Preface

Stringent cost and energy constraints in low-power wireless networks (such as wireless sensor networks) impose the use of low-cost radio transceivers that transmit low-power signals (typically, 0 dBm as maximum power). This fact limits the radio channel, making it more vulnerable to noise, interference, and multipath distortion.

Moreover, these radio transceivers typically rely on inexpensive and size constrained antennas. Often, infeasibility of prime antenna positioning further compromises its performance. This applies to both, antenna positioning in certain WSN node designs as well as node placement in deployments, leading to anisotropic connectivity.

Consequently, low-power radio links are extremely unreliable and often unpredictable. They experience quality fluctuation over time and space, and show asymmetric connectivity. The unreliability of links greatly affects the network performance. This raised the need for link quality estimation as a fundamental building block for network protocols and mechanisms (e.g., medium-access control (MAC), routing, mobility management, and topology control), in order to mitigate link unreliability.

Link quality estimation in low-power wireless networks is a challenging research problem due to the lossy and dynamic nature of the links. This book aims at providing a good understanding of several aspects of link quality estimations, which covers the design, evaluation, experimentation, and impact on higher layer protocols.

Organization of the Book

This book is organized into five chapters. Chapter 1 outlines the characteristics of low-power links. A vast array of research efforts tackled the empirical characterization of low-power links through real-world measurements with different platforms, under varying experimental conditions, assumptions, and scenarios. This first chapter provides a comprehensive survey of the most relevant key observations drawn from empirical studies on low-power links. Chapter 2 addresses the most important factors that affect low-power links, which is interference. This chapter discusses several aspects related to interference problems in low-power wireless networks, namely experimentation, measurement, modeling, and mitigation of external radio interference. Chapter 3 gives an overview of link quality estimation in low-power wireless networks. It starts by presenting the fundamental concepts related to link quality estimation. For example, it defines the link quality estimation process and decomposes it into different steps. It also provides important requirements for the design of efficient link quality estimators (LQEs). Then, a taxonomy of existing LQEs is given. Chapter 4 provides an extensive comparative performance study of most well-known LQEs, based on both simulation and real experimentation. The evaluation methodology consists in analysing the statistical properties of LQEs, independently of any external factor, such as collisions and routing. These statistical properties impact the performance of LQEs, in terms of reliability and stability. Chapter 5 investigates the impact of using reliable and efficient LQEs for improving higher layer protocols and mechanisms, namely routing and mobility management.

This book is the result of several years of research work of the authors on the link quality estimation and low-power radio links. To the best of our knowledge, this is the first book tackling link quality estimation in low-power wireless networks (such as wireless sensor/actuator networks). Thus, we hope it will serve as baseline reading material for students and as a reference text to orient researchers and system designers.

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