

Preface

With 5G, mobile networks and telecommunications networks have entered a new phase. 5G mobile networks use unique concepts and technologies to deliver current and future applications across a wired spectrum, from high bit-rate smartphones to high-availability car-to-x and mass IoT applications.

To understand and sufficiently appreciate this, Chapters 1 and 2 follow the evolutionary development steps of mobile networks. This includes an overview of 2G and 3G with the different 3GPP (3rd Generation Partnership Project) releases, the introduction of the NGN (Next Generation Network) concept with VoIP (Voice over IP), the corresponding protocols SIP (Session Initiation Protocol), H.248 and Diameter as well as the IMS (IP Multimedia Subsystem) to provide Multimedia over IP real-time services. A look at 4G with SAE (System Architecture Evolution) and LTE (Long Term Evolution) incl. VoLTE (Voice over LTE) completes the overview of the continuous development of mobile networks.

Starting with 4G, the increasing use of new network technologies such as NFV (Network Functions Virtualisation) and MEC (Multi-access Edge Computing) as well as SDN (Software Defined Networking) and SFC (Service Function Chaining) has become evident. Chapter 3 is dedicated to these essential technologies to implement the concept of so-called Future Networks and, consequently, 5G systems.

The approach to 5G is different from previous versions, which were mainly driven by technology. Chapter 4 shows that at the beginning of 5G, there were possible use cases and deployment scenarios. Based on these, the requirements for the different application areas were derived, and only then, the concepts and techniques required for the implementation were specified. The standardization is done in releases, as is usual with 3GPP. 5G systems are currently being introduced according to Release 15; Release 16 is currently in progress, while Release 17 has been started. In this context, as explained in Chapter 5, the ITU (International Telecommunication Union) should be mentioned in particular. It has defined a 5G target system based on the requirements and, it has identified possible frequency ranges for 5G. These, in turn, have been and are still allocated to the network operators by regulators.

Chapter 6 provides an overview of a 5G system based on the applied design principles, the implementation features, and associated functions, and the resulting network architecture.

Chapter 7 provides deeper insights into the 5G access networks, focusing on the extremely powerful radio transmission technology, as well as discussing the topologies, architectures, and protocols of the RAN (Radio Access Network).

The highly innovative 5G core network is the subject of Chapter 8, where we discuss new topics such as Service Based Architecture (SBA) and Network Slicing.

Chapter 9 summarizes the previously introduced concepts in an overall view, taking into account the 4G/5G migration, the use of the IMS in a 5G system, and the connection of various wired and wireless access networks up to satellite-supported base stations. The result is a network that implements FMC (Fixed Mobile Convergence) with only one core network technology. This is why 5G is not just a mobile network, but it also represents a new generation converged network.

Since this is still an IP network, we have to pay special attention to IT security by Chapter 10. A distinction is made between security for the communication network itself, security in the cloud infrastructure of the network operator, and the 3GPP security architecture standardized specifically for 5G.

This introduction to the 5th generation mobile networks is completed with an outline of the environmental influences due to electromagnetic radiation and the energy and raw material resources requirements in Chapter 11. Chapter 12 finally gives an outlook on the future with the further development of 5G at 3GPP, the work on a network 2030 at the ITU, and first considerations on 6G in different research projects.

Compared to the German-language edition, more extensive extensions were made in Section 5.3 on international regulation and Section 12.2 on the progress made in the specification of a Network 2030. Besides, necessary updates and additions were made to a small extent.

The book's main objective is to provide people interested in 5G technology and application scenarios with a well-founded knowledge for an introduction to 5G and encourage further discussion of this topic. For this, the book refers to numerous additional sources. This group of people includes persons with a general interest in technology, mostly employees of public and private network operators. This book should be of particular interest within the IT departments of potential 5G user companies and, of course, among computer science and electrical engineering students.

For more information about this book, please visit the web site www.5to6g.com. You are welcome to send me comments and suggestions by e-mail (trick@5to6g.com).

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