Wireless Powered Communication Networks: From Security Challenges to IoT Applications

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This textbook introduces Wireless Powered Communication Networks (WPCNs) as a promising paradigm to overcome the energy bottleneck suffered by traditional wireless communication networks, as well as emerging Internet-of-Things networks. It selectively spans a coherent spectrum of fundamental aspects in WPCNs, such as wireless energy transfer (WEH) techniques, radio frequency (RF) energy harvesting receiver model, simultaneous wireless information and power transfer (SWIPT), as well as the rate-energy tradeoff arising from the joint transmission of information and energy using the same waveform. It covers network models for WPCNs, including the baseline and dual-hop WPCN models and a variety of related extensions. This book further examines the key factors including throughput, fairness, and security that must be taken into account for impeccable operation of WPCNs. The new IoT applications are targeted as a key element in those factors. It will also include exercises and examples throughout the book, as well as their PLS solutions.

This is the first textbook examining the current research to provide a unified view of wireless power transfer (WPT) and information transmission in WPCNs from a physical layer security (PLS) perspective. Focused on designing efficient secure transmission schemes, analyzing energy evolvement process, and evaluating secrecy outage performance under different channel state information (CSI), the results presented in this book shed light on how to best balance security and throughput with prudent use of harvested energy in WCNs. It also provides an overview of the WPCNs by introducing the background of WPT, followed by a summary of the research conducted in the field. The authors describe the physical-layer security (PLS) problem in WPCNs, including the causes and the impacts of the problem on the performance of WPCNs. The authors extend the discussions by introducing the applications of WPCNs in the IoT.

From the Internet of Things (IoT) point of view, this textbook reviews the opportunities and challenges for the lately-emerged WPCN to seamlessly integrate into the IoT ecosystem. It specifically addresses the maximization problem of uplink and downlink sum-throughout in a dual-hop WPCN, while taking fairness among WPCN users as a constraint. The results provided in this book reveal valuable insights into improving the design and deployment of future WPCNs in the upcoming IoT environment.

This textbook targets advanced-level students studying wireless communications and research engineers working in this field. Industry engineers in mobile device and network development business with an interest in WPCNs and IoT, as well as their PLS solutions, will also find this book useful.