (AWGN) with two sided power spectral density $N_o/2$.
P	The transmitted power.
$r_k(t)$	The received signal at user k.
$r_{k,m}(t)$	The received signal at user k and subcarrier m.
$r^{(j)}(t)$	The received signal from the transmitted j^{th} antenna.
$S_k(t)$	The down-link transmitted signal for user k.
$S_{k,m}(t)$	The down-link transmitted signal for user k and subcarrier m.
T	The data bit duration.
T_S	The data symbol duration.
T_c	The pseudo noise (PN) code chip duration.
T_{CP}	The length of cyclic prefix.
T_o	The OFDM symbol duration.

U_k	The normalizing factor that keeps the instantaneous transmitted power constant regardless of the number of channel paths.
$\gamma_{k,\ell}$	The channel phase for user k and channel path ℓ.
$\gamma_{k,m,\ell}$	The channel phase for user k and channel path ℓ and subcarrier m.
ω_m	The orthogonal frequency of subcarrier m.
Y_i	The SNR for one branch from the transmit antenna i.

Abbreviations

ADSL	Asymmetric Digital Subcarrier Lines.
AWGN	Additive White Gaussian Noise.
BER	Bit Error Rate.
BPSK	Binary Phase Shift Keying.
BS	Base Station.
CDMA	Code Division Multiple Access.
CP	Cyclic Prefix.
DAB	Digital Audio Broadcasting.
DFT	Discrete Fourier Transform.
DS-SS	Direct Sequence Spread Spectrum.
DVB	Digital Video Broadcasting.
ETSI	European Telecommunications Standards Institute.
FDM	Frequency Division Multiplexing.
FFT	Fast Fourier Transform.
HDSL	High-bit-rate Digital Subcarrier Lines.
HDTV	High-definition Television.
ICI	Inter Carrier Interference.
IFFT	Inverse Fast Fourier Transform.
ISI	Intersymbol Interference.
LAN	Local Area Network.
MAI	Multiple Access Interference.
MC-CDMA	Multi-carrier CDMA.