

1. Record Nr.	UNINA9910819007803321
Autore	Abdalla Abdelgader M
Titolo	Optical and wireless convergence for 5G networks // edited by Abdelgader M Abdalla, Jonathan Rodriguez, Issa Elfergani, Antonio Teixeira
Pubbl/distr/stampa	Hoboken, New Jersey, USA : , : John Wiley & Sons, Inc., , 2020 [Piscataway, New Jersey] : , : IEEE Xplore, , [2019]
ISBN	1-119-49160-6 1-119-49159-2 1-119-49161-4
Descrizione fisica	1 online resource (353 pages)
Collana	THEi Wiley ebooks.
Disciplina	621.38456
Soggetti	Mobile communication systems Optical communications - Technological innovations
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	<p>&lt;P&gt;About the Editors ii&lt;/p&gt;         &lt;p&gt;Contributors v&lt;/p&gt;         &lt;p&gt;Preface xxvii&lt;/p&gt;         &lt;p&gt;Acknowledgments i&lt;/p&gt;         &lt;p&gt;Introduction iii&lt;/p&gt;         &lt;p&gt;&lt;b&gt;1 Towards a Converged Optical-Wireless Fronthaul/Backhaul Solution for 5G Networks and Beyond 1&lt;br /&gt;&lt;/b&gt;&lt;i&gt;Isiaka Ajewale Alimi, Nelson Jesus Muga, Abdelgader M. Abdalla, Catia Pinho, Jonathan Rodriguez, Paulo Pereira Monteiro, Antonio Lucios Teixeira&lt;/i&gt;&lt;/p&gt;         &lt;p&gt;1.1 Introduction 2&lt;/p&gt;         &lt;p&gt;1.2 Cellular Network Interface and Solution 3&lt;/p&gt;         &lt;p&gt;1.2.1 MBH/MFH Architecture 3&lt;/p&gt;         &lt;p&gt;1.2.2 Integrated MBH/MFH Transport Network 5&lt;/p&gt;         &lt;p&gt;1.3 5G Enabling Technologies 5&lt;/p&gt;         &lt;p&gt;1.3.1 Ultra-Densication 6&lt;/p&gt;         &lt;p&gt;1.3.2 C-RAN and RAN Virtualization 6&lt;/p&gt;         &lt;p&gt;1.3.3 Advanced radio coordination 8&lt;/p&gt;         &lt;p&gt;1.3.4 Millimeter-Wave Small Cells 9&lt;/p&gt;         &lt;p&gt;1.3.5 Massive MIMO 10&lt;/p&gt;         &lt;p&gt;1.3.6 New Multicarrier Modulations for 5G 10&lt;/p&gt;         &lt;p&gt;1.4 Fiber-Wireless Network Convergence 11&lt;/p&gt;         &lt;p&gt;1.5 Radio-over-Fiber Transmission Scheme 12&lt;/p&gt;         &lt;p&gt;1.5.1 Digital Radio-over-Fiber (D-RoF) Transmission 12&lt;/p&gt;         &lt;p&gt;1.5.2 Analog Radio-over-Fiber (A-RoF) Transmission 13&lt;/p&gt;         &lt;p&gt;1.6 Optical MBH/MFH Transport Network Multiplexing</p>

Schemes 14

1.6.1 Wavelength-Division Multiplexing (WDM) based Schemes 14

1.6.2 Spatial-Division Multiplexing (SDM) based Schemes 15

1.7 Wireless based MFH/MBH 18

1.7.1 FSO Communication Systems 18

1.7.2 Hybrid RF/FSO Technology 21

1.7.3 Relay-Assisted FSO Transmission 22

1.8 Experimental Channel measurement and characterization 23

1.9 Results and Discussions 24

1.10 Conclusion 24

Acknowledgments 24

Bibliography 25

**2 Hybrid Fiber Wireless (HFW) Extension for GPON Toward 5G 31**

*Rattana Chuenchom, Andreas Ste-an, Robert G. Walker, Stephen J. Clements, Yigal Leiba, Andrzej Banach, Mateusz Lech, Andreas Stohr*

2.1 Passive Optical Network 32

2.1.1 GPON and EPON standard 33

2.2 Transparent Wireless Extension of Optical Links 34

2.2.1 Transparent wireless extension of optical links using CRoF 34

2.3 Key Enabling Photonic and Electronic Technologies 36

2.3.1 Coherent Photonic Mixer 36

2.3.2 Single side band Mach-Zehnder modulator 38

2.3.3 High power amplifier in E-band for GPON extension 40

2.3.4 Integrated radio access units 42

2.4 Field Trial for 2.5 Gbit/s GPON over Wireless 43

2.4.1 RX Throughput and packet loss 48

2.4.2 Latency 48

2.4.3 Jitter 49

2.5 Conclusions 49

Bibliography 50

**3 Software Defened Networking and Network Function Virtualisation for Converged Accessmetro Networks 53**

*Marco Rumi , Frank Slyne*

3.1 Introduction 53

3.2 The 5G requirements driving network convergence and virtualisation 54

3.3 Access and metro convergence 57

3.3.1 Long-Reach Passive Optical Network 58

3.2 New architectures in support of 5G networks, network virtualisation and mobile functional split 59

3.4 Functional convergence and virtualisation of the central offices 62

3.4.1 Infrastructure 63

3.4.2 Management and Control 66

3.4.3 Cross-Layer Components 70

3.5 Conclusions 70

Bibliography 70

**4 Multicore Fibres for 5G Fronthaul Evolution 77**

*Ivana Gasulla, Jose Capmany*

4.1 Why 5G communications demand for optical Space-Division Multiplexing 77

4.2 Multicore Fibre Transmission Review 79

4.2.1 Homogeneous MCFs 80

4.2.2 Heterogeneous MCFs 81

4.3 Radio Access Networks using Multicore Fibre Links 82

4.3.1 Basic MCF link between Central O-ce and Base Station 84

4.3.2 MCF-based Radio over Fibre C-RAN 85

4.3.3 MCF-based Digital Radio over Fibre C-RAN 87

4.4 Microwave signal processing enabled by multicore fibres 88

4.4.1 Signal Processing over a Heterogeneous MCF link 90

4.4.2 RF Signal Processing over a Homogeneous MCF Multicavity device 92

4.5 Final Remarks 94

Bibliography 95

**5 Enabling VLC and Wi-Fi Network Technologies and Architectures Towards 5G 99**

*Isiaka Ajewale Alimi, Abdelgader M. Abdalla, Jonathan Rodriguez, Paulo Pereira Monteiro, Antonio Lu -- s Teixeira, Stanislav Zv-anovec, Zabih Ghassemlooy*

5.1 Introduction 100

5.2 Optical Wireless Systems 102

5.3 Visible Light Communication (VLC) System Fundamentals 104

5.4 VLC Current and Anticipated Future Applications 107

5.4.1 Underwater Wireless Communications 109

5.4.2 Airlines and Aviation 109

5.4.3 Hospitals 110

5.4.4 Vehicular Communication Systems 110

5.4.5 Sensitive Areas 111

<p>5.4.6 Manufacturing and Industrial Applications 111</p> <p>5.4.7 Retail Stores 112</p> <p>5.4.8 Consumer Electronics 112</p> <p>5.4.9 Internet of Things 112</p> <p>5.4.10 Other Application Areas 113</p> <p>5.5 Hybrid VLC and RF Networks 113</p> <p>5.6 Challenges and Open-Ended Issues 114</p> <p>5.6.1 Flicker and Dimming 115</p> <p>5.6.2 Data Rate Improvement 115</p> <p>5.7 Conclusions 116</p> <p>Acknowledgments 116</p> <p>Bibliography 117</p> <p><b>6 5G RAN: Key Radio Technologies and Hardware Implementation Challenges 123<br /></b><i>Hassan Hamdoun, Mohamed Hamid, Shoaib Amin, Hind Dafallah</i></p> <p>6.1 Introduction 123</p> <p>6.2 5G NR-enabled Use Cases 124</p> <p>6.2.1 eMBB and uRLLC 125</p> <p>6.2.2 Migration to 5G 126</p> <p>6.3 5G RAN Radio-enabling Technologies 126</p> <p>6.3.1 Massive MIMO (M-MIMO) 127</p> <p>6.3.2 Carrier Aggregation and Licensed Assisted Access to unlicensed spectrum 130</p> <p>6.3.3 Dual Connectivity 131</p> <p>6.3.4 Device-to-Device (D2D) communication 132</p> <p>6.4 Hardware Impairments 132</p> <p>6.4.1 Hardware Impairments-Transmitters 133</p> <p>6.4.2 Hardware Impairments -- Receivers 135</p> <p>6.4.3 Hardware Impairments -- Transceivers 135</p> <p>6.5 Technology and Fabrication challenges 136</p> <p>6.6 Conclusion 137</p> <p>Bibliography 137</p> <p><b>7 Millimeter Wave Antenna Design for 5G Applications 143<br /></b><i>Issa Elfergani, Abubakar Sadiq Hussaini, Abdelgader Abdalla, Jonathan Rodriguez, Raed Abd-Alhameed</i></p> <p>7.1 Introduction 144</p> <p>7.2 Antenna Design and Procedure 146</p> <p>7.3 Antenna Optimisation and Analysis 147</p> <p>7.3.1 The influence of ground plane length (GL) 148</p> <p>7.3.2 The effect of feeding strip position (Fp) 148</p> <p>7.3.3 The influences of the substrate type 149</p> <p>7.4 MMwave Antenna Design with notched frequency band 150</p> <p>7.5 MMwave Antenna Design with Loaded Capacitor 153</p> <p>7.6 Conclusion 156</p> <p>Acknowledgement 156</p> <p>Bibliography 156</p> <p><b>8 Wireless Signal Encapsulation on Seamless Fiber{mmWave System 161<br /></b><i>Pham Tien Dat, Atsushi Kanno, Naokatsu Yamamoto, Testuya Kawanishi</i></p> <p>8.1 Introduction 161</p> <p>8.2 Principle of signal encapsulation 163</p> <p>8.2.1 Downlink system 163</p> <p>8.2.2 Uplink system 165</p> <p>8.3 Examples of signal encapsulation 166</p> <p>8.3.1 Downlink transmission 166</p> <p>8.3.2 Uplink transmission 170</p> <p>8.3.3 MmWave link distance 173</p> <p>8.3.4 Conclusion 175</p> <p>Bibliography 176</p> <p><b>9 5G Optical Sensing Technologies 179<br /></b><i>Seedahmed S. Mahmoud , Bernhard Koziol, Jusak Jusak</i></p> <p>9.1 Introduction 179</p> <p>9.2 Optical Fibre Communication Network: Intrusion Methods 182</p> <p>9.3 Physical Protection of Optical Fibre Communication Cables 183</p> <p>9.3.1 Location-Based Optical Fibre Sensors 185</p> <p>9.3.2 Point-Based Optical Fibre Sensors 187</p> <p>9.3.3 Zone-Based Optical Fibre Sensors 189</p> <p>9.4 Design Consideration and Performance Characteristics 190</p> <p>9.4.1 Performance Parameters 190</p> <p>9.4.2 The Needs for Robust Signal Processing Methods 191</p> <p>9.4.3 System Installation and Technology Suitability 192</p> <p>9.5 Conclusions 193</p> <p>Bibliography 193</p> <p><b>10 T

## Sommario/riassunto

A complete guide to optical-wireless from 5G and beyond The mobile market has experienced unprecedented growth over the last few decades. Consumer trends have shifted towards mobile internet services supported by 3G and 4G networks worldwide. Inherent to

existing networks are problems such as lack of spectrum, high energy consumption, and inter-cell interference. These limitations have led to the emergence of 5G technology. It is clear that any 5G system will integrate optical communications, which is already a mainstay of wide area networks. Using an optical core to route 5G data raises significant questions of how wireless and optical can coexist in synergy to provide smooth, end-to-end communication pathways. Optical and Wireless Convergence for 5G Networks explores new emerging technologies, concepts, and approaches for seamlessly integrating optical-wireless for 5G and beyond. Considering both fronthaul and backhaul perspectives, this timely book provides insights on managing an ecosystem of mixed and multiple access network communications focused on optical-wireless convergence. Topics include Fiber&#150;Wireless "FiWi", Hybrid Fiber-Wireless "HFW", Visible Light Communication "VLC", 5G optical sensing technologies, approaches to real-time IoT applications, Tactile Internet, Fog Computing "FC", Network Functions Virtualization "NFV", Software-De???ned Networking "SDN", and many others. This book aims to provide an inclusive survey of 5G optical-wireless requirements, architecture developments, and technological solutions; in particular, this book: . Offers new insights on the highly relevant topic of 5G optical-wireless convergence. Guides early-stage researchers by providing a solid platform on which to build future research. Helps mobile/optical stakeholders to construct new project proposals that meet challenges associated with 5G and beyond at the international level. Includes contributions from international experts at the forefront of 5G research representing industrial and academia stakeholders. Presents background information suitable for a range of optical and wireless courses Optical and Wireless Convergence for 5G Networks is an indispensable resource for fixed and mobile stakeholders, wireless industry professionals, graduate students and postdoctoral researchers, and those in related areas of telecommunications and electronic engineering.

---