

TATA McGRAW-HILL
EDITION

NETWORK
PROFESSIONAL'S
LIBRARY



Building High-Speed Networks

- Speed up your network with ATM, DSL, Gigabit Ethernet, and other high-speed technologies
- Integrate voice and multimedia over IP networks and implement high-speed data storage with Fibre Channel
- Get insightful business case perspectives, cost/benefit analyses, and details on reliability

TERE' PARNELL

*SEE AND FORMER EXECUTIVE TECHNOLOGY
EDITOR FOR LAN TIMES

CONTENTS



Acknowledgments	xvii
Introduction	xix

Part I

Identifying the Bottlenecks

▼ 1 Do You Really Need a High-Speed Network?	3
Read This First	4
Ask Yourself Why	4
It May Be Bandwidth	5
And Then Again, It May Not Be Bandwidth	6
Server-Related Performance Problems	6
Processor Speed	6
Disk Subsystem	6
Random Access Memory	7
Network-Related Performance Problems	7
Network Interface Card Selection	7
Chattering Cards	8
Poor Network Interface Card Driver Support	8

Workstation-Related Performance Problems	
How to Determine that High-Speed Networking Will Help	8
Step One: Evaluate Your Server Usage	9
Step Two: Evaluate Your Server Configuration	9
Step Three: Evaluate Workstations.	10
Step Four: Evaluate Current Application Requirements	11
Step Five: Evaluate Future Application Requirements	12
Step Six: Evaluate Network Usage.	15
Step Seven: Read On.	15
▼ 2 The Backbone Is Connected to the...	16
How It All Began	17
Types of Backbones	18
Why Build a Backbone?	20
How Do You Build a Backbone?	22
Effects of Excessive Internetwork Traffic	24
Causes and Cures for a Clogged Backbone	26
The Final Analysis	26
What You Gain.	28
Selecting a High-Speed Backbone Protocol	29
▼ 3 Down on the Farm	31
Do Servers Grow on Farms?	32
Enterprise-Wide Access to Information	33
Distribute Processing Load Across Specialized Platforms	35
Implementations of Distributed Computing Systems	36
Distributed Application Processing	36
Distributed Databases	37
Data Warehousing	37
Building Blocks of Distributed Computing Systems	38
Relational Databases.	38
Structured Query Language	38
Middleware.	39
Data Propagation.	42
Network Requirements of a Server Farm	43
Indications of Bandwidth Drought on the Farm	44
Other Causes and Cures for Slow Performance on the Server Farm	44
Location of Data and Applications.	45
Inadequate Hardware	45
Buying the Farm	45

▼ 4 Closer to Home	47
Component Technologies	48
Electronic Mail and Messaging	48
An Electronic Mail System	49
Electronic Messaging Systems	49
Electronic Messaging System Standards and Tools	50
Electronic Mail and Messaging on the Internet	53
Client/Server Applications	54
Client/Server Architecture	54
How to Build a Client/Server Application to Minimize Traffic	54
Effects of Client/Server Computing on Network Traffic	56
Multimedia	56
Workflow Software	57
Groupware	58
Groupware in Action	58
Groupware Tools	59
Standard Generalized Markup Language (SGML)	59
Group Therapy	60
Location of Applications	60
Inadequate Hardware	61
“Chatty” Communication Protocols	61
Small Packet Size	62
Group Encounters	62
Group Things	62
▼ 5 The Wide Area	65
The Wide Area Defined	67
Dedicated Versus Switched Lines	67
Public Networks	70
Private Networks	71
A Word About Routers and Routing	72
Analog Lines	72
Digital Lines	73
Carrier Services	73
Symptoms of a Bandwidth Shortage Over the Wide Area	75
Is Your Hardware Adequate?	76
Can Applications Be Moved to the LAN?	76
Are Traffic Patterns Localized?	76
Can Your Servers Handle Larger Packet Sizes?	76
Are Your Communication Protocols Too “Chatty”?	76

Tests to Confirm Insufficient WAN Bandwidth	77
Requirements for Wide Area Protocols	78
Performance	78
Manageability	78
Packet Size and Overhead	78
Cost	78
▼ 6 The Cost of Converting to High Speed.	79
To Speed or Not to Speed	81
Hardware Worksheet	82
Servers	83
Hubs	83
Routers	83
Switches	84
Workstations	84
And a Smooth Road	84
Service Cost Worksheet	84
Staffing and Staff Development Worksheet	84
Time Estimate Worksheet	85
Applications Worksheet	85
Live Fast, Die Young	86
If You Still Find It's Worth It	86
Hardware Worksheet	86
Service Cost Worksheet	87
Staff Development Worksheet	89
Staffing Worksheet	90
Time Estimate Worksheet	91
Application Worksheet	92
WAN Services Worksheet	94
	95

Part II**Local Area Solutions**

▼ 7 Fiber Distributed Data Interface (FDDI)	99
What Makes It the Same—and What Makes It Different	100
Framing the Data	101
Determining the Path	102
Cabling Considerations	104
Cost of Ownership	107
Scalability	108

Setup and Configuration	109
Manageability	109
Performance	110
Evolving to Survive	110
Summary	110
▼ 8 100VG-AnyLAN	113
So Close, But So Far from 10Base-T	113
Getting Framed.	114
The Architecture	114
Cable Design Considerations	115
Preparing for 100VG-AnyLAN	117
Scalability	119
Manageability	120
Performance	121
Continuous Improvement.	122
Summary	122
▼ 9 100Base-T	125
A Smorgasbord of Specs.	126
Understanding the Differences Between 100Base-T and 10Base-T	126
Interoperability and Obstacles	130
Scalability Considerations.	131
Manageability Issues	133
Setup and Configuration Considerations	133
Summary	134
▼ 10 Gigabit Ethernet	137
Enter Gigabit Ethernet	139
The 802.3 Standard	139
1000Base-SX.	140
1000Base-LX	140
1000Base-CX	140
1000Base-T	140
How Gigabit Ethernet Differs from 100Base-T	140
Scalability Considerations.	142
Gigabit Ethernet and Full-Duplex Support	142
Cabling Considerations	142
Management	142
Cost	143
Performance.	143
Support for Voice and Video	143

Resource Reservation Protocol (RSVP)	144
Virtual LANs (vLANs)	145
Video Compression	148
Summary	150
▼ 11 Fibre Channel	151
Going Through Channels	151
The Standard and Its Supporting Groups	152
How Do They Do That?	154
Fibre Channel Layer 0 (FC-0): The Physical Interface	154
Fibre Channel Layer 1 (FC-1): The Transmission Protocol	155
Fibre Channel Layer 2 (FC-2): Signaling Protocol	156
Fibre Channel Layer 3 (FC-3): Common Services	158
Fibre Channel Layer 4 (FC-4): Upper Layer	
Protocol Mapping	160
Cabling Considerations	161
Brave New Topology	161
Installation and Configuration	162
Interoperability	163
Scalability	163
Manageability and Fault Tolerance	164
Performance	164
Advantages: Fibre Channel vs. ATM	164
Disadvantages	165
▼ 12 isoEthernet	167
The Second Coming of Ethernet	168
The IEEE 802.9a (isoEthernet) Standard	168
In the Beginning, There Was Ethernet	168
Enter isoEthernet	169
Two Networks in One	169
Time Division Multiplexing	173
Clockers	173
The Benefits of isoEthernet	174
isoEthernet and Wide Area Support	174
isoEthernet and Videoconferencing	174
Manageability	174
Scalability	175
Cost	175
Security and Fault Tolerance	175
Performance	175
Ease of Installation/Maintenance	175

Disadvantages of isoEthernet	176
Future Trends	177

Part III**How to Speed Up: Wide Area Solutions**

▼ 13 Integrated Services Digital Network	183
The Primordial Mire	184
Anatomy of the ISDN Species.	185
Channel Types	185
It's All in the Packaging	186
Basic Rate Interface ISDN	186
Primary Rate Interface ISDN	187
ISDN's Function in the Wide Area Food Chain.	187
Great Moments in Evolution: SPID-ing in the Ocean	189
The Goal of Evolution: What These Services Can Provide.	190
Bearer Services	190
Supplementary Services.	192
Teleservices.	193
Making ISDN Happen.	193
The Local Exchange Carrier's Part	193
The Home Front	195
Configuration and Installation	197
Cabling Considerations	201
Performance	202
Management and Fault Tolerance	202
Scalability	202
Availability and Pricing	202
The Future: Broadband ISDN	203
Advantages	203
Disadvantages	204
▼ 14 Switched Multimegabit Data Service.	205
What Is . . . ?	206
Cell-Based?	206
Switched?	208
Connectionless?	208
The Architecture	208
Standards Compliance	208
Where . . . ?	210

How . . .?	210
Access Method	210
Why . . .?	211
Installation and Configuration	211
Manageability	211
Scalability	211
Interoperability	212
Performance	213
Cost	213
Disadvantages	213
Limited Multimedia Support	214
Limited Usage	214
Limited Vendor Support	214
The Future.	214
▼ 15 Frame Relay	217
Son of ISDN	218
What It Is	218
How It Works.	219
Frame Relay vs. Packet Switching	219
Frame Format.	222
Frame Relay Network Devices	222
Frame Relay Connections.	223
Switched Virtual	223
Getting What You Pay for.	224
Management and How Little There Is of It	225
Statistical Multiplexing and Bandwidth on Demand	225
Installation and Configuration	227
Availability and Pricing	228
Management and Fault Tolerance	228
Interoperability.	229
Performance	230
Scalability	230
Can Your Vendor Do This?	230
The Experience Question	231
The Interoperability Question	231
The Performance Question	231
The Management Questions	231
The Good News	232
The Bad News	234
Voice and Frame Relay	234
Frame Relay Forum	234

▼ 16 Asynchronous Transfer Mode	235
How It Started	236
Who Started It	237
ATM: The Short Answer	237
If ATM is the Answer, What Were the Questions?	238
What Is a Cell?	238
What Is Switched?	239
What Is Connection-Oriented?	240
What Is Full Duplex?	240
What Is Point-to-Point?	240
What Is Dedicated Bandwidth?	241
How It All Works Together	242
Route Determination	242
Data Forwarding	243
ATM Switches	243
Cabling Considerations	244
Setup and Configuration	244
Scalability	245
Manageability	247
Performance	249
Fault Tolerance	250
Security	250
Cost of Ownership	251
The ATM and the OSI Models	251
The ATM Layer	251
The ATM Adaptation Layer (AAL)	252
ATM Migration Issues	253
LAN Emulation	253
Routing Issues	259
Expect to Phase It In	261
Desktop Migration Issues	262
Application Support	263
WAN Integration Issues	264
Other Issues to Consider	266
Availability of ATM Carrier Services	266
The Promised LAN	268
▼ 17 Digital Subscriber Line Services and Cable Modems	269
Digital Subscriber Line (DSL)	270
DSL Equipment	271
DSL Service Offerings	271
Asymmetric Digital Subscriber Line (ADSL)	271

High-Bit-Rate Digital Subscriber Line (HDSL)	273
Very High-Bit-Rate Digital Subscriber Line (VDSL)	274
Symmetric Digital Subscriber Line (SDSL)	274
Rate-Adaptive Digital Subscriber Line (RADSL)	274
Cable Modems	275
DSL vs. Cable Modems	275
	276
Part IV	
Network Construction Ahead	
▼ 18 How to Build Fast and Secure Intranets and Extranets	279
Intranets Demystified	280
Making New Rules.	280
Intranets: Enabling Technologies	281
Hypertext Markup Language (HTML)	281
Hypertext Transfer Protocol (HTTP)	284
Component Technology.	286
Push	288
Extranets.	290
Standard Data Exchange Formats	291
Security	291
And More Security	303
The Evolution of Computer Authentication	303
Public Key Cryptography and Authentication	308
Certificate Authorities	310
Public and Private Keys	316
Advanced Authentication Tools	320
Encryption	322
▼ 19 Management Systems for High-Speed Networks	341
Traffic Management	342
Packet Generators	342
Network Analyzers	343
Application Testers	343
Application Management	343
Device Management	344
Simple Network Management Protocol (SNMP)	345
Web-Based Network Management.	349
Java Management API.	350
Management Platforms	351
IETF Network Management Developments.	352

▼ 20 Speed Kills: Avoiding a Crash	353
First: Try Before You Buy	354
Second: Identify the Next Bottleneck	354
Third: Make a Schedule	355
Fourth: Get Your Budget Approved	355
It's a Wonderful Life	358
Doomsayer	358
Considering the Alternative	359
The Price Is Right	359
Benefit Analysis	360
Show Time	360
You Can't Always Get What You Want	360
Fifth: Set Expectations	361
Surviving Speed	362

Part V**Appendixes**

▼ A Open Systems	365
Specifying Open Systems	366
Move to Interoperability	367
Open Systems Interconnection (OSI) Model	368
▼ B The Standards Organizations	375
American National Standards Institute (ANSI)	376
International Consultative Committee for Telegraph and Telephone (CCITT)	376
Institute of Electrical and Electronic Engineers (IEEE)	376
International Standards Organization (ISO)	377
▼ C Bibliography	379
Index	381