

Network Slicing Based 5G and Future Mobile Networks: Mobility, Resource Management, and Challenges

Haijun Zhang, Na Liu, Xiaoli Chu, Keping Long, Abdol-Hamid Aghvami, and Victor C. M. Leung

The authors introduce a logical architecture for network-slicing-based 5G systems, and present a scheme for managing mobility between different access networks, as well as a joint power and subchannel allocation scheme in spectrum-sharing two-tier systems based on network slicing, where both the co-tier interference and cross-tier interference are taken into account.

ABSTRACT

5G networks are expected to be able to satisfy users' different QoS requirements. Network slicing is a promising technology for 5G networks to provide services tailored for users' specific QoS demands. Driven by the increased massive wireless data traffic from different application scenarios, efficient resource allocation schemes should be exploited to improve the flexibility of network resource allocation and capacity of 5G networks based on network slicing. Due to the diversity of 5G application scenarios, new mobility management schemes are greatly needed to guarantee seamless handover in network-slicing-based 5G systems. In this article, we introduce a logical architecture for network-slicing-based 5G systems, and present a scheme for managing mobility between different access networks, as well as a joint power and subchannel allocation scheme in spectrum-sharing two-tier systems based on network slicing, where both the co-tier interference and cross-tier interference are taken into account. Simulation results demonstrate that the proposed resource allocation scheme can flexibly allocate network resources between different slices in 5G systems. Finally, several open issues and challenges in network-slicing-based 5G networks are discussed, including network reconstruction, network slicing management, and cooperation with other 5G technologies.

INTRODUCTION

With the rapid development and innovations of mobile networking technologies, an entirely new era of mobile communications, the fifth generation (5G) of mobile communication systems, is coming. There is a consensus that 5G systems can be rolled out around 2020. 5G systems are expected to provide society with full connection, which can break through the limitations of time and space to create all-dimensional user-centered or service-centric interconnections between people and things [1].

5G networks aims to meet various user quality of service (QoS) requirements in different application scenarios (e.g., in terms of data transmission rate and latency) [2]. In scenarios where seamless wide-area coverage is needed, 5G systems should

provide users with seamless high-data-rate services anytime and anywhere, even at cell edges or with high-speed (up to 500 km/h) mobility. In metropolitan areas where the density and volume of wireless traffic demand are both very high, 5G networks should provide dense hotspot coverage with high capacity. In scenarios where reliable connections of a large number of widespread low-power nodes (e.g., wireless sensors) are needed, 5G networks should be able to connect millions of devices under the constraints of low power consumption and low cost per device. Extremely low latency and high reliability of 5G networks are required to meet the performance requirements of real-time, reliable, and secure communications in some vertical industries such as interconnected vehicles and industrial production control.

Faced with the abundant, distinct, customized service requirements, and in the new application scenarios mentioned above, the network architecture and networking technologies need to be revisited for 5G systems [3]. This has become the focus of research and development activities of operators, equipment vendors, and research institutes all over the world. In order to provide customized reliable services using limited network resources while reducing capital expenditure and operating expense of 5G networks, network slicing has recently been proposed by the wireless industry as a main enabler of network service convergence and on-demand customized services [4–6]. By slicing a physical network into several logical networks, network slicing can support on-demand tailored services for distinct application scenarios while using the same physical network. Supported by network slicing, network resources can be dynamically and efficiently allocated to logical network slices according to the corresponding QoS demands.

Network slicing has also attracted a lot of research interest in academia. In [7] a user-centric service slicing strategy considering different QoS requirements was proposed based on software defined networking (SDN), and a genetic algorithm was devised to optimize the virtualized radio resource management based on resource pooling. In [8], a network slicing mechanism was introduced for network edge nodes to offer low-la-

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Network Slicing for Future Wireless Communication Wanqing Guan,Haijun Zhang,2024-05-23 This book comprehensively discusses the development application and challenges of network slicing technology in wireless communications Starting with the basic concept and enabling technologies of network slicing this book introduces how to integrate AI Artificial Intelligence technology into the end to end deployment resource allocation and performance enhancement for multi tenant slicing An in depth exploration of managing multi domain slices deployed in the federated infrastructure networks is presented including on demand cooperation among multiple infrastructure networks distinct slice deployment hierarchical slice orchestration and fast slice adaption As a guide to leveraging AI to enhance traffic performance of multi tenant slicing and customize resource slicing for industrial scenarios this book provides insights modeling applications and research issues A holistic perspective on prominent role of network slicing in managing wireless network resources is provided as well Overall network slicing as a key technology of wireless networks enables to satisfy differentiated service demands of multiple tenants from vertical industries with the same shared physical infrastructure network As future wireless networks are expected to facilitate the evolution of vertical industries various vertical enterprises as tenants require an intelligent network slicing paradigm to provide highly customizable services AI based management system for network slicing excel at deploying slices rapidly allocating resources efficiently and avoiding service quality degradation With the increasing diversity of service demands and complexity of communication environment incorporating AI into network slicing is a necessity for improving flexibility and automation of resource management This book targets advanced level students in information and communication sciences as a secondary textbook Researchers and industry professionals working in various areas such as wireless communication systems network management and orchestration resource allocation and AI enabled wireless networks will also find this book useful as reference book

5G for Future Wireless Networks Keping Long,Victor C.M. Leung,Haijun Zhang,Zhiyong Feng,Yonghui Li,Zhongshan Zhang,2017-12-31 This book constitutes the proceedings of the First International Conference on 5G for Future Wireless Networks 5GWN 2017 held in Beijing China in April 2017 The 64 full papers were selected from 135 submissions and present the state of the art and practical applications of 5G technologies The exponentially growing data traffic caused by the development of mobile Internet and smart phones requires powerful networks The fifth generation 5G techniques are promising to meet the requirements of this explosive data traffic in future mobile communications

5G Verticals Rath Vannithamby,Anthony Soong,2020-04-20 A comprehensive text to an understanding the next generation mobile broadband and wireless Internet of Things IoT technologies 5G Verticals brings together in one comprehensive volume a group of visionaries and technical experts from academia and industry The expert authors discuss the applications and technologies that comprise 5G verticals The earlier network generations 2G to 4G were designed as on size fits all general purpose connectivity platforms with limited differentiation capabilities 5G networks have

the capability to demand customizable mobile networks and create an ecosystem for technical and business innovation involving vertical markets such as automotive healthcare manufacturing energy food and agriculture city management government public transportation media and more 5G will serve a large portfolio of applications with various requirements ranging from high reliability to ultra low latency going through high bandwidth and mobility In this book the authors explore applications and usages of various 5G verticals including a set of key metrics for these uses and their corresponding target requirements The book also examines the potential network architectures and enabling technologies to meet the requirements of 5G verticals This important book Offers a comprehensive resource to the promise of 5G Verticals Provides a set of key metrics for the uses and target requirements Contains illustrative examples of the technology and applications Includes contributions from experts in the field and professionals that developed the 5G standards Provides an analysis of specific vertical industries which have the potential to be among the first industries to use 5G Written for industry practitioners engineers and researchers 5G Verticals discusses the technology that enables the 5G system to be flexibly deployed and scaled

International Conference on Information Systems and Intelligent Applications Mostafa Al-Emran, Mohammed A. Al-Sharafi, Khaled Shaalan, 2022-10-22 This book sheds light on the fundamental and innovative topics in information systems and their societal impact on individuals and organizations It mainly focuses on the role of artificial intelligence in organizations human computer interaction IS in education and industry and IS security privacy and trust The outcomes are expected to assist the decision makers in formulating the required policies and procedures for using cutting edge technologies

New Trends in Information and Communications Technology Applications Abbas M. Al-Bakry, Safaa O. Al-Mamory, Mouayad A. Sahib, Loay E. George, Jaafar A. Aldhaibani, Haitham S. Hasan, George S. Oreku, 2023-06-10 This book constitutes the refereed proceedings of the 6th International Conference on New Trends in Information and Communications Technology Applications NTICT 2022 held in Baghdad Iraq during November 16 17 2022 The 14 full papers included in this book were carefully reviewed and selected from 53 submissions They were organized in topical sections as follows computing methodologies information systems network security and privacy

Artificial Intelligence and Sustainable Computing Manjaree Pandit, M. K. Gaur, Sandeep Kumar, 2025-05-02 This book presents high quality research papers presented at the 6th International Conference on Sustainable and Innovative Solutions for Current Challenges in Engineering and Technology ICSISCET 2024 held at Madhav Institute of Technology Science MITS Gwalior India during October 26 27 2024 The book extensively covers recent research in artificial intelligence AI that knit together nature inspired algorithms evolutionary computing fuzzy systems computational intelligence machine learning deep learning etc which is very useful while dealing with real problems due to their model free structure learning ability and flexible approach These techniques mimic human thinking and decision making abilities to produce systems that are intelligent efficient cost effective and fast The book provides a friendly and informative treatment of the topics which makes this book

an ideal reference for both beginners and experienced researchers Proceedings of Fourth International Conference on Computing, Communications, and Cyber-Security Sudeep Tanwar, Slawomir T. Wierzbach, Pradeep Kumar Singh, Maria Ganzha, Gregory Epiphaniou, 2023-07-01 This book features selected research papers presented at the Fourth International Conference on Computing Communications and Cyber Security IC4S 2022 organized in Ghaziabad India during October 21-22, 2022. The conference was hosted at KEC Ghaziabad in collaboration with WSG Poland, SFU Russia, CSRL India. It includes innovative work from researchers, leading innovators, and professionals in the area of communication and network technologies, advanced computing technologies, data analytics, and intelligent learning, the latest electrical and electronics trends, and security and privacy issues. *Advances on Broad-Band Wireless Computing, Communication and Applications*

Leonard Barolli, 2021-10-25 This book states that information networks of today are going through a rapid evolution. Different kinds of networks with different characteristics are emerging, and they are integrating in heterogeneous networks. For these reasons, there are many interconnection problems which may occur at different levels of the hardware and software design of communicating entities and communication networks. These kinds of networks need to manage an increasing usage demand, provide support for a significant number of services, guarantee their QoS, and optimize the network resources. The success of all IP networking and wireless technology has changed the ways of living for the people around the world. The progress of electronic integration and wireless communications is going to pave the way to offer people the access to the wireless networks on the fly, based on which all electronic devices will be able to exchange the information with each other in a ubiquitous way whenever necessary. The aim of the book is to provide latest research findings, innovative research results, methods, and development techniques from both theoretical and practical perspectives related to the emerging areas of broadband and wireless computing. *Machine Learning for Mobile Communications* Sinh Cong Lam, Chiranjil Lal

Chowdhary, Tushar, Hrishikesh Jaware, Subrata Chowdhury, 2024-06-17 Machine Learning for Mobile Communications will take readers on a journey from basic to advanced knowledge about mobile communications and machine learning. For learners at the basic level, this book volume discusses a wide range of mobile communications topics from the system level, such as system design and optimization, to the user level, such as power control and resource allocation. The authors also review the state of the art machine learning, one of the biggest emerging trends in both academia and industry. For learners at the advanced level, this book discusses solutions for long-term problems with future mobile communications, such as resource allocation, security, power control, and spectral efficiency. The book brings together some of the top mobile communications and machine learning experts throughout the world who contributed their knowledge and experience regarding system design and optimization. This book discusses the 5G new radio system design and architecture as specified in 3GPP documents. Highlights the challenges including security and privacy, energy, and spectrum efficiency from the perspective of 5G new radio systems. Identifies both theoretical and practical problems that can occur in mobile communication systems.

Covers machine learning techniques such as autoencoder and Q learning in a comprehensive manner Explores how to apply machine learning techniques to mobile systems to solve modern problems This book is for senior undergraduate and graduate students and academic researchers in the fields of electrical engineering electronics and communication engineering and computer engineering Future Trends in 5G and 6G Mangesh M. Ghonge,Ramchandra Sharad Mangrulkar,Pradip M. Jawandhiya,Nitin Goje,2021-12-30 This book offers a comprehensive overview of basic communication and networking technologies It focuses on emerging technologies such as Software Defined Network SDN based ad hoc networks 5G Machine Learning and Deep Learning solutions for communication and networking Cloud Computing etc It also includes discussions on practical and innovative applications including Network Security Smart Cities e health and Intelligent Systems Future Trends in 5G and 6G Challenges Architecture and Applications addresses several key issues in SDN energy efficient systems the Internet of Things Big Data Cloud Computing and Virtualization Machine Learning Deep Learning Cryptography and 6G wireless technology and its future It provides students researchers and practicing engineers with an expert guide to the fundamental concepts challenges architecture applications and state of the art developments in communication and networking Proceedings of the 9th International Conference on Computer Engineering and Networks Qi Liu,Xiaodong Liu,Lang Li,Huiyu Zhou,Hui-Huang Zhao,2020-07-01 This book gathers papers presented at the 9th International Conference on Computer Engineering and Networks CENet2019 held in Changsha China on October 18 20 2019 It examines innovations in the fields of computer engineering and networking and explores important state of the art developments in areas such as Information Security Information Hiding and Cryptography Cyber Security and Intelligent Computing and Applications The book also covers emerging topics in computer engineering and networking along with their applications discusses how to improve productivity by using the latest advanced technologies and examines innovation in the fields of computer engineering and networking particularly in intelligent computing and security Federated Learning for Future Intelligent Wireless Networks Yao Sun,Chaoqun You,Gang Feng,Lei Zhang,2023-12-27 Federated Learning for Future Intelligent Wireless Networks Explore the concepts algorithms and applications underlying federated learning In Federated Learning for Future Intelligent Wireless Networks a team of distinguished researchers deliver a robust and insightful collection of resources covering the foundational concepts and algorithms powering federated learning as well as explanations of how they can be used in wireless communication systems The editors have included works that examine how communication resource provision affects federated learning performance accuracy convergence scalability and security and privacy Readers will explore a wide range of topics that show how federated learning algorithms concepts and design and optimization issues apply to wireless communications Readers will also find A thorough introduction to the fundamental concepts and algorithms of federated learning including horizontal vertical and hybrid FL Comprehensive explorations of wireless communication network design and optimization for federated learning Practical discussions of novel federated

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Advanced Information Networking and Applications Leonard Barolli,2023-03-14 Networks of today are going through a rapid evolution and there are many emerging areas of information networking and their applications Heterogeneous networking supported by recent technological advances in low power wireless communications along with silicon integration of various functionalities such as sensing communications intelligence and actuations are emerging as a critically important disruptive computer class based on a new platform networking structure and interface that enable novel low cost and high volume applications Several of such applications have been difficult to realize because of many interconnections problems To fulfill their large range of applications different kinds of networks need to collaborate and wired and next generation wireless systems should be integrated in order to develop high performance computing solutions to problems arising from the complexities of these networks This volume covers the theory design and applications of computer networks distributed computing and information systems The aim of the volume *Advanced Information Networking and Applications* is to provide latest research findings innovative research results methods and development techniques from both theoretical and practical perspectives related to the emerging areas of information networking and applications

Blockchain for 5G-Enabled IoT Sudeep Tanwar,2021-04-09 This book addresses one of the most overlooked practical methodological and moral questions in the journey to secure and handle the massive amount of data being generated from smart devices interactions the integration of Blockchain with 5G enabled IoT After an overview this book discusses open issues and challenges which may hinder the growth of Blockchain technology Then this book

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Information Theory for Data Communications and Processing Shlomo Shamai (Shitz), Abdellatif Zaidi, 2021-01-13 Modern current and future communications processing aspects motivate basic information theoretic research for a wide variety of systems for which we do not have the ultimate theoretical solutions for example a variety of problems in network information theory as the broadcast interference and relay channels which mostly remain unsolved in terms of determining capacity regions and the like Technologies such as 5G cellular communications Internet of Things IoT and mobile edge networks among others not only require reliable rates of information measured by the relevant capacity and capacity regions but are also subject to issues such as latency vs reliability availability of system state information priority of information secrecy demands energy consumption per mobile equipment sharing of communications resources time frequency space etc This book composed of a collection of papers that have appeared in the Special Issue of the Entropy journal dedicated to Information Theory for Data Communications and Processing reflects in its eleven chapters novel contributions based on the firm basic grounds of information theory The book chapters address timely theoretical and practical aspects that constitute both interesting and relevant theoretical contributions as well as direct implications for modern current and future communications systems

Fluctuation-Induced Network Control and Learning Masayuki Murata, Kenji Leibnitz, 2021-03-16 From theory to application this book presents research on biologically and brain inspired networking and machine learning based on Yuragi which is the Japanese term describing the noise or fluctuations that are inherently used to control the dynamics of a system The Yuragi mechanism can be found in various biological contexts such as in gene expression dynamics molecular motors in muscles or the visual recognition process in the brain Unlike conventional network protocols that are usually designed to operate under controlled conditions with a predefined set of rules the probabilistic behavior of Yuragi based control permits the system to adapt to unknown situations in a distributed and self organized manner leading to a higher scalability and robustness The book consists of two parts Part 1 provides in four chapters an introduction to the biological background of the Yuragi concept as well as how these are applied to networking problems Part 2 provides additional contributions that extend the original Yuragi concept to a Bayesian attractor model from human perceptual decision making In the six chapters of the second part applications to various fields in information network control and

artificial intelligence are presented ranging from virtual network reconfigurations a software defined Internet of Things and low power wide area networks This book will benefit those working in the fields of information networks distributed systems and machine learning who seek new design mechanisms for controlling large scale dynamically changing systems

Cloud Computing's Transformative Power in Computing Environments Hashim, Aisha Hassan Abdalla,Ahmed, Zeinab E.,Khalifa, Othman O.,Saeed, Rashid A.,2025-07-08 Cloud computing has revolutionized the way data is stored processed and accessed offering scalable and cost effective solutions for individuals businesses and governments alike Its integration with technologies is accelerating innovation across sectors from healthcare and education to finance and manufacturing By enabling on demand access to computing resources cloud technology enhances flexibility collaboration and efficiency in digital operations As the digital landscape evolves understanding and leveraging cloud computing is critical for driving technological progress and meeting the demands of an increasingly connected world Cloud Computing s Transformative Power in Computing Environments provides a deep understanding of the transforming ability of cloud computing technologies in computing environments It focuses on understanding the principles practical implementations and future trends in cloud computing Covering topics such as 5G networks digital transformation and wireless energy harvesting this book is an excellent resource for academicians researchers educators IT professionals policymakers and more

Fundamentals of 6G Communications and Networking Xingqin Lin,Jun Zhang,Yuanwei Liu,Joongheon Kim,2023-12-11 This book begins with a historical overview of the evolution of mobile technologies and addresses two key questions why do we need 6G and what will 6G be The remaining chapters of this book are organized into three parts Part I covers the foundation of an end to end 6G system by presenting 6G vision driving forces key performance indicators and societal requirements on digital inclusion sustainability and intelligence Part II presents key radio technology components for the 6G communications to deliver extreme performance including new radio access technologies at high frequencies joint communications and sensing AI driven air interface among others Part III describes key enablers for intelligent 6G networking including network disaggregation edge computing data driven management and orchestration network security and trustworthiness among others This book is relevant to researchers professionals and academics working in 5G 6G and beyond

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