CROSS-LAYER RESOURCE ALLOCATION IN WIRELESS COMMUNICATIONS

Techniques and Models from PHY and MAC Layer Interaction

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Preface

Recently, there has been considerable interest in the idea of cross-layer design of wireless networks. This is motivated by the need to provide a greater level of adaptivity to variations of wireless channels. This book examines the interaction between the physical and medium access control layers. In particular, the book considers the impact of signal processing techniques that enable mulipacket transmission and reception on the throughput and design of protocols. Main emphasis is given to the spatial dimension. The book can be found interesting for researchers and professionals working either in the PHY layer or in the MAC layer, who want to get initiated into the MAC or PHY layer, respectively. Concerning resource allocation strategies in wireless communication systems, contributions from the wireless communications research community are either in the information theory field or in the networking field with an evident isolation between them. This book explores the advantages of breaking down such traditional isolation and considers resource allocation cross-layer techniques, models and methodologies that will help researchers from these two fields to increase their synergy.

The book is intended as a reference book for researchers and graduate students of the wireless communications community, which provides with a general framework for cross-layer design. There are many publications and books regarding cross-layer designs, but there is a lack of a general framework. The general framework in this book aims at the joint design of scheduling, power control, adaptive modulation and its interplay with channel state information.

The whole book consists of eight chapters. First, in Chapter 1, the fundamental concepts of this book are introduced. In Chapters 2 and 3, a detailed description of the concept of spectral efficiency in both single-user and multi-user systems is presented. Then, with the performance metric clearly defined and understood, the optimal resource allocation in multi-user SISO systems is studied in Chapter 4. In Chapter 5, multi-user SIMO channels are

examined, whereas the multi-user MISO channel is analyzed in Chapter 6. The delay, the other performance metric mentioned previously, is presented in Chapter 7 where the resource allocation strategies presented in previous chapters are analyzed in terms of delay. Finally, the book considers a general perspective on how cross-layer resource allocation should be considered in multi-user OFDMA systems.

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List of Acronyms

2G	Second Generation
3G	Third Generation
AP	Access Point
AGWN	Additive Gaussian White Noise
ARQ	Automatic Repeat Request
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
BS	Base Station
CAC	Connection Admission Control
CDMA	Code Division Multiple Access
CSI	Channel State Information
DPC	Dirty Paper Coding
FD	Frame Division
FDMA	Frame Division Multiple Access
FEC	Forward Error Correction
GSM	Global System for Mobile communications
HMUD	Heterogeneous Multi User Diversity
HSDPA	High Speed Downlink Packet Access
IFFT	Inverse Fast Fourier Transform
IP	Internet Protocol
IS-95	Interim Standard 95
KKT	Karush–Kuhn–Tucker
LAN	Local Area Network
LDPC	Low-Density Parity-Check code
MAC	Medium Access Control
MCS	Modulation and Coding Scheme
MIMO	Multiple-Input Multiple-Output
MISO	Multiple-Input Single-Output
MMSE	Mininum Mean Square Error
MUD	Multi-User Diversity
MUX	Multiplexing
OSI	Open Systems Interconnection
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access

PER	Packet Error Rate
PF	Proportional Fair
PHY	PHYsical layer
PSR	Packet Success Rate
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
RR	Round Robin
SIC	Successive Interference Cancelation
SIMO	Single-Input-Multiple-Output
SISO	Single-Input-Single-Output
SER	Symbol Error Rate
SD	Spatial Diversity
SDMA	Spatial Diversity Multiple Access
SNR	Signal to Noise Ratio
SVD	Singular Value Decomposition
TDD	Time Division Duplexing
TDMA	Time Division Multiple Access
UMTS	Universal Mobile Telecommunications System
VoIP	Voice over IP
ZF	Zero Forcing

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