

Preface

The proliferation of wireless communications stands out as one of the most significant phenomena in the history of technology. Wireless devices and technologies have become pervasive much more rapidly than anyone could have imagined and they will continue to be a key element of modern society for the foreseeable future. Today, the term “wireless” is used almost synonymously with radio frequency (RF) technologies as a result of the wide-scale deployment and utilization of wireless RF devices and systems. With the ever-growing popularity of data-heavy wireless communications, the demand for RF spectrum is outstripping supply and the time has come to seriously consider other viable options for wireless communication using the upper parts of the electromagnetic spectrum for applications where access to huge bandwidth is a requirement.

Utilization of the optical band of the electromagnetic spectrum for wireless transmission opens doors of opportunity in areas as yet largely unexplored. Optical frequencies range from 300 GHz to 300 petahertz (PHz) and include infrared, visible and ultraviolet bands—a spectral range that dwarfs the 300 GHz that the RF band represents. Optical wireless communication (OWC) systems offer significant technical and operational advantages such as higher bandwidth capacity, robustness to electromagnetic interference, inherent security, low power requirements and unregulated spectrum. Variations of OWC can be employed in a diverse range of communication applications from very short-range (in the order of millimeters) optical interconnects within integrated circuits through outdoor inter-building links (on the order of kilometers) to satellite communications (larger than 10,000 kms).

With its significant advantages and wide range of application areas, OWC is one of the most promising current opportunities for high-impact research in the information and communication technology area. However, in many respects, OWC technology is still in its infancy and calls for consolidated research efforts to harness the enormous potential of the optical spectrum for communication applications. With the aim to build a European scientific network on OWC, the COST IC1101 Action “Optical Wireless Communication—An Emerging Technology (OPTICWISE)” was launched in November 2011 for 4 years. COST (European

Cooperation in Science and Technology) is one of the longest running European frameworks supporting cooperation among scientists and researchers across Europe. OPTICWISE has been the very first COST Action dedicated solely to this emerging field with enormous potential and brought together more than 150 researchers from European academic and research institutions, government bodies and companies involved in two major OWC sub-fields, namely free space optical communication (FSO) and visible light communication (VLC).

OPTICWISE has played a key role in synergizing the interdisciplinary scientific expertise of European researchers in various scientific disciplines including the electromagnetic propagation theory, atmospheric physics, information/communication theory, networking, communication systems, photonic components, devices and systems. Through integrated research capability made possible by the OPTICWISE, Action participants have explored and developed novel methods, models, techniques, strategies, and tools in infrared, visible, and ultraviolet spectral bands. This resulted in a large number of joint publications. Such contributions have led to a much better understanding of OWC which was treated as a niche technology in the past. In addition to theoretical contributions, several Action participants have contributed to the design and building of proof-of-concept VLC and FSO systems demonstrating the promise of OWC systems for achieving low-cost, ultra-high bandwidth, and reliable future generation heterogeneous communication networks.

To document on the one hand the multidisciplinary research carried out within COST IC1101 and on the other hand to encourage newcomers to this emerging field, this book introduces researchers, practitioners, graduate, and postgraduate students to the diverse research on OWC in a comprehensive manner. The book starts with an introductory chapter, which provides an overview of OWC field highlighting different sub-fields and major application areas. The rest of the book is categorized into four main parts. The first part (Chaps. 2–8) consists of chapters which deal with the propagation modeling and channel characterization of OWC channels at different spectral bands/applications. The second part (Chaps. 9–19) starts with a chapter that provides a unified information-theoretic treatment of OWC and then continues with the chapters on advanced physical layer methodologies to approach these ultimate limits under practical constraints. On the top of physical layer is the upper-layer protocols and cross-layer designs, which are dealt in the third part of the book (Chaps. 20–24). The last part of the book (Chaps. 25–28) features chapters each of which focuses on different OWC applications.

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Istanbul, Turkey

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COST (European Cooperation in Science and Technology) is a pan-European intergovernmental framework. Its mission is to enable break-through scientific and technological developments leading to new concepts and products and thereby contribute to strengthening Europe's research and innovation capacities. It allows researchers, engineers and scholars to jointly develop their own ideas and take new initiatives across all fields of science and technology, while promoting multi- and interdisciplinary approaches. COST aims at fostering a better integration of less research intensive countries to the knowledge hubs of the European Research Area. The COST Association, an International not-for-profit Association under Belgian Law, integrates all management, governing and administrative functions necessary for the operation of the framework. The COST Association has currently 36 Member Countries (www.cost.eu).



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