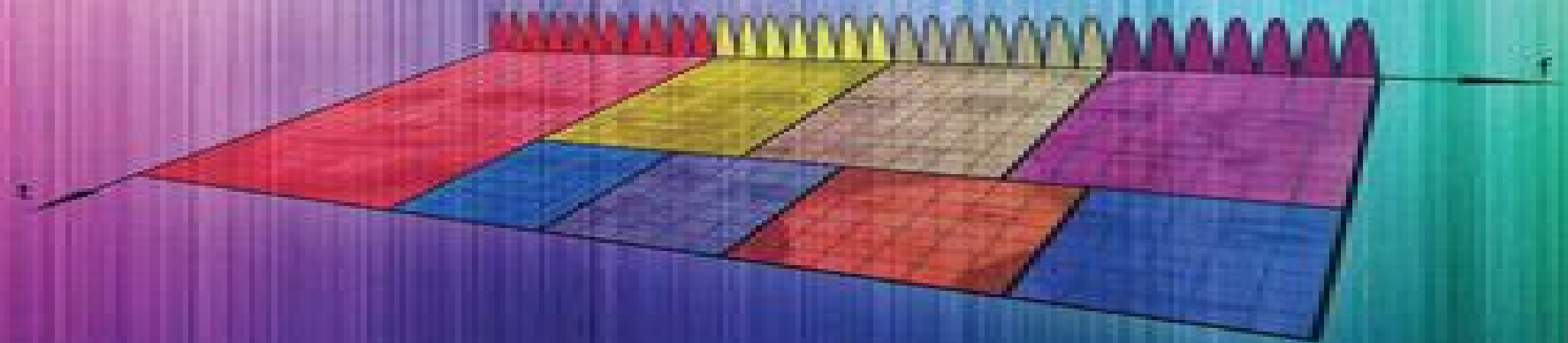


Evaluation of HSDPA and LTE

From Testbed Measurements
to System Level Performance



SEBASTIAN CABAN • CHRISTIAN MEHLFÜHRER
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Evaluation Of Hsdpa And Lte From Testbed Measurements To System Level Performance

Ashok Kumar



Evaluation Of Hsdpa And Lte From Testbed Measurements To System Level Performance:

Evaluation of HSDPA and LTE Markus Rupp, Sebastian Caban, Christian Mehlführer, Martin Wrulich, 2011 This book explains how the performance of modern cellular wireless networks can be evaluated by measurements and simulations With the roll out of LTE high data throughput is promised to be available to cellular users In case you have ever wondered how high this throughput really is this book is the right read for you At first it presents results from experimental research and simulations of the physical layer of HSDPA WiMAX and LTE Next it explains in detail how measurements on such systems need to be performed in order to achieve reproducible and repeatable results The book further addresses how wireless links can be evaluated by means of standard compliant link level simulation The major challenge in this context is their complexity when investigating complete wireless cellular networks Consequently it is shown how system level simulators with a higher abstraction level can be designed such that their results still match link level simulations Exemplarily the book finally presents optimizations of wireless systems over several cells This book Explains how the performance of modern cellular wireless networks can be evaluated by measurements and simulations Discusses the concept of testbeds highlighting the challenges and expectations when building them Explains measurement techniques including the evaluation of the measurement quality by statistical inference techniques Presents throughput results for HSDPA WiMAX and LTE Demonstrates simulators at both link level and system level Provides system level and link level simulators for WiMAX and LTE on an accompanying website https://www.nt.tu-wien.ac.at/downloads/featured_downloads This book is an insightful guide for researchers and engineers working in the field of mobile radio communication as well as network planning Advanced students studying related courses will also find the book interesting

Evaluation of HSDPA and LTE Markus Rupp, Sebastian Caban, Christian Mehlführer, Martin Wrulich, 2011-12-12 This book explains how the performance of modern cellular wireless networks can be evaluated by measurements and simulations With the roll out of LTE high data throughput is promised to be available to cellular users In case you have ever wondered how high this throughput really is this book is the right read for you At first it presents results from experimental research and simulations of the physical layer of HSDPA WiMAX and LTE Next it explains in detail how measurements on such systems need to be performed in order to achieve reproducible and repeatable results The book further addresses how wireless links can be evaluated by means of standard compliant link level simulation The major challenge in this context is their complexity when investigating complete wireless cellular networks Consequently it is shown how system level simulators with a higher abstraction level can be designed such that their results still match link level simulations Exemplarily the book finally presents optimizations of wireless systems over several cells This book Explains how the performance of modern cellular wireless networks can be evaluated by measurements and simulations Discusses the concept of testbeds highlighting the challenges and expectations when building them Explains measurement techniques including the evaluation of the measurement quality by statistical inference

techniques Presents throughput results for HSDPA WiMAX and LTE Demonstrates simulators at both link level and system level Provides system level and link level simulators for WiMAX and LTE on an accompanying website https://www.nt.tuwien.ac.at/downloads/featured_downloads This book is an insightful guide for researchers and engineers working in the field of mobile radio communication as well as network planning Advanced students studying related courses will also find the book interesting

The Vienna LTE-Advanced Simulators Markus Rupp, Stefan Schwarz, Martin Taranetz, 2016-03-23 This book introduces the Vienna Simulator Suite for 3rd Generation Partnership Project 3GPP compatible Long Term Evolution Advanced LTE A simulators and presents applications to demonstrate their uses for describing designing and optimizing wireless cellular LTE A networks Part One addresses LTE and LTE A link level techniques As there has been high demand for the downlink DL simulator it constitutes the central focus of the majority of the chapters This part of the book reports on relevant highlights including single user SU multi user MU and single input single output SISO as well as multiple input multiple output MIMO transmissions Furthermore it summarizes the optimal pilot pattern for high speed communications as well as different synchronization issues One chapter is devoted to experiments that show how the link level simulator can provide input to a testbed This section also uses measurements to present and validate fundamental results on orthogonal frequency division multiplexing OFDM transmissions that are not limited to LTE A One chapter exclusively deals with the newest tool the uplink UL link level simulator and presents cutting edge results In turn Part Two focuses on system level simulations From early on system level simulations have been in high demand as people are naturally seeking answers when scenarios with numerous base stations and hundreds of users are investigated This part not only explains how mathematical abstraction can be employed to speed up simulations by several hundred times without sacrificing precision but also illustrates new theories on how to abstract large urban heterogeneous networks with indoor small cells It also reports on advanced applications such as train and car transmissions to demonstrate the tools capabilities

Advances in Mobile Computing and Communications M. Bala Krishna, Jaime Lloret Mauri, 2016-08-19 By 2020 if not before mobile computing and wireless systems are expected to enter the fifth generation 5G which promises evolutionary if not revolutionary services What those advanced services will look like sound like and feel like is the theme of the book **Advances in Mobile Computing and Communications Perspectives and Emerging Trends in 5G Networks** The book explores futuristic and compelling ideas in latest developments of communication and networking aspects of 5G As such it serves as an excellent guide for advanced developers communication network scientists researchers academicians and graduate students The authors address computing models communication architecture and protocols based on 3G LTE LTE A 4G and beyond Topics include advances in 4G radio propagation and channel modeling aspects of 4G networks limited feedback for 4G and game theory application for power control and subcarrier allocation in OFDMA cellular networks Additionally the book covers millimeter wave technology for 5G networks multicellular heterogeneous networks and energy efficient mobile wireless network

operations for 4G and beyond using HetNets Finally the authors delve into opportunistic multiconnect networks with P2P WiFi and cellular providers and video streaming over wireless channels for 4G and beyond *Foundations of MIMO Communication* Robert W. Heath Jr.,Angel Lozano,2018-12-06 Understand the fundamentals of wireless and MIMO communication with this accessible and comprehensive text Viewing the subject through an information theory lens but also drawing on other perspectives it provides a sound treatment of the key concepts underpinning contemporary wireless communication and MIMO all the way to massive MIMO Authoritative and insightful it includes over 330 worked examples and 450 homework problems with solutions and MATLAB code and data available online Altogether this is an excellent resource for instructors and graduate students as well as an outstanding reference for researchers and practicing engineers

Simulation Technologies in Networking and Communications Al-Sakib Khan Pathan,Muhammad Mostafa Monowar,Shafiullah Khan,2014-11-06 Simulation is a widely used mechanism for validating the theoretical model of networking or communication systems Although the claims made based on simulations are considered to be reliable how reliable they really are is best determined with real world implementation trials This book addresses various issues covering different mechanisms related to simulation technologies in networking and communications fields Focusing on the practice of simulation testing instead of the theory it reviews and evaluates popular simulation modeling tools and recommends the best tools for specific tests *Mobile Networks and Management* Kostas Pentikousis,CALVO RAMON AGUERO,Marta García-Arranz,Symeon Papavassiliou,2011-05-31 This book constitutes the thoroughly refereed post conference proceedings of the Second International ICST Conference on Mobile Networks and Management MONAMI 2010 held in Santander Spain in September 2010 The 29 revised full papers presented were carefully reviewed and selected for inclusion in the proceedings The papers are organized in topical sections on routing and virtualization autonomic networking mobility management multiaccess selection wireless network management wireless networks and future research directions

Enhancing Upper-level Performance from Below Ruofan Jin,2015 *Design, Deployment and Performance of 4G-LTE Networks* Ayman ElNashar,Mohamed A. El-saidny,Mahmoud Sherif,2014-03-13 This book provides an insight into the key practical aspects and best practice of 4G LTE network design performance and deployment Design Deployment and Performance of 4G LTE Networks addresses the key practical aspects and best practice of 4G networks design performance and deployment In addition the book focuses on the end to end aspects of the LTE network architecture and different deployment scenarios of commercial LTE networks It describes the air interface of LTE focusing on the access stratum protocol layers PDCP RLC MAC and Physical Layer The air interface described in this book covers the concepts of LTE frame structure downlink and uplink scheduling and detailed illustrations of the data flow across the protocol layers It describes the details of the optimization process including performance measurements and troubleshooting mechanisms in addition to demonstrating common issues and case studies based on actual field results The book provides detailed performance analysis

of key features enhancements such as C DRX for Smartphones battery saving CSFB solution to support voice calls with LTE and MIMO techniques The book presents analysis of LTE coverage and link budgets alongside a detailed comparative analysis with HSPA Practical link budget examples are provided for data and VoLTE scenarios Furthermore the reader is provided with a detailed explanation of capacity dimensioning of the LTE systems The LTE capacity analysis in this book is presented in a comparative manner with reference to the HSPA network to benchmark the LTE network capacity The book describes the voice options for LTE including VoIP protocol stack IMS Single Radio Voice Call Continuity SRVCC In addition key VoLTE features are presented Semi persistent scheduling SPS TTI bundling Quality of Service QoS VoIP with C DRX Robust Header Compression RoHC and VoLTE Vocoders and De Jitter buffer The book describes several LTE and LTE A advanced features in the evolution from Release 8 to 10 including SON eICIC CA CoMP HetNet Enhanced MIMO Relays and LBS This book can be used as a reference for best practices in LTE networks design and deployment performance analysis and evolution strategy Conveys the theoretical background of 4G LTE networks Presents key aspects and best practice of 4G LTE networks design and deployment Includes a realistic roadmap for evolution of deployed 3G 4G networks Addresses the practical aspects for designing and deploying commercial LTE networks Analyzes LTE coverage and link budgets including a detailed comparative analysis with HSPA References the best practices in LTE networks design and deployment performance analysis and evolution strategy Covers infrastructure sharing scenarios for CAPEX and OPEX saving Provides key practical aspects for supporting voice services over LTE Written for all 4G engineers designers working in networks design for operators network deployment engineers R D engineers telecom consulting firms measurement performance tools firms deployment subcontractors senior undergraduate students and graduate students interested in understanding the practical aspects of 4G LTE networks as part of their classes research or projects

WCDMA for UMTS Harri Holma, Antti Toskala, 2007-09-27 Written by the leading experts in the field the best selling book on UMTS is now updated to cover 3GPP High Speed Packet Access HSPA evolution HSPA in Release 7 and on going Long Term Evolution LTE activity for Release 8 These technologies enhance the capabilities of the existing WCDMA HSPA networks to offer higher data rates beyond 100 Mbps WCDMA for UMTS Fourth Edition also covers 3GPP WCDMA Release 99 High Speed Downlink Packet Access HSDPA in Release 5 and High Speed Uplink Packet Access HSUPA in Release 6 which are already deployed commercially Multimedia Broadcast Multicast System MBMS is also described in detail Key updates include Continues to provide both updated descriptions of the 3GPP standard as well as the latest end user and system performance estimates Updated HSDPA and HSUPA including link budgets and Iub dimensioning Detailed MBMS description 3GPP Release 7 HSPA evolution full description 3GPP Release 8 LTE overall description and 3GPP schedule Dedicated chapter on terminal design challenges for the new high speed radio technologies

LTE System Performance Simulations Ashok Kumar, 2014-10-01 Demand for multimedia services in mobile communication is dramatically increasing day by day Previously available technologies such as

GSM UMTS HSPA and HSPA were enough capable of fulfilling the needs of voice and multimedia services for at least a decade To fulfill the future needs of data communication on mobile devices 3rd Generation Partnership Project 3GPP has introduced a new technology which is known as Long Term Evolution of UMTS LTE LTE promises to provide higher data rates on mobile devices than all other mobile technologies i e 100 Mbps in downlink and 50 Mbps in uplink the data rate can be further increased to 326 4 Mbps in downlink and 86 4 Mbps in uplink by using higher bandwidth higher order modulation and MIMO In this book performance of LTE networks is analysed for different bandwidth scheduling network layouts and environments HSPA Performance and Evolution Pablo Tapia,Jun Liu,Yasmin Karimli,Martin Feuerstein,2009-03-03

Written from an operator s viewpoint HSPA Performance and Evolution explores the lessons learned and techniques developed for optimally deploying HSPA High Speed Packet Access The essential distinctions between rolling out HSPA compared to earlier UMTS and GSM technologies are explained covering the many issues that must be specifically handled Areas in standards which have been left open for interpretation causing significant differences between vendor implementations are identified and solutions explored This book is invaluable in enabling wireless operators to extract maximum performance offered by 3GPP s HSPA radio technology consisting of both downlink HSDPA and uplink HSUPA elements It focuses on real world performance sharing practical implementation methods and tradeoffs for deploying optimizing and maintaining networks using the HSPA air interface Examines algorithms equipment and performance perspectives to identify and explain HSPA Measures performance and sets network parameters for optimal tradeoffs Presents results from practical and real world network performances Explores the evolution of HSPA technology into HSPA and eventually next generation LTE technologies *WCDMA for UMTS* Harri Holma,Antti Toskala,2010-10-28 Now in its fifth edition the bestselling book on UMTS has been updated to cover 3GPP WCDMA and High Speed Packet Access HSPA from Release 99 to Release 9 Written by leading experts in the field the book explains HSPA performance based on simulations and field experience and illustrates the benefits of HSPA evolution HSPA both from the operators and from the end user s perspective It continues to provide updated descriptions of the 3GPP standard including the physical layer radio protocols on layers 1 3 and a system architecture description The challenges and solutions regarding terminal RF design are also discussed including the benefits of HSPA power saving features There is also the addition of a new chapter on femto cells as part of the updates to this fifth edition Key updates include HSPA evolution HSPA Multicarrier HSPA solutions HSPA femto cells home base stations TD SCDMA system description Terminal power consumption optimization Updated description of LTE

Performance evaluation of channel estimation techniques for LTE downlink system Kahsay Meresa,2016-12-03 In this thesis channel estimation techniques for LTE downlink named Least Square Minimum Mean Square error and Maximum Likelihood estimation techniques are studied for the pilot symbol based channel estimation In addition to this the performances of these three channel estimation techniques were also studied by introducing averaging

interpolation and hybrid methods This work also investigates the complexity of the channel estimation techniques in terms of the number of complex multiplications and by varying the FFT size and number of CP cyclic prefix furthermore the effect of varying the number of antennas at the transmitter and receiver ends where 2×2 and 4×4 antenna arrangements are considered as a case studies The performance of these channel estimation techniques is also studied for EVA standard channel model in LTE The considered channel model is EVA standard channel model with Doppler shift of 300HZ

Performance evaluation of channel estimation techniques for an LTE downlink system Kahsay Kiross,2016-12-19 Thesis M A from the year 2016 in the subject Engineering Communication Technology grade 75% Mekelle University course Communication engineering language English abstract In this thesis channel estimation techniques for LTE downlink named Least Square Minimum Mean Square error and Maximum Likelihood estimation techniques are studied for the pilot symbol based channel estimation In addition to this the performances of these three channel estimation techniques were also studied by introducing averaging interpolation and hybrid methods This work also investigates the complexity of the channel estimation techniques in terms of the number of complex multiplications and by varying the FFT size and number of CP furthermore the effect of varying the number of antennas at the transmitter and receiver ends where 2×2 and 4×4 antenna arrangements are considered as a case studies The performance of these channel estimation techniques is also studied for EVA standard channel model in LTE The considered channel model is EVA standard channel model with Doppler shift of 300HZ Simulation results in this thesis show that the ML channel estimation technique has the best performance In terms of number of complex multiplications it is proved the ML has lower complexity From the interpolating techniques it is shown the performance of the algorithm integrated with hybrid technique has the best performance In addition to this it is shown that as the number of transmit and receive antennas increase from 2×2 to 4×4 the performance of the estimator increases

Experimental Test Bed to Enable Realistic Evaluations for Direct Transfer Trip Relaying Via Private Wireless LTE Communications Emma Raszmann,2021 **BLER Performance Evaluation of LTE Device-to-Device Communications** Jian Wang,2016 Long Term Evolution LTE supporting Device to Device D2D communication is a feature introduced in 3rd Generation Partnership Project 3GPP release 12 D2D communication is critical in public safety applications which enables communication among first responders when the network infrastructure may not be available In order to characterize the performance of D2D communications using network simulation tool e g ns 3 accurate physical layer error model is important In this document we present our D2D physical channel simulations to study the Block Error Rate BLER performance of the physical channels We also demonstrate how to integrate the simulation results into network simulator to perform system level simulation

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