

Contents

Part I Peer-to-Peer Computing

Chapter 1 A New Computing Model for the Internet 3

- What is Peer-to-Peer Computing?—First Take 4
- In One Word: Interoperability 7
- The Popular View of Peer-to-Peer 8
- Why and Why Now? 11
- What is Peer-to-Peer Computing 13
- P2P Computing vs. P2P Network and P2P Communications 19
- What P2P Computing Can Do for You 20
- The Peer-to-Peer Challenge 22

Chapter 2 Envision the Future 25

- A Day in the Life of a Peer 25
- The User's Perspective 32
- The Implications for IT 35
- The Potential for the Application Developer 37

Chapter 3 Precursors—A Historical Perspective 39

- Direct Exchanges—The Beginning 40
- Distributed Processing 41
- Early Collaborative Applications 46

Part II Laying the Foundations

Chapter 4 Architecture and Infrastructure 51

- Nomenclature and Concepts 52

Architecture, Infrastructure, and Middleware	53
The Net Infrastructure	57
Objectives, Attributes, and Requirements of the Middleware	60
Middleware Services	66
Design Approaches	71
Endeavors Technologies, Inc.	72
Applied Meta, Inc., now AVAKI Corporation	73
Proksim Software	73
Foundation for Intelligent Physical Agents (FIPA)	74
Groove Networks, Inc.	74
Grid Computing	75

Chapter 5 An Overview of Reference Architectures 77

Infrastructure for Distributed Computing	80
Entropy: Internet-based Distributing Computing	81
United Devices: Creating the MetaProcessor Platform for Tapping into Unused Resources	84
Environments for Content Sharing	86
OpenCola: Delivery of Relevant Content	88
Mangosoft: Clustering and Technologies for Distributed File Systems	92
NextPage: Unifying Content without Centralizing	97
The Escher Group: Data Management and Distributed Messaging	100
Frameworks for Collaborations	105
Groove Networks: Internet-Based Collaboration	105
Endeavors: Inclusive Peer-to-Peer Collaboration with Magi	109
Engenia: Information Sharing and Interactivity	112
Towards a General-Purpose P2P Infrastructure	116
AVAKI: Integrated Architecture for Secure Resource Sharing	116
Grid Computing for Large-Scale Resource Sharing	119
Summary of Approaches and Objectives	123

Chapter 6 First, Peers Need to Communicate	127
About Addresses, Names, and Protocols	128
What is TCP/IP?	129
Addresses on the Net	131
Associating Names with Addresses	133
The Tree of Protocols and Other Standards	135
Dealing with Firewalls and NATs	139
NATs and How They Work	140
Firewalls	144
Addressing NAT and Firewall Traversal	145
NATs and Firewalls—Where Do We Go From Here?	149
Current Practices	151
The Interplay of Protocol Use	151
Employing Higher Level Protocols	152
Proprietary Protocols	153
Managing on the Net	155
Concluding Observations	158
Chapter 7 Next, Name and Find Everyone and Everything	159
The Name Space Issue	159
Group Identities	162
Examples of P2P Naming Schemes	163
Useful Technologies	168
Metadata for P2P Services	168
Intelligent Agents in P2P Computing	169
Finding Out About Things: Search, Discovery, and Directories	171
Protocols	173
Discovery and Search Practices	175
In Closing	179
Chapter 8 Then, Peers Wish to Stay Connected	181
Intermittent Presence	182
Fault-tolerance	183
Content Coherency and Synchronization	184
Availability of Resources	186
Availability of Content	187
Intermediation—With Fault-tolerance and Performance	188
System Management	189
Lessons, Observations	190
Chapter 9 Security—The Big Concern	193
Why Security is Such a Big Deal for P2P	194
Authentication: Know Who You're Talking to	196
Authorization: You Control What is Allowed on Your System	198
Data Integrity: No one Modified Your Transmissions	201

Security Models and Practices	203
Security for an Object-based Infrastructure	203
Security in Shared Spaces	208
Grid Security Infrastructure	211
Securing Distributed Internet Computing	214
Applying Security Basics in P2P Networks	215
The Peer-to-Peer Trusted Library	218
Concluding Remarks	221

Chapter 10 Cooperative Management of Shared Resources 223

Managing Distributed Resources	224
Computational Resources	229
Shared Storage	231
Network Bandwidth	233
Control of Resource Usage	235

Part III Successes and Challenges

Chapter 11 Applying Peer-to-Peer Technologies 239

Interactive Collaborations	240
Collaboration and Communities	240
P2P and Online Development Projects	242
Online Gaming Communities	243
Computing Communities	244
Join Forces for Virus Protection	245
Relevant Content through P2P	246
Network-Wide File Sharing	247
P2P and Knowledge Management	247
Distribution of Content the P2P Way	248
Usages of Edge Services	249
Applying P2P to Search and Discovery	251

Distributed Computing	252
Distributed Computing on the Internet	252
Distributed Computing on the Intranet	255
Grid Computing	256
Web Testing	259
Concluding Remarks	261

Chapter 12 Challenges and Outlook 263

Technical Challenges	263
Connectivity	264
Security and Privacy	264
Fault-tolerance and Availability	265
Scalability	267
Self-managed Systems	268
Interoperability—Standards, Protocols	269
Social and Mindset Challenges	272
Looking Ahead	279
Industry Initiatives and Research	279
Outlook	281

References 283

Glossary 289

Index 313