Chapter 1

Introductory Chapter: Network Coding

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1. Introduction

Network coding is a novel approach that allows nodes in the network to perform coding operation at the packet level. In particular, network coding represents a powerful approach to protect data from losses due to link disconnections and can also allow exploiting the combination of multiple links to deliver data to users with the possibility of recoding at intermediate nodes. This phenomenon will reduce the information congestion at some nodes or links which will improve the network information flow such as to increase network throughput and robustness.

2. Outline of research contributions

This book attempts to present cutting-edge research in the field of network coding.

In "*Digital All-Optical Physical-layer Network Coding,*" the authors present the concept of digital All-Optical Physical-layer Network Coding (AOPNC) for mm-wave fiber-wireless signals modulated with up to 2.5 Gb/s OOK data, focusing on digital encoding schemes that are based on optical XOR logical gates. The encoding operation is performed on-the-fly at the Central Office (CO), and the resulting packet is broadcasted at the end users, where the electrical decoding takes place. The AOPNC scheme in principle can be applied also in RoF networks employing other phase modulation formats, such as DPSK-SCM and dual polarization (DP)–DQPSK-SCM modulation techniques.

In "*Network Coding for Distributed Antenna Systems,*" the authors explore virtual MIMO-assisted distributed antenna system (DAS) and network coding (NC) to improve the performance of networks. An analysis is presented to provide design insights that could help in identifying the network parameters to achieve the desired QoS. The results highlight the advantages of employing NC in VMIMO-assisted DAS.

In "*Bringing the cloud to the fog for Industry 4.0*," the authors focus on the benefits and open challenges of the Industrial IoT (IIoT) architecture together with the implementation of network coding techniques. The IIoT architectures require low-latency communications as well as guaranteed reliability to allow the performance of on-premise advanced cloud analytics for time-critical IIoT applications, i.e., bringing the cloud to the fog. This chapter also describes the communication process across the different levels of the architecture based on network coding.

In "*Efficient Frontier and Benchmarking for Energy Multicast in Wireless Network Coding*," a network coding algorithm is studied, and its performance is investigated for the data envelopment analysis (DEA). The DEA methodology is necessary because coded packet is not fully efficient technique for energy efficiency. The DEA framework allows network administrators to evaluate the technical efficiency rather than averages and standard deviation and determine how the inefficient wireless networks will attain a targeted efficiency frontier. The presented system model is based on frontier analysis that is consisting of several models including envelopment and benchmarking. These models are considered for evaluating the technical efficiency of multicast energy and performing the benchmark in wireless networks nodes without sacrificing the overall network performance. The author's aim is to achieve economic efficiency by ensuring that wireless networks are multicast at the targeted energy rather than average energy.

3. Conclusion

Recently, the field of network coding (NC) has attracted intense research focus for its potential in providing enhanced network throughput and reduced network congestions. However, it is challenging to incorporate network coding, into the existing network architecture. This book provides few current research efforts which are supplemented with extensive references to enable researchers for further investigation of network coding applied to communications in wireless and wired networks.

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