

Epc And 4g Packet Networks Driving The Le Broadband Revolution Author Magnus Olsson Published On November 2012

This revised edition of Communication Systems from GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband Second Edition (Wiley 2010) contains not only a technical description of the different wireless systems available today, but also explains the rationale behind the different mechanisms and implementations; not only the 'how' but also the 'why'. In this way, the advantages and also limitations of each technology become apparent. Offering a solid introduction to major global wireless standards and comparisons of the different wireless technologies and their applications, this edition has been updated to provide the latest directions and activities in 3GPP standardization up to Release 12, and importantly includes a new chapter on Voice over LTE (VoLTE). There are new sections on Building Blocks of a Voice Centric Device, Building Blocks of a Smart Phone, Fast Dormancy, IMS and High-Speed Downlink Packet Access, and Wi-Fi-Protected Setup. Other sections have been considerably updated in places reflecting the current state of the technology. • Describes the different systems based on the standards, their practical implementation and design assumptions, and the performance and capacity of each system in practice

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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

Internet of Things: Technologies and Applications for a New Age of Intelligence outlines the background and overall vision for the Internet of Things (IoT) and Cyber-Physical Systems (CPS), as well as associated emerging technologies. Key technologies are described including device communication and interactions, connectivity of devices to cloud-based infrastructures, distributed and edge computing, data collection, and methods to derive information and knowledge from connected devices and systems using artificial intelligence and machine learning. Also included are system architectures and ways to integrate these with enterprise architectures, and considerations on potential business impacts and regulatory requirements. Presents a comprehensive overview of the end-to-end system requirements for successful IoT solutions Provides a robust framework for analyzing the technology and market requirements for a broad variety of IoT solutions Covers in-depth security solutions for IoT systems Includes a detailed set of use cases that give examples of real-world implementation

5G Physical Layer: Principles, Models and Technology Components explains fundamental physical layer design principles, models and components for the 5G new radio access technology – 5G New Radio (NR). The physical layer models include radio wave propagation and hardware impairments for the full range of frequencies

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considered for the 5G NR (up to 100 GHz). The physical layer technologies include flexible multi-carrier waveforms, advanced multi-antenna solutions, and channel coding schemes for a wide range of services, deployments, and frequencies envisioned for 5G and beyond. A MATLAB-based link level simulator is included to explore various design options. 5G Physical Layer is very suitable for wireless system designers and researchers: basic understanding of communication theory and signal processing is assumed, but familiarity with 4G and 5G standards is not required. With this book the reader will learn: The fundamentals of the 5G NR physical layer (waveform, modulation, numerology, channel codes, and multi-antenna schemes). Why certain PHY technologies have been adopted for the 5G NR. The fundamental physical limitations imposed by radio wave propagation and hardware impairments. How the fundamental 5G NR physical layer functionalities (e.g., parameters/methods/schemes) should be realized. The content includes: A global view of 5G development – concept, standardization, spectrum allocation, use cases and requirements, trials, and future commercial deployments. The fundamentals behind the 5G NR physical layer specification in 3GPP. Radio wave propagation and channel modeling for 5G and beyond. Modeling of hardware impairments for future base stations and devices. Flexible multi-carrier waveforms, multi-antenna solutions, and channel coding schemes for 5G and beyond. A simulator including hardware impairments, radio propagation, and various waveforms. Ali Zaidi is a strategic product manager at Ericsson, Sweden.

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Fredrik Athley is a senior researcher at Ericsson, Sweden. Jonas Medbo and Ulf Gustavsson are senior specialists at Ericsson, Sweden. Xiaoming Chen is a professor at Xi'an Jiaotong University, China. Giuseppe Durisi is a professor at Chalmers University of Technology, Sweden, and a guest researcher at Ericsson, Sweden. The Definitive Guide to LTE Technology Long-Term Evolution (LTE) is the next step in the GSM evolutionary path beyond 3G technology, and it is strongly positioned to be the dominant global standard for 4G cellular networks. LTE also represents the first generation of cellular networks to be based on a flat IP architecture and is designed to seamlessly support a variety of different services, such as broadband data, voice, and multicast video. Its design incorporates many of the key innovations of digital communication, such as MIMO (multiple input multiple output) and OFDMA (orthogonal frequency division multiple access), that mandate new skills to plan, build, and deploy an LTE network. In Fundamentals of LTE , four leading experts from academia and industry explain the technical foundations of LTE in a tutorial style—providing a comprehensive overview of the standards. Following the same approach that made their recent Fundamentals of WiMAX successful, the authors offer a complete framework for understanding and evaluating LTE. Topics include Cellular wireless history and evolution: Technical advances, market drivers, and foundational networking and communications technologies Multicarrier modulation theory and practice: OFDM system design, peak-to-average power ratios, and SC-FDE solutions Frequency

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Domain Multiple Access: OFDMA downlinks, SC-FDMA uplinks, resource allocation, and LTE-specific implementation Multiple antenna techniques and tradeoffs: spatial diversity, interference cancellation, spatial multiplexing, and multiuser/networked MIMO LTE standard overview: air interface protocol, channel structure, and physical layers Downlink and uplink transport channel processing: channel encoding, modulation mapping, Hybrid ARQ, multi-antenna processing, and more Physical/MAC layer procedures and scheduling: channel-aware scheduling, closed/open-loop multi-antenna processing, and more Packet flow, radio resource, and mobility management: RLC, PDCP, RRM, and LTE radio access network mobility/handoff procedures

This book provides a clear, concise, complete and authoritative introduction to System Architecture Evolution (SAE) standardization work and its main outcome: the Evolved Packet Core (EPC), including potential services and operational scenarios. After providing an insightful overview of SAE's historical development, the book gives detailed explanations of the EPC architecture and key concepts as an introduction. In-depth technical descriptions of EPC follow, including thorough functional accounts of the different components of EPC, protocols, network entities and procedures. Case studies of deployment scenarios show how the functions described within EPC are placed within a live network context, while a description of the services that are predicted to be used shows what EPC as a core network can enable. This book is an essential resource for professionals and students who need to understand the latest

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developments in SAE and EPC, the 'engine' that connects broadband access to the internet. All of the authors have from their positions with Ericsson been actively involved in GPRS, SAE and 3GPP from a business and technical perspective for many years. Several of the authors have also been actively driving the standardization efforts within 3GPP. "There is no doubt that this book, which appears just when the mobile industry starts its transition away from legacy GSM/GPRS and UMTS networks into the future will become the reference work on SAE/LTE. There are no better qualified persons than the authors of this book to provide both communication professionals and an interested general public with insights into the inner workings of SAE/LTE. Not only are they associated with one of the largest mobile network equipment vendors in the world, they have all actively contributed to and, in some cases, been the driving forces behind the development of SAE/LTE within 3GPP." - from the foreword by Dr. Ulf Nilsson, TeliaSonera R&D, Mobility Core and Connectivity "The authors have done an excellent job in writing this book. Their familiarity with the requirements, concepts and solution alternatives, as well as the standardization work allows them to present the material in a way that provides easy communication between Architecture and Standards groups and Planning/ Operational groups within service provider organizations." - from the foreword by Dr. Kalyani Bogineni, Principal Architect, Verizon Up-to-date coverage of SAE including the latest standards development Easily accessible overview of the architecture and concepts defined by SAE Thorough description of the Evolved Packet

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Core for LTE, fixed and other wireless accesses Comprehensive explanation of SAE key concepts, security and Quality-of-Service Covers potential service and operator scenarios including interworking with existing 3GPP and 3GPP2 systems Detailed walkthrough of network entities, protocols and procedures Written by established experts in the SAE standardization process, all of whom have extensive experience and understanding of its goals, history and vision

Following on from the successful first edition (March 2012), this book gives a clear explanation of what LTE does and how it works. The content is expressed at a systems level, offering readers the opportunity to grasp the key factors that make LTE the hot topic amongst vendors and operators across the globe. The book assumes no more than a basic knowledge of mobile telecommunication systems, and the reader is not expected to have any previous knowledge of the complex mathematical operations that underpin LTE. This second edition introduces new material for the current state of the industry, such as the new features of LTE in Releases 11 and 12, notably coordinated multipoint transmission and proximity services; the main short- and long-term solutions for LTE voice calls, namely circuit switched fallback and the IP multimedia subsystem; and the evolution and current state of the LTE market. It also extends some of the material from the first edition, such as inter-operation with other technologies such as GSM, UMTS, wireless local area networks and cdma2000; additional features of LTE Advanced, notably heterogeneous networks and traffic offloading; data transport in the

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evolved packet core; coverage and capacity estimation for LTE; and a more rigorous treatment of modulation, demodulation and OFDMA. The author breaks down the system into logical blocks, by initially introducing the architecture of LTE, explaining the techniques used for radio transmission and reception and the overall operation of the system, and concluding with more specialized topics such as LTE voice calls and the later releases of the specifications. This methodical approach enables readers to move on to tackle the specifications and the more advanced texts with confidence.

Describing the essential aspects that need to be considered during the deployment and operational phases of 3GPP LTE/SAE networks, this book gives a complete picture of LTE systems, as well as providing many examples from operational networks. It demystifies the structure, functioning, planning and measurements of both the radio and core aspects of the evolved 3G system. The content includes an overview of the LTE/SAE environment, architectural and functional descriptions of the radio and core network, functionality of the LTE applications, international roaming principles, security solutions and network measurement methods. In addition, this book gives essential guidelines and recommendations about the transition from earlier mobile communications systems towards the LTE/SAE era and the next generation of LTE, LTE-Advanced. The book is especially suitable for the operators that face new challenges in the planning and deployment phases of LTE/SAE, and is also useful for network vendors, service providers, telecommunications consultancy companies and

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technical institutes as it provides practical information about the realities of the system. Presents the complete end-to-end planning and measurement guidelines for the realistic deployment of networks Explains the essential and realistic aspects of commercial LTE systems as well as the future possibilities An essential tool during the development of transition strategies from other network solutions towards LTE/SAE Contains real-world case studies and examples to help readers understand the practical side of the system

Get up to speed on 5G and prepare for the roll out of the next generation of mobile technology. The book begins with an introduction to 5G and the advanced features of 5G networks, where you'll see what makes it bigger, better, and faster. You will learn 5G NSA and SA packet core design along with some design challenges, taking a practical approach towards design and deployment. Next, you will understand the testing of the 5G packet core and how to automate it. The book concludes with some advanced service provider strategies, including architectural considerations for service providers to enhance their network and provide services to non-public 5G networks. 5G Mobile Core Network is intended for those who wish to understand 5G, and also for those who work extensively in a service provider environment either as operators or as vendors performing activities such as network design, deployment, testing, and automation of the network. By the end of this book you will be able to understand the benefits in terms of CAPEX and OPEX while considering one design over another.

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Consulting engineers will be able to evaluate the design options in terms of 5G use cases, the scale of deployment, performance, efficiency, latency, and other key considerations. What You Will Learn Understand the life cycle of a deployment right from pre-deployment phase to post-deployment phase See use cases of 5G and the various options to design, implement, and deploy them Examine the deployment of 5G networks to large-scale service providers Discover the MVNO/MVNE strategies that a service provider can implement in 5G Who This Book Is For Anyone who is curious about 5G and wants to learn more about the technology.

2G/GSM and 3G/UMTS are key mobile communication technologies, chosen by more than 2 billion people around the world. In order to adapt to new services, increasing demand for user bandwidth, quality of service and requirements for network convergence, major evolutions are introduced in 3G network standard. Evolved Packet System (EPS) presents the EPS evolution of the 3G/UMTS standard introduced by the 3rd Generation Partnership Project (3GPP) standard committee. This new topic is looked at from a system perspective, from the radio interface to network and service architecture. Hundreds of documents being issued by Standard organisations are summarised in one book to allow the reader to get an accessible comprehensive view of EPS evolution. Proposes a system view of Evolved UMTS, from the radio to Core and service architecture Gives a comprehensive and global view of the system that technical specifications do not provide Describes the new system as well as the

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inheritance and migration from 2G/GSM and 3G/UMTS Written by experts in the field who specialise in two complementary but very different technical domains (i.e. "radio interface" and "network architecture") Contains many figures and examples for better understanding. This book is essential for industry professionals in the telecommunication business, telecommunication system architects and designers, product manufacturers and operators and postgraduate students.

An Introduction to LTE explains the technology used by 3GPP Long Term Evolution. The book covers the whole of LTE, both the techniques used for radio communication between the base station and the mobile phone, and the techniques used for signalling communication and data transport in the evolved packet core. It avoids unnecessary detail, focussing instead on conveying a sound understanding of the entire system. The book is aimed at mobile telecommunication professionals, who want to understand what LTE is and how it works. It is invaluable for engineers who are working on LTE, notably those who are transferring from other technologies such as UMTS and cdma2000, those who are experts in one part of LTE but who want to understand the system as a whole, and those who are new to mobile telecommunications altogether. It is also relevant to those working in non technical roles, such as project managers, marketing executives and intellectual property consultants. On completing the book, the reader will have a clear understanding of LTE, and will be able to tackle the more specialised books and the 3GPP specifications with confidence. Key features - Covers

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the latest developments in release 10 of the 3GPP specifications, including the new capabilities of LTE-Advanced Includes references to individual sections of the 3GPP specifications, to help readers understand the principles of each topic before going to the specifications for more detailed information Requires no previous knowledge of mobile telecommunications, or of the mathematical techniques that LTE uses for radio transmission and reception

Get a comprehensive and detailed insight into the Evolved Packet Core (EPC) with this clear, concise and authoritative guide a fully updated second edition that covers the latest standards and industry developments **KEY FEATURES** The only book to describe and explain the entire EPC including architecture, features and protocols, giving you the knowledge and insight to see the potential in EPC, develop EPC products and deploy LTE/EPC mobile broadband Networks The Second Edition includes 150+ new pages and numerous new illustrations. The content has also been focused towards the mainstream deployment scenarios Written by established experts in the 3GPP standardization process, with extensive, in-depth experience of its goals, development and future direction Case studies of deployment scenarios show how the functions described within EPC are placed within a live network context Forewords written by Dr. Kalyani Bogineni and Dr. Ulf Nilsson **DESCRIPTION** The latest additions to the Evolved Packet System (EPS) including e.g. Positioning, User Data Management, eMBMS, SRVCC, VoLTE, CSFB A detailed description of the nuts and

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bolts of EPC that are required to really get services up and running on a variety of operator networks An in-depth overview of the EPC architecture and its connections to the wide variety of network accesses, including LTE, LTE-Advanced, WCDMA/HSPA, GSM, WiFi, etc. The most common operator scenarios of EPS and the common issues faced in their design The reasoning behind many of the design decisions taken in EPC, in order to understand the full details and background of the all-IP core NEW CONTENT TO THIS EDITION 150+ New pages, new illustrations and call flows Covers 3GPP Release 9, 10 and 11 in addition to release 8 Expanded coverage on Diameter protocol, interface and messages Architecture overview Positioning User Data Management eMBMS (LTE Broadcasting) H(e)NodeB/Femto Cells LIPA/SIPTO/Breakout architectures Deployment Scenarios WiFi interworking VoLTE/MMTel, CS fallback and SRVCC SAE is the core network that supports LTE, the next key stage in development of the UMTS network to provide mobile broadband. It aims to provide an efficient, cost-effective solution for the ever-increasing number of mobile broadband subscribers There is no other book on the market that covers the entire SAE network architecture; this book summarizes the important parts of the standards, but goes beyond mere description and offers real insight and explanation of the technology Fully updated with the latest developments since the first edition published, and now including additional material and insights on industry trends and views regarding future potential applications of SAE"

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Comprehensive Handbook Demystifies 5G for Technical and Business Professionals in Mobile Telecommunication Fields Much is being said regarding the possibilities and capabilities of the emerging 5G technology, as the evolution towards 5G promises to transform entire industries and many aspects of our society. 5G for the Connected World offers a comprehensive technical overview that telecommunication professionals need to understand and take advantage of these developments. The book offers a wide-ranging coverage of the technical aspects of 5G (with special consideration of the 3GPP Release 15 content), how it enables new services and how it differs from LTE. This includes information on potential use cases, aspects of radio and core networks, spectrum considerations and the services primarily driving 5G development and deployment. The text also looks at 5G in relation to the Internet of Things, machine to machine communication and technical enablers such as LTE-M, NB-IoT and EC-GSM. Additional chapters discuss new business models for telecommunication service providers and vertical industries as a result of introducing 5G and strategies for staying ahead of the curve. Other topics include: Key features of the new 5G radio such as descriptions of new waveforms, massive MIMO and beamforming technologies as well as spectrum considerations for 5G radio regarding all possible bands Drivers, motivations and overview of the new 5G system – especially RAN architecture and technology enablers (e.g. service-based architecture, compute-storage split and network exposure) for native cloud deployments Mobile edge computing, Non-3GPP

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access, Fixed-Mobile Convergence Detailed overview of mobility management, session management and Quality of Service frameworks 5G security vision and architecture Ultra-low latency and high reliability use cases and enablers, challenges and requirements (e.g. remote control, industrial automation, public safety and V2X communication) An outline of the requirements and challenges imposed by massive numbers of devices connected to cellular networks While some familiarity with the basics of 3GPP networks is helpful, 5G for the Connected World is intended for a variety of readers. It will prove a useful guide for telecommunication professionals, standardization experts, network operators, application developers and business analysts (or students working in these fields) as well as infrastructure and device vendors looking to develop and integrate 5G into their products, and to deploy 5G radio and core networks.

Fifth-generation cellular radio access networks are currently being standardized as 5G New Radio (NR). The primary objectives of 5G NR are to provide enhanced mobile broadband (eMBB) and ultra-reliable low latency communication (URLLC) capabilities. This innovative resource analyzes these applications in detail to help readers understand how the flexible design of NR makes it suitable for a wide range of use cases and applications. The rationale behind the design decisions made during the NR standardization process are explored. Readers will be able to understand the performance limits of NR when applied to non-eMBB scenarios and how NR compares

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to 4G and IEEE 802.x connectivity solutions for such scenarios. The main features of 5G phase 2 are explored, as well as the use cases that can be addressed by 5G phase 2. The mathematical models are included to help explain the future evolution of NR in Release 16 and beyond. This is the only book that describes both the standards features of NR and the mathematical models/open research issues for 5G, appealing to both industry practitioners and academic researchers.

LTE (Long Term Evolution) is commonly marketed as 4G. LTE and LTE Advanced have been recognized by ITU-R and ITU-T (International Telecommunications Union – Telecommunications) as the principal solution for the future mobile communication networks standards. They are thus the framework of what the marketing calls 4G and possibly also 5G. This book describes various aspects of LTE as well as the change of paradigm, which it is bringing to mobile communications, focusing on LTE standards and architecture, OFDMA, the Full IP Core Network and LTE security.

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.

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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

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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.

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

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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

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Future mobile access networks will require upgraded telecommunications networks; 3G LTE/SAE is the next step, allowing data rates above 100 Mbps. Telecommunications engineers will need to understand the new SAE/ EPC architecture and its tendency towards automatic configuration, but the complexity, length and dryness of the standards documents make it difficult for them to find the information they need and work out how to apply it to their daily product and network development. This book - a new edition of SAE and the Evolved Packet Core - provides clear, concise and comprehensive coverage of the entire SAE/ EPC architecture, explaining concepts and standards and how they are used in commercial service settings. More than just a précis of the standards, it gives real insight into their development and the real-world scenarios in which they have been used since the publication of the first edition. This second edition places more emphasis on key aspects such as mobile systems and protocols (Diameter, GTP, S1-AP), and includes new coverage of femtocells, SIPTO, LIPA, LTE relay and LTE Advanced. Up-to-date coverage of SAE including the latest standards development Easily accessible overview of the architecture and concepts defined by SAE Thorough description of the Evolved Packet Core for LTE, fixed and other wireless accesses Comprehensive explanation of SAE key concepts, security and Quality-of-Service Covers potential service and operator scenarios including interworking with existing 3GPP and 3GPP2 systems Detailed walkthrough of network entities, protocols and procedures Written by established experts in the SAE standardization process, all of whom have extensive experience and understanding of its goals, history and vision Updated new edition covering all aspects of network planning and optimization This welcome new edition provides comprehensive coverage of all aspects of network planning in all the

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technologies, from 2G to 5G, in radio, transmission and core aspects. Written by leading experts in the field, it serves as a handbook for anyone engaged in the study, design, deployment and business of cellular networks. It increases basic understanding of the currently deployed, and emerging, technologies, and helps to make evolution plans for future networks. The book also provides an overview of the forthcoming technologies that are expected to make an impact in the future, such as 5G. Fundamentals of Cellular Network Planning and Optimization, Second Edition encompasses all the technologies as well as the planning and implementation details that go with them. It covers 2G (GSM, EGPRS), 3G (WCDMA) and 4G (LTE) networks and introduces 5G. The book also looks at all the sub-systems of the network, focusing on both the practical and theoretical issues. Provides comprehensive coverage of the planning aspects of the full range of today's mobile network systems, covering radio access network, circuit and packet switching, signaling, control, and backhaul/Core transmission networks New elements in book include HSPA, Ethernet, 4G/LTE and 5G Covers areas such as Virtualization, IoT, Artificial Intelligence, Spectrum Management and Cloud By bringing all these concepts under one cover, Fundamentals of Cellular Network Planning and Optimization becomes essential reading for network design engineers working with cellular service vendors or operators, experts/scientists working on end-to-end issues, and undergraduate/post-graduate students.

EPC and 4G Packet Networks Driving the Mobile Broadband Revolution Academic Press
As the cellular world and the Internet converge, mobile networks are transitioning from circuit to packet and the Internet Protocol (IP) is now recognized as the fundamental building block for all next-generation communication networks. The all-IP vision provides the flexibility to deliver

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cost-effective services and applications that meet the evolving needs of mobile users. RF engineers, mobile network designers, and system architects will be expected to have an understanding of IP fundamentals and how their role in delivering the end-to-end system is crucial for delivering the all-IP vision that makes the Internet accessible anytime, anywhere. IP Design for Mobile Networks discusses proper IP design theory to effectively plan and implement your next-generation mobile network so that IP integrates all aspects of the network. The book outlines, from both a standards and a design theory perspective, both the current and target state of mobile networks, and the technology enablers that will assist the migration. This IP transition begins with function-specific migrations of specific network domains and ends with an end-to-end IP network for radio, transport, and service delivery. The book introduces many concepts to give you exposure to the key technology trends and decision points affecting today's mobile operators. The book is divided into three parts: Part I provides an overview of how IP is being integrated into mobile systems, including radio systems and cellular networks. Part II provides an overview of IP, the technologies used for transport and connectivity of today's cellular networks, and how the mobile core is evolving to encompass IP technologies. Part III provides an overview of the end-to-end services network based on IP, including context awareness and services. Presents an overview of what mobile networks look like today—including protocols used, transport technologies, and how IP is being used for specific functions in mobile networks Provides an all-inclusive reference manual for IP design theory as related to the broader application of IP for mobile networks Imparts a view of upcoming trends in mobility standards to better prepare a network evolution plan for IP-based mobile networks This book is part of the Networking Technology Series from Cisco Press®,

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which offers networking professionals valuable information for constructing efficient networks, understanding new technologies, and building successful careers. ciscopress.com

5G Core Networks: Powering Digitalization provides an overview of the 5G Core network architecture, as well as giving descriptions of cloud technologies and the key concepts in the 3GPP rel-15/16 specifications. Written by the authors who are heavily involved in development of the 5G standards and who wrote the successful book on EPC and 4G Packet Networks, this book provides an authoritative reference on the technologies and standards of the 3GPP 5G Core network. Content includes:

- An overview of the 5G Core Architecture
- The Stand-Alone and Non-Stand-Alone Architectures
- Detailed presentation of 5G Core key concepts
- An overview of 5G Radio and Cloud technologies
- Learn The differences between the 5G Core network and previous core network generations
- How the interworking with previous network standards is defined
- Why certain functionality has been included and what is beyond the scope of 5G Core
- How the specifications relate to state-of-the-art web-scale concepts and virtualization technologies
- Details of the protocol and service descriptions
- Examples of network deployment options

Provides a clear, concise and comprehensive view of 5GS/5GC

Written by established experts in the 5GS/5GC standardization process, all of whom have extensive experience and understanding of its goals, history and vision

Covers potential service and operator scenarios for each architecture

Explains the Service Based Architecture, Network Slicing and support of Edge Computing, describing the benefits they will bring

Explains what options and parts of the standards will initially be deployed in real networks, along with their migration paths

This extensively updated second edition of LTE Signaling, Troubleshooting and Performance

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Measurement describes the LTE signaling protocols and procedures for the third generation of mobile communications and beyond. It is one of the few books available that explain the LTE signaling messages, procedures and measurements down to the bit & byte level, and all trace examples are taken for a real lab and field trial traces. This book covers the crucial key performance indicators (KPI) to be measured during field trials and deployment phase of new LTE networks. It describes how statistic values can be aggregated and evaluated, and how the network can be optimized during the first stages of deployment, using dedicated examples to enhance understanding. Written by experts in the field of mobile communications, this book systematically describes the most recent LTE signaling procedures, explaining how to identify and troubleshoot abnormal network behavior and common failure causes, as well as describing the normal signaling procedures. This is a unique feature of the book, allowing readers to understand the root cause analysis of problems related to signaling procedures. This book will be especially useful for network operators and equipment manufacturers; engineers; technicians; network planners; developers; researchers; designers; testing personnel and project managers; consulting and training companies; standardization bodies. How prepared are you to build fast and efficient web applications? This eloquent book provides what every web developer should know about the network, from fundamental limitations that affect performance to major innovations for building even more powerful browser applications—including HTTP 2.0 and XHR improvements, Server-Sent Events (SSE), WebSocket, and WebRTC. Author Ilya Grigorik, a web performance engineer at Google, demonstrates performance optimization best practices for TCP, UDP, and TLS protocols, and explains unique wireless and mobile network optimization requirements. You'll then dive into

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performance characteristics of technologies such as HTTP 2.0, client-side network scripting with XHR, real-time streaming with SSE and WebSocket, and P2P communication with WebRTC. Deliver superlative TCP, UDP, and TLS performance Speed up network performance over 3G/4G mobile networks Develop fast and energy-efficient mobile applications Address bottlenecks in HTTP 1.x and other browser protocols Plan for and deliver the best HTTP 2.0 performance Enable efficient real-time streaming in the browser Create efficient peer-to-peer videoconferencing and low-latency applications with real-time WebRTC transports

Fundamentals of 5G Mobile Networks provides an overview of the key features of the 5th Generation (5G) mobile networks, discussing the motivation for 5G and the main challenges in developing this new technology. This book provides an insight into the key areas of research that will define this new system technology paving the path towards future research and development. The book is multi-disciplinary in nature, and aims to cover a whole host of intertwined subjects that will predominantly influence the 5G landscape, including Future Internet, cloud computing, small cells and self-organizing networks (SONs), cooperative communications, dynamic spectrum management and cognitive radio, Broadcast-Broadband convergence, 5G security challenge, and green RF. The book aims to be the first of its kind towards painting a holistic perspective on 5G Mobile, allowing 5G stakeholders to capture key technology trends on different layering domains and to identify potential inter-disciplinary design aspects that need to be solved in order to deliver a 5G Mobile system that operates seamlessly as a piece of the 5G networking jigsaw. Key features:

- Addresses the fundamentals of 5G mobile networks serving as a useful study guide for mobile researchers

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and system engineers aiming to position their research in this fast evolving arena. • Develops the Small cells story together with next generation SON (self-organizing networks) systems as solutions for addressing the unprecedented traffic demand and variations across cells. • Elaborates Mobile Cloud technology and Services for future communication platforms, acting as a source of inspiration for corporations looking for new business models to harness the 5G wave. • Discusses the open issues facing broad scale commercial deployment of white space networks, including the potential for applications towards the future 5G standard. • Provides a scientific assessment for broadcast and mobile broadband convergence coupled together with a 'win-win' convergence solution to harmonize the broadcasting and mobile industry. • Describes the key components, trends and challenges, as well as the system requirements for 5G transceivers to support multi standard radio, a source of inspiration for RF engineers and vendors to tie down the requirements and potential solutions for next generation handsets.

This book provides a common framework for mobility management that considers the theoretical and practical aspects of systems optimization for mobile networks. In this book, the authors show how an optimized system of mobility management can improve the quality of service in existing forms of mobile communication. Furthermore, they provide a theoretical approach to mobility management, as well as developing the model for systems optimization, including practical case studies using network layer and mobility layer protocols in different deployment scenarios. The authors also address the different ways in which the specific mobility protocol can be developed,

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taking into account numerous factors including security, configuration, authentication, quality of service, and movement patterns of the mobiles. Key Features: Defines and discusses a common set of optimization methodologies and their application to all mobility protocols for both IPv4 and IPv6 networks Applies these technologies in the context of various layers: MAC layer, network layer, transport layer and application layer covering 802.11, LTE, WiMax, CDMA networks and protocols such as SIP, MIP, HIP, VoIP, and many more Provides a thorough analysis of the required steps during a mobility event such as discovery, network selection, configuration, authentication, security association, encryption, binding update, and media direction Includes models and tables illustrating the analysis of mobility management as well as architecture of sample wireless and mobility test beds built by the authors, involving inter-domain and intra-domain mobility scenarios This book is an excellent resource for professionals and systems architects in charge of designing wireless networks for commercial (3G/4G), LTE, IMS, military and Ad Hoc environment. It will be useful deployment guide for the architects wireless service providers. Graduate students, researchers in industry and academia, and systems engineers will also find this book of interest.

Get a comprehensive and detailed insight into the Evolved Packet Core (EPC) with this clear, concise and authoritative guide – a fully updated second edition that covers the latest standards and industry developments. The latest additions to the Evolved Packet System (EPS) including e.g. Positioning, User Data Management, eMBMS, SRVCC,

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VoLTE, CSFB. A detailed description of the nuts and bolts of EPC that are required to really get services up and running on a variety of operator networks. An in-depth overview of the EPC architecture and its connections to the wide variety of network accesses, including LTE, LTE-Advanced, WCDMA/HSPA, GSM, WiFi, etc. The most common operator scenarios of EPS and the common issues faced in their design. The reasoning behind many of the design decisions taken in EPC, in order to understand the full details and background of the all-IP core

NEW CONTENT TO THIS EDITION •
150+ New pages, new illustrations and call flows • Covers 3GPP Release 9, 10 and 11 in addition to release 8 • Expanded coverage on Diameter protocol, interface and messages • Architecture overview • Positioning • User Data Management • eMBMS (LTE Broadcasting) • H(e)NodeB/Femto Cells • LIPA/SIPTO/Breakout architectures • Deployment Scenarios • WiFi interworking • VoLTE/MMTel, CS fallback and SRVCC

SAE is the core network that supports LTE, the next key stage in development of the UMTS network to provide mobile broadband. It aims to provide an efficient, cost-effective solution for the ever-increasing number of mobile broadband subscribers. There is no other book on the market that covers the entire SAE network architecture; this book summarizes the important parts of the standards, but goes beyond mere description and offers real insight and explanation of the technology. Fully updated with the latest developments since the first edition published, and now including additional material and insights on industry trends and views regarding future potential.

applications of SAE

Essential reference providing best practice of LTE-A, VoLTE, and IoT

Design/deployment/Performance and evolution towards 5G This book is a practical guide to the design, deployment, and performance of LTE-A, VoLTE/IMS and IoT. A comprehensive practical performance analysis for VoLTE is conducted based on field measurement results from live LTE networks. Also, it provides a comprehensive introduction to IoT and 5G evolutions. Practical aspects and best practice of LTE-A/IMS/VoLTE/IoT are presented. Practical aspects of LTE-Advanced features are presented. In addition, LTE/LTE-A network capacity dimensioning and analysis are demonstrated based on live LTE/LTE-A networks KPIs. A comprehensive foundation for 5G technologies is provided including massive MIMO, eMBB, URLLC, mMTC, NGCN and network slicing, cloudification, virtualization and SDN. Practical Guide to LTE-A, VoLTE and IoT: Paving the Way Towards 5G can be used as a practical comprehensive guide for best practices in LTE/LTE-A/VoLTE/IoT design, deployment, performance analysis and network architecture and dimensioning. It offers tutorial introduction on LTE-A/IoT/5G networks, enabling the reader to use this advanced book without the need to refer to more introductory texts. Offers a complete overview of LTE and LTE-A, IMS, VoLTE and IoT and 5G Introduces readers to IP Multimedia Subsystems (IMS) Performs a comprehensive evaluation of VoLTE/CSFB Provides LTE/LTE-A network capacity and dimensioning Examines IoT and 5G evolutions

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towards a super connected world Introduce 3GPP NB-IoT evolution for low power wide area (LPWA) network Provide a comprehensive introduction for 5G evolution including eMBB, URLLC, mMTC, network slicing, cloudification, virtualization, SDN and orchestration Practical Guide to LTE-A, VoLTE and IoT will appeal to all deployment and service engineers, network designers, and planning and optimization engineers working in mobile communications. Also, it is a practical guide for R&D and standardization experts to evolve the LTE/LTE-A, VoLTE and IoT towards 5G evolution. 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

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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.

Infrastructure for Homeland Security Environments Wireless Sensor Networks helps readers discover the emerging field of low-cost standards-based sensors that promise a high order of spatial and temporal resolution and accuracy in an ever-increasing universe of applications. It shares the latest advances in science and engineering paving the way towards a large plethora of new applications in such areas as infrastructure protection and security, healthcare, energy, food safety, RFID, ZigBee, and processing. Unlike other books on wireless sensor networks that focus on limited topics in the field, this book is a broad introduction that covers all the major technology, standards, and application topics. It contains everything readers need to know to enter this burgeoning field, including current applications and promising research and development; communication and networking protocols; middleware architecture for wireless sensor networks; and security and management. The straightforward and engaging writing style of this book makes even complex concepts and processes easy to follow and understand. In addition, it offers several features that help readers grasp the material and then apply their knowledge in designing their own wireless sensor network systems:

- * Examples illustrate how concepts are applied to the development and application of
- * wireless sensor networks
- * Detailed case studies set forth all the

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steps of design and implementation needed to solve real-world problems * Chapter conclusions that serve as an excellent review by stressing the chapter's key concepts * References in each chapter guide readers to in-depth discussions of individual topics This book is ideal for networking designers and engineers who want to fully exploit this new technology and for government employees who are concerned about homeland security. With its examples, it is appropriate for use as a coursebook for upper-level undergraduates and graduate students.

This book provides a comprehensive overview of the latest research and standardization progress towards the 5th generation (5G) of mobile communications technology and beyond. It covers a wide range of topics from 5G use cases and their requirements, to spectrum, 5G end-to-end (E2E) system architecture including core network (CN), transport network (TN) and radio access network (RAN) architecture, network slicing, security and network management. It further dives into the detailed functional design and the evaluation of different 5G concepts, and provides details on planned trials and pre-commercial deployments across the globe. While the book naturally captures the latest agreements in 3rd Generation Partnership Project (3GPP) New Radio (NR) Release 15, it goes significantly beyond this by describing the likely developments towards the final 5G system that will ultimately utilize a wide range of spectrum bands, address all envisioned 5G use cases, and meet or exceed the International Mobile Telecommunications (IMT) requirements for the year 2020 and

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beyond (IMT-2020). 5G System Design: Architectural and Functional Considerations and Long Term Research is based on the knowledge and consensus from 158 leading researchers and standardization experts from 54 companies or institutes around the globe, representing key mobile network operators, network vendors, academic institutions and regional bodies for 5G. Different from earlier books on 5G, it does not focus on single 5G technology components, but describes the full 5G system design from E2E architecture to detailed functional design, including details on 5G performance, implementation and roll-out.

This book describes the concept of a Software Defined Mobile Network (SDMN), which will impact the network architecture of current LTE (3GPP) networks. SDN will also open up new opportunities for traffic, resource and mobility management, as well as impose new challenges on network security. Therefore, the book addresses the main affected areas such as traffic, resource and mobility management, virtualized traffics transportation, network management, network security and techno economic concepts. Moreover, a complete introduction to SDN and SDMN concepts. Furthermore, the reader will be introduced to cutting-edge knowledge in areas such as network virtualization, as well as SDN concepts relevant to next generation mobile networks. Finally, by the end of the book the reader will be familiar with the feasibility and opportunities of SDMN concepts, and will be able to evaluate the limits of performance and scalability of these new technologies while applying them to mobile broadb and

networks.

This timely book provides an overview of technologies for Public Safety Networks (PSNs). Including real-life examples of network application and services, it introduces readers to the many public safety network technologies and covers the historical developments as well as emerging trends in PSNs such as today's 4G and tomorrow's 5G cellular network related solutions. *em style="mso-bidi-font-style: normal;"*Public Safety Networks from LTE to 5G explores the gradual changes and transformation in the PSNs from the traditional approaches in communications, and examines the new technologies that have permeated this realm, as well as their advantages. It gives readers a look at the challenges public safety networks face by developing solutions for data rates such as introducing broadband data services into safer communication. Topics covered include: TETRA and TETRAPOL; Digital Mobile Radio (DMR), Next-Generation Digital Narrowband (NXDN), Digital Private Mobile Radio (dPMR); and Professional Digital Trunking (PDT). The book also presents information on FirstNet, ESN, and Safenet; Satellite Communications in EMS (Emergency Management) and Public Protection and Disaster Relief (PPDR); Wi-Fi in Ambulances; Technology in Patrol Communications; and more.

This book constitutes the proceedings of the 6th International ICST Conference, TridentCom 2010, held in Berlin, Germany, in May 2010. Out of more than 100 submitted contributions the Program Committee finally selected 15 full papers, 26

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practices papers, and 22 posters. They focus on topics as Internet testbeds, future Internet research, wireless sensors, media and mobility, and monitoring in large scale testbeds.

Get a comprehensive and detailed insight into the Evolved Packet Core (EPC) with this clear, concise and authoritative guide - a fully updated second edition that covers the latest standards and industry developments

KEY FEATURES " The only book to describe and explain the entire EPC including architecture, features and protocols, giving you the knowledge and insight to see the potential in EPC, develop EPC products and deploy LTE/EPC mobile broadband Networks " The Second Edition includes 150+ new pages and numerous new illustrations. The content has also been focused towards the mainstream deployment scenarios " Written by established experts in the 3GPP standardization process, with extensive, in-depth experience of its goals, development and future direction " Case studies of deployment scenarios show how the functions described within EPC are placed within a live network context " Forewords written by Dr. Kalyani Bogineni and Dr. Ulf Nilsson

DESCRIPTION " The latest additions to the Evolved Packet System (EPS) including e.g. Positioning, User Data Management, eMBMS, SRVCC, VoLTE, CSFB " A detailed description of the nuts and bolts of EPC that are required to really get services up and running on a variety of operator networks " An in-depth overview of the EPC architecture and its connections to the wide variety of network accesses, including LTE, LTE-Advanced,

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WCDMA/HSPA, GSM, WiFi, etc." The most common operator scenarios of EPS and the common issues faced in their design " The reasoning behind many of the design decisions taken in EPC, in order to understand the full details and background of the all-IP core NEW CONTENT TO THIS EDITION " 150+ New pages, new illustrations and call flows " Covers 3GPP Release 9, 10 and 11 in addition to release 8 " Expanded coverage on Diameter protocol, interface and messages " Architecture overview " Positioning " User Data Management " eMBMS (LTE Broadcasting) " H(e)NodeB/Femto Cells " LIPA/SIPTO/Breakout architectures " Deployment Scenarios " WiFi interworking " VoLTE/MMTel, CS fallback and SRVCC SAE is the core network that supports LTE, the next key stage in development of the UMTS network to provide mobile broadband. It aims to provide an efficient, cost-effective solution for the ever-increasing number of mobile broadband subscribers There is no other book on the market that covers the entire SAE network architecture; this book summarizes the important parts of the standards, but goes be ...

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

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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.

This book investigates new enabling technologies for Fi-Wi convergence. The editors discuss Fi-Wi technologies at the three major network levels involved in the path towards convergence: system level, network architecture level, and network management level. The main topics will be: a. At system level: Radio over Fiber (digitalized vs. analogic, standardization, E-band and beyond) and 5G wireless

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technologies; b. Network architecture level: NGPON, WDM-PON, BBU Hotelling, Cloud Radio Access Networks (C-RANs), HetNets. c. Network management level: SDN for convergence, Next-generation Point-of-Presence, Wi-Fi LTE Handover, Cooperative MultiPoint.

Long Term Evolution (LTE) was originally an internal 3GPP name for a program to enhance the capabilities of 3G radio access networks. The nickname has now evolved to become synonymous with 4G. This book concentrates on 4G systems, also known as LTE-Advanced. Telecommunications engineers and students are provided with a history of these systems, along with an overview of a mobile telecommunications system. The overview addresses the components in the system as well as their function. This resource guides telecommunications engineers through many important aspects of 4G including the air interface physical layer, Radio Access Networks, and 3GPP standardization, to name a few.

This book presents the architecture of two networks that make up the backbone of the telephone service VoLTE and video service ViLTE. The 4G mobile network makes it possible to construct bearers through which IP packets, containing either telephone signals (SIP, SDP) or voice or video media (RTP stream), are transported. The IMS network performs the processing of the telephone signal to provide VoLTE and ViLTE services, including call routing and the provision of additional services. Different procedures are described: the set-up and termination of a session, interconnection with

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third-party networks, roaming and intra-system handover. The inter-system handover PS-CS is a special case that occurs when the mobile loses 4G network coverage over the course of a session. The e-SRVCC mechanism enables continuity of the service during the switch of the telephone communication to the 2G or 3G networks. The SMS service for short messages, which is a special telephone service in itself, is provided by two structures, one relying on the IMS network, and a second on the CSFB functionality.

We have telephony to talk to each other, messaging to dispatch mail or instant messages, browsing to read published content and search engines to locate content sites. However, current mobile networks do not provide the possibility for one application rich terminal to communicate with another in a peer-to-peer session beyond voice calls. Mobile telephony with the current technology has been hugely successful and shows that there is immense value in communicating with peers while being mobile, and with increasingly available smarter multimedia terminals the communication experience will be something more than just exchanging voice. Those multimedia terminals need IP multimedia networks. Hence, the Third Generation Partnership Project (3GPP) has developed a standard for SIP based IP multimedia service machinery known as 'The IMS (IP Multimedia Subsystem)' and this informative book explains everything you need to know about it..... Presents the architecture and functionality of logical elements of IMS and their interfaces providing detailed

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description of how elements are connected, what protocols are used and how they are used Explains how the optimisation and security of the mobile communication environment has been designed in the form of user authentication and authorisation based on mobile identities Illustrates how optimisation at the radio interface is achieved using specific rules at the user to network interface. This includes signalling compression mechanisms as well as security and policy control mechanisms, allowing radio loss and recovery detection Addresses important aspects from an operator's point of view while developing architecture such as charging framework, policy and service control Describes many services on top of IMS in detail, including voice, presence, messaging and conferencing. Written in a manner that allows readers to choose the level of knowledge and understanding they need to gain about the IMS, this volume will have instant appeal to a wide audience ranging from marketing managers, research and development engineers, network engineers, developers, test engineers to university students.

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