The Deployment and Performance of Indoor/Outdoor DS-CDMA Systems with Multiuser Detection

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Abstract

This thesis investigates the deployment and performance of indoor/outdoor DS-CDMA systems assuming both conventional receivers and multiuser detection receivers at the base stations.

In the first part of this thesis, measured propagation data and a DS-CDMA system performance testbed (based on a Monte Carlo analysis) are used to quantify both the downlink and uplink outage probabilities for a variety of deployment scenarios: (a) indoor-only systems; (b) interfering indoor/outdoor systems; and (c) interfering indoor systems located adjacent to each other. The results reveal that optimal indoor deployment strategies are heavily dependent on both the location and strength of interference emanating from outdoors. Indoor base station deployment strategies that are optimal in the absence of outdoor interference are often suboptimal if outdoor interference is present.

In the second part of this thesis, two simple multiuser detection techniques are chosen for implementation in the DS-CDMA system performance testbed: successive interference cancellation (SIC) and parallel interference cancellation (PIC). The performance estimation results show that orders-of-magnitude improvements in uplink outage probability are possible with both SIC and PIC. The extent of these improvements is dependent on the deployment strategy used, the fractional residual interference cancellation error, and the uplink power control algorithm (for the case of SIC). If perfect interference cancellation is assumed, it is evident from the results of this thesis that the cancellation of signals in parallel (PIC) provides no additional benefit to system performance than ranking and cancelling the signals sequentially (SIC).

Dedication

To my Lord Jesus Christ, thank you for coming into my life and filling me with so much hope, purpose and ambition.

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List of Abbreviations and Acronyms

16QAM	16 Quadrature Amplitude Modulation
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
CW	Continuous Wave
DECT	Digital Enhanced Cordless Telecommunications
DS-CDMA	Direct Sequence Code Division Multiple Access
FDMA	Frequency Division Multiple Access
FH-CDMA	Frequency Hopping Code Division Multiple Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
MAI	Multiple Access Interference
MIMO	Multiple-Input-Multiple-Output
MLSE	Maximum Likelihood Sequence Estimator
MMSE	Minimum Mean Square Error
PC	Power Control
PIC	Parallel Interference Cancellation
PPM-CDMA	Pulse Position Modulation Code Division Multiple Access
QPSK	Quadrature Phase Shift Keying
RMS	Root Mean Square
SIC	Successive Interference Cancellation
SIR	Signal to Interference Ratio
TDMA	Time Division Multiple Access
UMTS	Universal Mobile Telecommunications System
VCO	Voltage Controlled Oscillator
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access