

Handbook of Peer-to-Peer Networking

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Editors

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 Springer

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For our parents.
-Xuemin Shen, Heather Yu,
John F. Buford and Mursalin Akon

Preface

Peer-to-peer networking is a disruptive technology for large scale distributed applications that has recently gained wide interest due to the successes of peer-to-peer (P2P) content sharing, media streaming, and telephony applications. There are a large range of other applications under development or being proposed. The underlying architectures share features such as decentralization, sharing of end system resources, autonomy, virtualization, and self-organization. These features constitute the P2P paradigm. This handbook broadly addresses a large cross-section of current research and state-of-the-art reports on the nature of this paradigm from a large number of experts in the field.

Several trends in information and network technology such as increased performance and deployment of broadband networking, wireless networking, and mobile devices are synergistic with and reinforcing the capabilities of the P2P paradigm. There is general expectation in the technical community that P2P networking will continue to be an important tool for networked applications and impact the evolution of the Internet. A large amount of research activity has resulted in a relatively short time, and a growing community of researchers has developed.

The *Handbook of Peer-to-Peer Networking* is dedicated to discussions on P2P networks and their applications. This is a comprehensive book on P2P computing. It addresses all issues currently developed as well as under development including P2P architectures, search and queries, incentive mechanisms, multimedia streaming, service oriented architectures, collaboration to share non-storage resources, mobile P2P, theory and analysis, and P2P databases. In addition, it covers rather practical perspectives such as traffic characteristics and trends of P2P applications, the E-business model in P2P applications, and software characteristics. Finally, the book contains chapters on emerging P2P concepts and applications.

The goal of this handbook is to provide an exhaustive view of the state-of-the-art of the P2P networking field. In organizing the book, the following objectives were followed:

- Provide an overview of the fundamentals of P2P networks
- Describe the current practice in P2P applications and industries

- Comprehensively cover the areas of interest
- Give the most recent perspective from the P2P research community

This book is written for researchers, professionals, and computer science and engineering students at the advanced undergraduate level and higher who are familiar with networking and network protocol concepts and basic ideas about algorithms. For the more advanced parts of the book, the reader should have general familiarity with Internet protocols such as TCP and IP routing. For some sections of the book such as discussions of mobility or multicasting, familiarity with mobility in IP and IP multicasting will be helpful but is not required.

The *Handbook of Peer-to-Peer Networking* is intended to provide readers with a comprehensive reference for the most current developments in the field. It offers broad coverage P2P networking with fifty chapters written by international experts. In addition, we hope the book becomes an important reference to those who are active in the field. The fifty chapters of the *Handbook of Peer-to-Peer Networking* are organized into the following sections:

- **An Introduction to Peer-to-Peer Networking** – This section contains background chapters accessible to the general reader, and covers the basic models, applications, and usage.
- **Unstructured P2P Overlay Architectures** – The majority of deployed P2P applications use unstructured overlays. These chapters cover the organizational principles and discuss a variety of examples, including overlays using social and semantic relationships.
- **Structured P2P Overlay Architectures** – Structured overlays have been a widely studied alternative approach, with over fifty different designs having been proposed. These chapters describe some of the leading models and their algorithms, as well as dynamics, bootstrapping, formalization, and stabilization.
- **Search and Query Processing** – Search is perhaps the most fundamental service in an overlay. A wide range of techniques are discussed, from basic keyword search to semantic search, and database query processing and indexing mechanisms applied to the P2P architecture.
- **Incentive Mechanisms** – In practice, peers are not altruistic, so techniques to ensure fair and mutual resource sharing have been proposed. An important category is incentive mechanisms which allows peers to participate proportional to their resource contribution to other peers.
- **Trust, Anonymity, and Privacy** – In most P2P overlays, peers are in autonomous security domains, and have no a priori basis for safe cooperation. Peer reputation management is an important category of enabling trust, and is discussed here in three chapters. In addition, work on anonymity in P2P networks and private P2P networks are presented in two chapters.
- **Broadcast and Multicast Services** – Multicast services are some of the earliest use of overlays and are often described as application layer or end system multicast to distinguish them from network layer multicast. This section has a rich coverage of work in both multicast and broadcast mechanisms, include gossip-based approaches and hybrid designs.

- **Multimedia Content Delivery** – The inherent scalability of the P2P paradigm makes it an attractive choice for large scale media streaming. The first chapter in this section examines key business models for P2P content delivery. The remaining chapters address recent work in IPTV and Video-on-Demand in P2P networks.
- **Mobile P2P** – When peers roam or are operating in ad hoc networks, the efficiency and stability of the overlay is effected. The growing importance of mobile and ad hoc networking for many applications has attracted research on the use of P2P overlays in MANETs, which is discussed in three chapters in this section.
- **Fault Tolerance in P2P Networks** – Uneven workloads and instability due to churn are some of the practical issues in operating large-scale P2P systems. Various load balancing techniques have been studied for adapting to uneven workloads, and are surveyed in one chapter in this section. Stabilization of the overlay and automatically correcting network partitions are topics of two other chapters.
- **Measurement and P2P Traffic Characteristics** – Another topic of great practical interest is the network traffic of P2P applications, which has become the dominant flow on the Internet. This issue affects both network operators, as discussed in one chapter, and the design of the overlay, as described in three other chapters.
- **Advanced P2P Computing and Networking** – Four special topics represent areas of P2P research that will gain more attention in future years are discussed in this section: formal models of P2P software, the use of web services in the P2P architecture; support for publish-subscribe and event-driven processing; and enabling collaborative applications in a P2P overlay.

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