

Contents

1	Evolution of Mobile Networks — 1
1.1	Connection Concepts and Routing Principles — 4
1.2	Evolution of 2G/3G Mobile Networks — 10
1.3	NGN (Next Generation Network) — 15
1.4	VoIP (Voice over IP) and SIP (Session Initiation Protocol) — 19
2	3G/4G Mobile Networks and NGN (Next Generation Networks) — 30
2.1	3GPP Releases (3rd Generation Partnership Project) — 30
2.2	IMS (IP Multimedia Subsystem) and NGN — 32
2.3	H.248/Megaco Protocol — 40
2.4	Diameter Protocol — 46
2.5	SAE (System Architecture Evolution) and LTE (Long Term Evolution) — 58
2.6	VoLTE (Voice over LTE) — 61
3	Future Networks — 65
3.1	NFV (Network Functions Virtualization) and MEC (Multi-access Edge Computing) — 65
3.2	SDN (Software Defined Networking) and SFC (Service Function Chaining) — 74
3.3	Future Networks Concept — 95
4	5G Use Cases and Requirements — 99
4.1	5G Use Cases and Usage Scenarios — 99
4.2	Application Areas for 5G — 107
4.3	5G Requirements — 112
5	5G Standardization and Regulation — 121
5.1	Frequencies — 121
5.2	Standardization — 125
5.3	Regulation — 127
6	5G Networks at a Glance — 133
6.1	Design Principles — 133
6.2	Features and Functions — 135
6.3	5G Network Architecture — 142
7	5G Access Networks — 145
7.1	Radio Transmission Technology — 145

- 7.2 RAN (Radio Access Network) — 157
 - 7.3 Open-RAN (O-RAN) — 163
- 8 5G Core Network — 167**
 - 8.1 Basic System Architecture and Protocols — 168
 - 8.2 Core Network Functions — 178
 - 8.3 Service Based Architecture (SBA) — 182
 - 8.4 Network Slicing — 195
- 9 5G System — 204**
 - 9.1 4G/5G Migration — 206
 - 9.2 5G and IMS — 209
 - 9.3 Access Networks and Fixed Mobile Convergence (FMC) — 211
 - 9.4 5G and IoT — 219
 - 9.5 5G Campus Networks — 223
 - 9.6 5G System in an Overall View — 226
- 10 5G and Security — 230**
 - 10.1 Security for the Communication Network — 234
 - 10.2 Security in the Cloud Infrastructure — 236
 - 10.3 3GPP Security Architecture for 5G — 242
- 11 5G and Environment — 249**
 - 11.1 New Issues through 5G Technology — 249
 - 11.2 Electromagnetic Radiation and Health — 250
 - 11.3 Exposure and Limit Values — 255
 - 11.4 Influences of the Network Architecture — 257
 - 11.5 Energy Requirements, Raw Materials, and Sustainability — 259
- 12 Future Developments — 267**
 - 12.1 Further Development of 5G — 267
 - 12.2 Network 2030 — 271
 - 12.3 Research, Regulation, and Standardization on 6G — 278
 - 12.4 6G Use Cases and Usage Scenarios — 285
 - 12.5 6G Requirements — 292
 - 12.6 Technologies for 6G and Network Architectures — 296
- Abbreviations — 307**
- References — 323**
- Index — 335**