

**Real-time Performance Analysis of Mobile  
Networks for Emerging Services in  
UMTS/HSDPA**

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by

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**UNIVERSITY OF  
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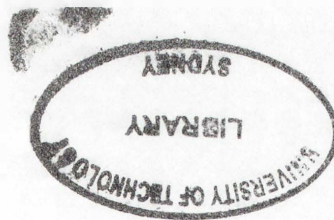
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## ABSTRACT

Whereas the network performance in terms of service capabilities and spectrum efficiency has been significantly improved due to the advanced mobile networks and technologies, the inherent high-interference due to the air interface of the Radio Access Networks (RAN) and varying Quality of Service (QoS) requirements per service per user are continuously challenging the performance of mobile cellular networks. The network performance can be measured and analysed by selected Key Performance Indicators (KPI).

To further study mobile network performance in the context of provisions of services, computer simulations are commonly used for modeling and optimisations. However, the mobile network performance obtained during real-time measurements is very dependent on the particular service, location, network/service providers, infrastructure, user equipment, dynamic change of mobile traffic density and so on, while the simulation environment is largely based on assumptions and simplifications of the real-world scenarios

Therefore, this thesis focus on investigating the real-time performance measurements of commercial WCDMA and HSDPA networks for emerging multimedia services, such as video telephony and video streaming. Moreover, this thesis provides the feasibility of using real-time performance measurements as a supplementary research methodology and finally implementing the methodology to make more accurate and realistic MATLAB-based computer simulations for WCDMA and HSDPA RRM functionalities.

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## ABBREVIATIONS

For the purposes of the present document, the following abbreviations apply

16 QAM	16-Quadrature Amplitude Modulation
3G	Third Generation
3GPP	Third Generation Partnership Project
ACK	Acknowledgements
AMC	Adaptive Modulation and Coding
BE	Best Effort
BER	Bit Error Rate
BLER	Block Error Rate
BPSK	Binary Phase Shift Keying
CCTrCH	Composite Transport Channel
CDMA	Code Division Multiple Access
CN	Core Network
CPICH	Common Pilot Channel
CQI	Channel Quality Indicator
CS	Circuit Switched
DCCH	Digital Control Channel
DCH	Dedicated Transport Channel
DPCCH	Dedicated Physical Control Channel
DPCH	Downlink Dedicated Physical Channel
DPDCH	Dedicated Physical Data Channel
$E_c/N_0$	Received energy per chip divided by the power density in the band
EDGE	Enhanced Data Rates for GSM Evolution
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
G-factor	Geometry Factor
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSA	Global mobile Suppliers Association
GSM	Global System for Mobile Communication
HARQ	Hybrid ARQ
HO	Handover
HSDPA	High Speed Downlink Packet Access
HS-DPCCH	High Speed Dedicated Physical Control Channel
HS-DSCH	High Speed Downlink Shared Channel
HSPA	High Speed Packet Access
HS-SCCH	High Speed Shared Control Channel
HSUPA	High Speed Uplink Packet Access



## ABBREVIATIONS

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IP	Internet Protocol
KPI	Key Performance Indicator
L1	Layer 1
L3	Layer 3
LOS	Line-Of-Sight
LTE	Long Term Evolution
MAC	Medium Access Control
MAC-hs	High Speed Medium Access protocol
ME	Mobile Equipment
MMS	Multimedia Messaging Service
MMSC	Multimedia Messaging Centre
MO	Mobile Originated
MOS	Mean Opinion Score
MS	Mobile Station
MSC	Mobile Switching Centre
MT	Mobile Terminated
NACK	Negative Acknowledgements
NGN	Next Generation Network
NP	Network Performance
NRT	Non-Real Time
OVSF	Orthogonal Variable Spreading Factor
PC	Power Control
P-CPICH	Primary CPICH
PCS	Personal Communication Service
PG	Processing Gain
PoC	Push-to-talk over Cellular
PS	Packet Switched
QoE	Quality of Experience
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RAB	Radio Access Bearer
RAN	Radio Access Networks
RB	Radio Bearer
RF	Radio Frequency
RL	Radio Link
RLC	Radio Link Control
RMS	Root Mean Square
RRC	Radio Resource Control
RRM	Radio Resource Management
RSCP	Received Signal Code Power
RSSI	Received Signal Strength Indicator
RT	Real Time

## ABBREVIATIONS

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Rx	Receive, or Receiver, or Reception
SDU	Service Data Unit
SF	Spreading Factor
SHO	Soft Handover
SINR	Signal to Interference and Noise Ratio
SIR	Signal-to-Interference Ratio
SMS	Short Message Service
TB	Transport Block
TDMA	Division Multiple Access
TE	Terminal Equipment
TFCI	Transport Format Combination Indicator
TTI	Transmission Time Interval
Tx	Transmit, or Transmitter, or Transmission
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network
VT	Video Telephony
WAP	Wireless Application Protocol
WCDMA	Wideband Code Division Multiple Access