

Lte Advanced Air Interface Technology

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Lte Advanced Air Interface Technology

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GREYSON DALTON

LTE Air Interface Protocols Cambridge University Press
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.

LTE, LTE-Advanced and WiMAX Pearson Education

A comparative introduction to major global wireless standards, technologies and their applications From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, 3rd Edition provides technical descriptions of the various wireless technologies currently in use. It explains the rationales behind their differing mechanisms and implementations while exploring the advantages and limitations of each technology. This edition has been fully updated and substantially expanded to reflect the significant evolution in mobile network technology occurring over the past several years. The chapter on LTE has been extensively enhanced with new coverage of current implementations of LTE carrier aggregation, mobility management, cell reselection and handover procedures, as well as the latest developments in 5G radio and core networks in 3GPP. It now features additional information on the TD-LTE air interface, IPv6 in mobile networks, Network Function Virtualization (NFV) and Narrowband Internet of Things (NB-IOT). Voice-over-LTE (VoLTE) is now treated extensively in a separate chapter featuring coverage of the VoLTE call establishment

process, dedicated bearer setup, header compression, speech codec and bandwidth negotiation, supplementary service configuration and VoLTE emergency calls. In addition, extensive coverage of Voice-over-Wifi and mission critical communication for public safety organizations over LTE has been added. The WLAN chapter now provides coverage of WPA2-Professional with certificates for authentication in large deployments, such as the global Eduroam network and the new WLAN 60 GHz air interface. Bluetooth evolution has been addressed by including a detailed description of Bluetooth Low Energy (BLE) in the chapter devoted to Bluetooth. Describes the different systems based on the standards, their practical implementation and design assumptions, and the performance and capacity of each system in practice is analyzed and explained Questions at the end of each chapter and answers on the accompanying website make this book ideal for self-study or as course material.

Mobile WiMAX Academic Press

Opportunities are at hand for professionals eager to learn and apply the latest theories and practices in air interface technologies. Written by experienced researchers and professionals, LTE-Advanced Air Interface Technology thoroughly covers the performance targets and technology components studied by 3GPP for LTE-Advanced. Besides being an expla

LTE-Advanced Artech House

Single Carrier Frequency Division Multiple Access (SC-FDMA) is a novel method of radio transmission under consideration for deployment in future cellular systems; specifically, in 3rd Generation Partnership Project Long Term Evolution (3GPP LTE) systems. SC-FDMA has drawn great attention from the communications industry as an attractive alternative to Orthogonal Frequency Division Multiple Access (OFDMA). Introduction to Single Carrier FDMA places SC-FDMA in the wider context of wireless communications, providing the reader with an in-depth tutorial on SC-FDMA technology. The book introduces the reader to this new multiple access technique that utilizes single carrier modulation along with orthogonal frequency multiplexing and frequency domain equalization, plus its applications in communications settings. It considers the similarities with and differences from orthogonal frequency division modulation, multiplexing, and multiple access used extensively in cellular, broadcasting, and digital subscriber loop applications. Particular reference is made to the peak power characteristics of an SC-FDMA signal as an added advantage over OFDMA. Provides an extensive overview of the principles of SC-FDMA and its relation to other transmission techniques. Explains how the details of a specific implementation influence the tradeoffs among various figures of merit. Describes in detail the configuration of the SC-FDMA uplink transmission scheme published by 3GPP. Features link level simulation of an uplink SC-FDMA system using MATLAB. This is an essential text for industry engineers who are researching and developing 3GPP LTE systems. It is suitable for engineers designing wireless network equipment, handsets, data cards, modules, chipsets, and test equipment as well as those involved in designing LTE

infrastructure. It would also be of interest to academics, graduate students, and industry researchers involved in advanced wireless communications, as well as business analysts who follow the cellular market.

LTE-Advanced Air Interface Technology Academic Press

Understand the new technologies of the LTE standard and their impact on system performance improvements with this practical guide.

From GSM to LTE-Advanced Pro and 5G Academic Press

This practical, one-stop guide will quickly bring you up to speed on LTE and LTE-Advanced. With everything you need to know about the theory and technology behind the standards, this is a must-have for engineers and managers in the wireless industry. • First book of its kind describing technologies and system performance of LTE-A • Covers the evolution of digital wireless technology, basics of LTE and LTE-A, design of downlink and uplink channels, multi-antenna techniques and heterogeneous networks • Analyzes performance benefits over competing technologies, including WiMAX and 802.16m • Reflects the latest LTE Release-10 standards • Includes numerous examples, including extensive system and link results • Unique approach is accessible to technical and non-technical readers alike

Practical Guide to LTE-A, VoLTE and IoT Wiley

This book focuses on LTE with full updates including LTE-Advanced (Release-11) to provide a complete picture of the LTE system. Detailed explanations are given for the latest LTE standards for radio interface architecture, the physical layer, access procedures, broadcast, relaying, spectrum and RF characteristics, and system performance. Key technologies presented include multi-carrier transmission, advanced single-carrier transmission, advanced receivers, OFDM, MIMO and adaptive antenna solutions, radio resource management and protocols, and different radio network architectures. Their role and use in the context of mobile broadband access in general is explained, giving both a high-level overview and more detailed step-by-step explanations. This book is a must-have resource for engineers and other professionals in the telecommunications industry, working with cellular or wireless broadband technologies, giving an understanding of how to utilize the new technology in order to stay ahead of the competition. New to this edition: In-depth description of CoMP and enhanced multi-antenna transmission including new reference-signal structures and feedback mechanisms Detailed description of the support for heterogeneous deployments provided by the latest 3GPP release Detailed description of new enhanced downlink control-channel structure (EPDDCH) New RF configurations including operation in non-contiguous spectrum, multi-bands base stations and new frequency bands Overview of 5G as a set of well-integrated radio-access technologies, including support for higher frequency bands and flexible spectrum management, massive antenna configurations, and ultra-dense deployments Covers a complete update to the latest 3GPP Release-11 Two new chapters on HetNet, covering small cells/heterogeneous deployments, and CoMP, including Inter-site coordination Overview of current status of LTE release 12 including further enhancements of local-area, CoMP and multi-antenna transmission, Machine-type-communication, Device-to-device communication

3G, 4G and Beyond John Wiley & Sons

Opportunities are at hand for professionals eager to learn and apply the latest theories and practices in air interface technologies. Written by experienced researchers and professionals, *LTE-Advanced Air Interface Technology* thoroughly covers the performance targets and technology components studied by 3GPP for LTE-Advanced. Besides being an explanatory text about LTE-Advanced air interface technology, this book

exploits the technical details in the 3GPP specification, and explains the motivation and implication behind the specifications. After a general description of wireless cellular technology evolution and the performance targets and major technical features of LTE-Advanced, *LTE-Advanced Air Interface Technology* discusses various innovative technical features in detail, including Innovative concepts in carrier aggregation techniques Collaborative multipoint (CoMP) theory and performance analysis Enhanced multi-antenna solutions or multiple-input, multiple-output (MIMO) technology, in particular, multiuser and multilayer MIMO Relaying issues Self-organizing and heterogeneous networks Interference suppression and enhanced intercell interference coordination (eICIC) technology This book opens the door of LTE-A technology for practitioners in any stage of wireless communications. Beginning with basic communication principles, the book demonstrates how a complete wireless theory is built. Readers can work independently on original case studies and simulation programming examples, with an emphasis on technology and performance. Designed for professionals interested in gaining an upper hand, this book is the ideal educational and informative resource in the emerging field of air interface technology.

LTE and the Evolution to 4G Wireless John Wiley & Sons

Even as newer cellular technologies and standards emerge, many of the fundamental principles and the components of the cellular network remain the same. Presenting a simple yet comprehensive view of cellular communications technologies, *Cellular Communications* provides an end-to-end perspective of cellular operations, ranging from physical layer details to call set-up and from the radio network to the core network. This self-contained source for practitioners and students represents a comprehensive survey of the fundamentals of cellular communications and the landscape of commercially deployed 2G and 3G technologies and provides a glimpse of emerging 4G technologies.

Signal Processing for 5G John Wiley & Sons

While 3G has been an outstanding success, the ever-growing demand for higher data rates and higher quality mobile communication services continues to fuel conflict between the rapidly growing number of users and limited bandwidth resources. In the future, a 100-fold increase in mobile data traffic is expected. That will necessitate further improvements to 3GPP LTE (Long-Term Evolution) and create limitless opportunities for engineers who understand the technology and how to apply it to deliver enhanced services. *Long Term Evolution: 3GPP LTE Radio and Cellular Technology* outlines the best way to position yourself now for future success. With coverage ranging from basic concepts to current research, this comprehensive reference contains technical information about all aspects of 3GPP LTE. It details low chip rate, high-speed downlink/uplink packet access (HSxPA)/TDSCDMA EV 1x, LTE TDD, and 3G TDD. It introduces new technologies and covers methodologies to study the performance of frequency allocation schemes. The authors also discuss the proposed architecture of Mobile IPRR and distributed dynamic architecture in wireless communication, covering performance evaluation of the TD-SCDMA LTE System. With each passing day, more and more users are demanding mobile broadband data access everywhere, to facilitate synchronization of e-mails, Internet access, specific applications, and file downloads to mobile devices such as cell phones, smart phones, PDAs, and notebooks. LTE, successor to the 3G mobile radio network, is essential to creating radio coverage in the rollout phase and high capacity all over the radio cell in the long term. The 3GPP LTE will become increasingly crucial to supporting the high demand of data traffic rates generated by future mobile user

terminals. Authored by international experts in the field, this practical book is an extremely valuable guide that addresses emerging current and future technologies associated with LTE and its future direction.

LTE Signaling Cambridge University Press

This book presents a detailed pedagogical description of the 5G commercial wireless communication system design, from an end to end perspective. It compares and contrasts NR with LTE, and gives a concise and highly accessible description of the key technologies in the 5G physical layer, radio access network layer protocols and procedures. This book also illustrates how the 5G core and EPC is integrated into the radio access network, how virtualization and edge computer fundamentally change the way users interact with the network, as well as 5G spectrum issues. This book is structured into six chapters. The first chapter reviews the use cases, requirements, and standardization organization and activities for 5G. These are 5G requirements and not NR specifically, as technology that meets the requirements, may be submitted to the ITU as 5G technology. This includes a set of Radio Access Technologies (RATs), consisting of NR and LTE; with each RAT meeting different aspects of the requirements. The second chapter describes the air interface of NR and LTE side by side. The basic aspects of LTE that NR builds upon are first described, followed by sections on the NR specific technologies, such as carrier/channel, spectrum/duplexing (including SUL), LTE/NR co-existence and new physical layer technologies (including waveform, Polar/LDPC codes, MIMO, and URLLC/mMTC). In all cases the enhancements made relative to LTE are made apparent. The third chapter contains descriptions of NR procedures (IAM/Beam Management/Power control/HARQ), protocols (CP/UP/mobility, including grant-free), and RAN architecture. The fourth chapter includes a detailed discussion related to end-to-end system architecture, and the 5G Core (5GC), network slicing, service continuity, relation to EPC, network virtualization, and edge computing. The fifth and major chapter describes the ITU submission and how NR and LTE meet the 5G requirements in significant detail, from the rapporteur responsible for leading the preparation and evaluation, as well as some field trial results. Engineers, computer scientists and professionals with a passing knowledge of 4G LTE and a comprehensive understanding of the end to end 5G commercial wireless system will find this book to be a valuable asset.

Advanced-level students and researchers studying and working in communication engineering, who want to gain an understanding of the 5G system (as well as methodologies to evaluate features and technologies intended to supplement 5G) will also find this book to be a valuable resource.

Cellular Communications John Wiley & Sons

From the editors of the highly successful WCDMA for UMTS, this new book gives a complete and up-to-date overview of Long Term Evolution (LTE) in a systematic and clear manner. It starts with an in-depth explanation of the background and standardization process before moving on to examine the system architecture evolution (SAE). The basics of air interface modulation choices are introduced and key subjects such as 3GPP LTE physical layer and protocol solutions are described. Mobility aspects and radio resource management together with radio and end-to-end performance are assessed. The voice solution and voice capacity in LTE are also illustrated. Finally, the main differences between LTE TDD and FDD modes are examined and HSPA evolution in 3GPP Releases 7 and 8 is described. LTE for UMTS is one of the first books to provide a comprehensive guide to the standards and technologies of LTE. Key features of the book include: Covers all the key aspects of LTE in a systematic manner Presents full description of 3GPP Release 8 LTE Examines

the expected performance of LTE Written by experts actively involved in the 3GPP standards and product development.

LTE for UMTS John Wiley & Sons

This practical hands-on new resource presents LTE technologies from end-to-end, including network planning and the optimization tradeoff process. This book examines the features of LTE-Advanced and LTE-Advanced Pro and how they integrate into existing LTE networks. Professionals find in-depth coverage of how the air interface is structured at the physical layer and how the related link level protocols are designed and work. This resource highlights potential 5G solutions as considered in releases 14 and beyond, the migration paths, and the challenges involved with the latest updates and standardization process. Moreover, the book covers performance analysis and results, as well as SON specifications and realization. Readers learn about OFDMA, and how DFT is used to implement it. Link budgeting, parameter estimations, and network planning and sizing is explained. Insight into core network architecture is provided, including the protocols and signaling used for both data and voice services. The book also presents a detailed chapter on the end-to-end data transfer optimization mechanisms based on the TCP protocol. This book provides the tools needed for network planning and optimization while addressing the challenges of LTE and LTE-advanced networks.

From GSM to LTE John Wiley & Sons

Written by experts actively involved in the 3GPP standards and product development, LTE for UMTS, Second Edition gives a complete and up-to-date overview of Long Term Evolution (LTE) in a systematic and clear manner. Building upon on the success of the first edition, LTE for UMTS, Second Edition has been revised to now contain improved coverage of the Release 8 LTE details, including field performance results, transport network, self optimized networks and also covering the enhancements done in 3GPP Release 9. This new edition also provides an outlook to Release 10, including the overview of Release 10 LTE-Advanced technology components which enable reaching data rates beyond 1 Gbps. Key updates for the second edition of LTE for UMTS are focused on the new topics from Release 9 & 10, and include: LTE-Advanced; Self optimized networks (SON); Transport network dimensioning; Measurement results.

From GSM to LTE-Advanced CRC Press

A concise introduction to IMT-Advanced Systems, including LTE-Advanced and WiMAX There exists a strong demand for fully extending emerging Internet services, including collaborative applications and social networking, to the mobile and wireless domain. Delivering such services can be possible only through realizing broadband in the wireless. Two candidate technologies are currently competing in fulfilling the requirements for wireless broadband networks, WiMAX and LTE. At the moment, LTE and its future evolution LTE-Advanced are already gaining ground in terms of vendor and operator support. Whilst both technologies share certain attributes (utilizing Orthogonal Frequency Division Multiple Access (OFDMA) in downlink, accommodating smart antennas and full support for IP-switching, for example), they differ in others (including uplink technology, scheduling, frame structure and mobility support). Beyond technological merits, factors such as deployment readiness, ecosystem maturity and migration feasibility come to light when comparing the aptitude of the two technologies. LTE, LTE-Advanced and WiMAX: Towards IMT-Advanced Networks provides a concise, no-nonsense introduction to the two technologies, covering both interface and networking considerations. More critically, the book gives a multi-faceted comparison, carefully analyzing and distinguishing the characteristics of each technology and spanning both technical and economic merits. A "big picture" understanding of the

market strategies and forecasts is also offered. Discusses and critically evaluates LTE, LTE-Advanced and WiMAX (Legacy and Advanced) Gives an overview of the principles and advances of each enabling technology Offers a feature-by-feature comparison between the candidate technologies Includes information which appeals to both industry practitioners and academics Provides an up-to-date report on market and industry status

Mobile Terminal Receiver Design John Wiley & Sons

A revised edition of the text that offers a comparative introduction to global wireless standards, technologies, and their applications The revised and updated fourth edition of *From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband* offers an authoritative guide to the technical descriptions of the various wireless technologies currently in use. The author—a noted expert on the topic—explains the rationale behind their differing mechanisms and implementations while exploring the advantages and limitations of each technology. The fourth edition reflects the significant changes in mobile network technology that have taken place since the third edition was published. The text offers a new chapter on 5G NR that explores its non-standalone and standalone architecture. In the Wi-Fi chapter, additional sections focus on the new WPA3 authentication protocol, the new 802.11ax air interface and protocol extensions like 802.11k and 11v for meshed networks. This important book: Presents the various systems based on the standards, their practical implementation and design assumptions, and their performance and capacity Provides an in-depth analysis of each system in practice Offers an updated edition of the most current changes to mobile network technology Includes questions at the end of each chapter and answers on the accompanying website that make this book ideal for self-study or as course material Written for students and professionals of wireless technologies, the revised fourth edition of *From GSM to LTE-Advanced Pro and 5G* provides an in-depth review and description of the most current mobile networks and broadband.

Single Carrier FDMA CRC Press

A comprehensive reference on the call procedures of 4G RAN and Core networks, LTE Signaling, Troubleshooting and Optimization describes the protocols and procedures of LTE. It explains essential topics from basic performance measurement counters, radio quality and user plane quality to the standards, architecture, objectives and functions of the different interfaces. The first section gives an overview of LTE/EPC network architecture, reference points, protocol stacks, information elements and elementary procedures. The proceeding parts target more advanced topics to cover LTE/EPC signalling and radio quality analysis. This book supplements the information provided in the 3GPP standards by giving readers access to a universal LTE/EPC protocol sequence to ensure they have a clear understanding of the issues involved. It describes the normal signaling procedures as well as explaining how to identify and troubleshoot abnormal network behavior and common failure causes. Enables the reader to understand the signaling procedures and parameters that need to be analyzed when monitoring UMTS networks Covers the essential facts on signaling procedures by providing first hand information taken from real LTE/EPC traces A useful reference on the topic, also providing sufficient details for test and measurement experts who need to analyze LTE/EPC signaling procedures and measurements at the most detailed level Contains a description of LTE air interface monitoring scenarios as well as other key topics up to an advanced level LTE Signaling, Troubleshooting and Optimization is the Long Term Evolution successor to the previous Wiley books UMTS Signaling and UMTS Performance Measurement.

The Vienna LTE-Advanced Simulators John Wiley & Sons

A comparative introduction to major global wireless standards, technologies and their applications From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, 3rd Edition provides technical descriptions of the various wireless technologies currently in use. It explains the rationales behind their differing mechanisms and implementations while exploring the advantages and limitations of each technology. This edition has been fully updated and substantially expanded to reflect the significant evolution in mobile network technology occurring over the past several years. The chapter on LTE has been extensively enhanced with new coverage of current implementations of LTE carrier aggregation, mobility management, cell reselection and handover procedures, as well as the latest developments in 5G radio and core networks in 3GPP. It now features additional information on the TD-LTE air interface, IPv6 in mobile networks, Network Function Virtualization (NFV) and Narrowband Internet of Things (NB-IOT). Voice-over-LTE (VoLTE) is now treated extensively in a separate chapter featuring coverage of the VoLTE call establishment process, dedicated bearer setup, header compression, speech codec and bandwidth negotiation, supplementary service configuration and VoLTE emergency calls. In addition, extensive coverage of Voice-over-Wifi and mission critical communication for public safety organizations over LTE has been added. The WLAN chapter now provides coverage of WPA2-Professional with certificates for authentication in large deployments, such as the global Eduroam network and the new WLAN 60 GHz air interface. Bluetooth evolution has been addressed by including a detailed description of Bluetooth Low Energy (BLE) in the chapter devoted to Bluetooth. Describes the different systems based on the standards, their practical implementation and design assumptions, and the performance and capacity of each system in practice is analyzed and explained Questions at the end of each chapter and answers on the accompanying website make this book ideal for self-study or as course material.

From GSM to LTE-Advanced Pro and 5G John Wiley & Sons

Developed by the Third Generation Partnership Project, long term evolution (LTE) is an important new 4G wireless broadband technology that provides significantly increased peak data rates, reduced latency, scalable bandwidth capacity, and backwards compatibility with existing GSM and UMTS technologies. For these reasons, LTE is now being utilized by most major service providers. This unique and timely book answers the demands of engineers in the field, offering expert guidance on how LTE works. The book serves as a self-training resource, helping you understand the complex air interface protocols related to LTE. You gain practical knowledge of layer 2 and layer 3 functions and get clear explanations of configuration parameters in NAS and Layer 3 messages. Moreover, you find in-depth coverage of all relevant NAS and physical layer processes. The book features over 115 illustrations that support key topics throughout.

5G New Radio John Wiley & Sons

A comprehensive and invaluable guide to 5G technology, implementation and practice in one single volume. For all things 5G, this book is a must-read. Signal processing techniques have played the most important role in wireless communications since the second generation of cellular systems. It is anticipated that new techniques employed in 5G wireless networks will not only improve peak service rates significantly, but also enhance capacity, coverage, reliability, low-latency, efficiency, flexibility, compatibility and convergence to meet the increasing demands imposed by applications such as big data, cloud service, machine-to-machine (M2M) and mission-critical communications. This book is a comprehensive and detailed guide to all signal

processing techniques employed in 5G wireless networks. Uniquely organized into four categories, New Modulation and Coding, New Spatial Processing, New Spectrum Opportunities and New System-level Enabling Technologies, it covers everything from network architecture, physical-layer (down-link and up-link), protocols and air interface, to cell acquisition, scheduling and rate adaption, access procedures and relaying to spectrum allocations. All technology aspects and major roadmaps of global 5G standard development and deployments are included in the book. Key Features: Offers step-by-step guidance on bringing 5G technology into practice, by applying algorithms and design methodology to real-time circuit implementation, taking into account rapidly growing applications that have multi-standards and multi-systems. Addresses spatial signal processing for 5G, in particular massive multiple-input multiple-output (massive-

MIMO), FD-MIMO and 3D-MIMO along with orbital angular momentum multiplexing, 3D beamforming and diversity. Provides detailed algorithms and implementations, and compares all multicarrier modulation and multiple access schemes that offer superior data transmission performance including FBMC, GFDM, F-OFDM, UFMC, SEFDM, FTN, MUSA, SCMA and NOMA. Demonstrates the translation of signal processing theories into practical solutions for new spectrum opportunities in terms of millimeter wave, full-duplex transmission and license assisted access. Presents well-designed implementation examples, from individual function block to system level for effective and accurate learning. Covers signal processing aspects of emerging system and network architectures, including ultra-dense networks (UDN), software-defined networks (SDN), device-to-device (D2D) communications and cloud radio access network (C-RAN).