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Radio Resource Allocation Over Fading Channels Under Statistical Delay Constraints

 Springer

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Preface

Wireless data transmission suffers from the fading nature of wireless channels, where the instantaneous channel conditions and hence transmission rates randomly fluctuate over time. Consequently, data arrivals at each transmitter might not be transmitted instantly. To cope with this situation, the transmitter employs buffer to store the data temporarily for later transmission. While data buffering enables more efficient radio resource allocation to opportunistically select the good fading conditions for transmission, it introduces queuing delay that needs to be controlled in order to meet the end-to-end delay quality-of-service (QoS) requirements in supporting delay-sensitive communications. This SpringerBrief presents radio resource allocation schemes for buffer-aided communications systems over fading channels under statistical delay constraints in terms of upper-bounded average delay or delay-outage probability.

This Brief starts by considering a source-destination communications link with data arriving at the source transmission buffer. In the first scenario, the joint optimal data admission control and power allocation problem for throughput maximization is considered, where the source is assumed to have a maximum power and an average delay constraint. In the second scenario, optimal power allocation problems for energy harvesting (EH) communications systems under average delay or delay-outage constraints are explored, where the EH source harvests random amounts of energy from renewable energy sources, and stores the harvested energy in a battery during the course of data transmission. Online resource allocation algorithms are developed when the statistical knowledge of the random channel fading, data arrivals, and EH processes governing the system dynamics is unknown a priori. The Brief continues with a source-relay-destination communications link with buffers available at both source and relay, as part of a multi-hop network. Optimal resource allocation schemes for this 3-node relaying system to maximize its effective capacity under a delay-outage constraint are proposed, with special emphasis on relay roles: Half-duplex (HD) or full-duplex (FD) relay operation. With HD relay, the adaptive link selection relaying problem jointly with both fixed and adaptive power allocation schemes is investigated. In each transmission frame, either the source-relay link or the relay-destination link is selected to be active depending on

the channel conditions. With FD relay under the presence of non-zero residual self-interference (SI), this Brief presents source and relay power allocation schemes for both cases of available knowledge of the channel state information at transmitter (CSIT): instantaneous or statistical.

The target readers of this informative and practical SpringerBrief are researchers and professionals working in wireless networking and communications areas. The content is also valuable for advanced-level students interested in network communications and radio resource allocation.

We dedicate this work to our families.

Clayton, VIC, Australia
Montreal, QC, Canada

Khoa Tran Phan
Tho Le-Ngoc

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Acronyms

5G	Fifth-generation
AC-PA	Admission control-power allocation
AWGN	Additive white Gaussian noise
B-FD	Buffer-aided full-duplex relaying
B-FD-APA	Buffer-aided full-duplex relaying with adaptive power allocation
B-FD-SPA	Buffer-aided full-duplex relaying with static power allocation
B-HD	Buffer-aided half-duplex relaying
B-HD-ALS	Buffer-aided half-duplex relaying with adaptive link scheduling
B-HD-FLS	Buffer-aided half-duplex relaying with fixed link scheduling
CSI	Channel state information
CSIT	Channel state information at the transmitters
DT	Direct transmission
E2E	End-to-end
EC	Effective capacity
ECCA	Energy constrained control algorithm
EH	Energy harvesting
FD	Full-duplex relaying
HD	Half-duplex relaying
i.i.d.	Independent and identically distributed
INR	Self-interference-to-noise power ratio
KKT	Karush-Kuhn-Tucker
LMGF	Log moment generating function
LTE	Long-term evolution
M2M	Machine-to-machine
MDP	Markov decision process
MIMO	Multiple-input multiple-output
N-FD-APA	Non-buffer full-duplex relaying with adaptive power allocation

N-FD-SPA	Non-buffer full-duplex relaying with static power allocation
pdf	Probability distribution function
QoS	Quality-of-service
RVIA	Relative value iterative algorithm
SI	Self-interference
SINR	Signal-to-interference-plus-noise power ratio
SNR	Signal-to-noise power ratio