

Mike Meyers'

CompTIA Network+® Guide to Managing and Troubleshooting Networks

Second Edition

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To the ITC production team: Thank you for producing a marvelous book that I'm proud to call my own.

■ *This book is dedicated to Ms. K and Rat Dog.*

About This Book

■ Important Technology Skills

Information technology (IT) offers many career paths, leading to occupations in such fields as PC repair, network administration, telecommunications, Web development, graphic design, and desktop support. To become competent in any IT field, however, you

need certain basic computer skills. Mike Meyers' Network+ Guide to Managing and Troubleshooting Networks builds a foundation for success in the IT field by introducing you to fundamental technology concepts and giving you essential computer skills.

Cross-Check
questions develop reasoning skills: ask, compare, contrast, and explain.

Key Terms, identified in red, point out important vocabulary and definitions that you need to know.

Tech Tip sidebars provide inside information from experienced IT professionals.

Check Your CATs!
You've already seen CAT levels in Chapter 3, "Cabling and Topology," so check your memory and review the different speeds of the various CAT levels. Could 10BaseT use CAT 2? Could it use CAT 6? What types of devices can use CAT 1?

10BaseT also introduced the networking world to the **RJ-45 connector** (Figure 4.9). Each pin on the RJ-45 connects to a single wire inside the cable; this enables devices to put voltage on the individual wires within the cable. The pins on the RJ-45 are numbered from 1 to 8, as shown in Figure 4.10. The 10BaseT standard designates some of these numbered wires for specific purposes. As mentioned earlier, although the cable has four pairs, 10BaseT uses only two of the pairs. 10BaseT devices use pins 1 and 2 to send data, and pins 3 and 6 to receive data. Even though one pair of wires sends data and another receives data, a 10BaseT device cannot send and receive simultaneously. The rules of CSMA/CD still apply: only one device can use the segment contained in the hub without causing a collision. Later versions of Ethernet will change this rule.

As RJ-45 connectors are usually called a *crimp*, and the act of securing it is an act of installing a crimp onto the end of a piece of UTP cable is called *crimping*. The tool used to secure a crimp onto the end of a cable is a **crimper**. Each wire inside a UTP cable must connect to the proper pin inside the crimp. Manufacturers color-code each wire within a piece of four-pair UTP to assist in properly matching the ends. Each pair of wires consists of a solid-colored wire and a striped wire: blue/blue-white, orange/orange-white, brown/brown-white, and green/green-white (Figure 4.11).

The Telecommunications Industry Association/Electronics Industries Alliance (TIA/EIA) defines the industry standard for correct crimping of four-pair UTP for 10BaseT networks. Two standards currently exist: **TIA/EIA 568A** and **TIA/EIA 568B**. Figure 4.12 shows the TIA/EIA 568A and TIA/EIA 568B color-code standards. Note that the wire pairs used by 10BaseT (1 and 2; 3 and 6) come from the same color pairs (green/green-white and orange/orange-white). Following an established color-code scheme, such as TIA/EIA 568A, ensures that the wires match up correctly at each end of the cable.

Figure 4.9 Two views of an RJ-45 connector

The real name for RJ-45 is "8 Position 8 Contact (8P8C) modular plug." The name RJ-45 is so dominant, however, that nobody but the nerdiest of nerds call it that. Stick to RJ-45.

Figure 4.10 The pins on an RJ-45 connector are numbered 1 through 8.

Figure 4.11 Color-coded pairs

Mike Meyers' CompTIA Network+ Guide to Managing and Troubleshooting Networks

Makes Learning Fun! —
Rich, colorful text and enhanced illustrations bring technical subjects to life.

Table 5.1 Gigabit Ethernet Summary

Standard	Cabling	Cable Details	Connectors	Length
1000BaseCX	Copper	Twistax	25 m	
1000BaseSX	Multimode fiber	850 nm	Variable—LC is common	220–500 m
1000BaseLX	Single-mode fiber	1300 nm	Variable—LC, SC are common	5 km
1000BaseT	CAT 5e/6 UTP	Four-pair/twisted-pair	RJ-45	100 m

LC and MT-RJ are the most popular types of SFF fiber connections, but many others exist, as outlined in Table 5.1. The fiber industry has no standard beyond ST and SC connectors, which means that different makers of fiber equipment may have different connections.

10-Gigabit Ethernet

The ongoing demand for bandwidth on the Internet means that the networking industry is continually reaching for faster LAN speeds. **10-Gigabit Ethernet (10 GbE)** is showing up in high-level LANs, with the anticipation of trickle down to the desktops in the near future.

Because 10 GbE is still a new technology, there are a large number of standards in existence. Over time many of these standards will certainly grow in popularity and some will disappear. For now, though, the landscape is in flux. 10 GbE has a number of fiber standards and two copper standards. 10 GbE was first and foremost designed with fiber optics in mind. As a result, it has only been since 2008 that 10-GbE copper products have actually (and very expensively) begun to appear for sale.

Fiber-based 10 GbE

When the IEEE members sat down to formalize specifications on Ethernet running at 10 Gbps, they faced an interesting task in several ways. First, they had to maintain the integrity of the Ethernet frame. Data is king, after all, and the goal was to create a network that could interoperate with any other Ethernet network. Second, they had to figure out how to transfer those numbers at such amazing speeds. These were not easy tasks, and some interesting ramifications because of two factors. They could use the traditional Physical layer mechanisms defined by the Ethernet standard. But, there was already in place a perfectly usable ~10 Gbps fiber network called **SONET**, used for wide area networking (WAN) transmissions. What to do?

The IEEE created a whole set of 10-GbE standards that could use traditional LAN Physical layer mechanisms, plus a set of standards that could take advantage of the SONET infrastructure and run over the WAN fiber. To make the 10-Gbps jump as easy as possible, the IEEE also recognized the need for

Tech Tip
Implementing Multiple Types of Gigabit Ethernet
Because Ethernet packets don't vary among the many flavors of Ethernet, network hardware manufacturers have long built devices capable of supporting more than one flavor right out of the box. If you'll excuse the pun, ancient hubs supported 10Base2 and 10BaseT at the same time, for example. The Gigabit Ethernet folks created a standard for modular ports called a gigabit interface converter (GBIC). With many Gigabit Ethernet switches and other hardware, you can simply pull out a GBIC module that supports one flavor of Gigabit Ethernet and plug it in another. You can replace an RJ-45 port GBIC, for example, with an SC, GBIC, and it'll work just fine. Electronically, the switch or other Gigabit device is just that—Gigabit Ethernet—so the physical connections don't matter. Ingenious!

Chapter 5: Modern Ethernet

Engaging and Motivational —
Using a conversational style and proven instructional approach, the authors explain technical concepts in a clear, interesting way using real-world examples.

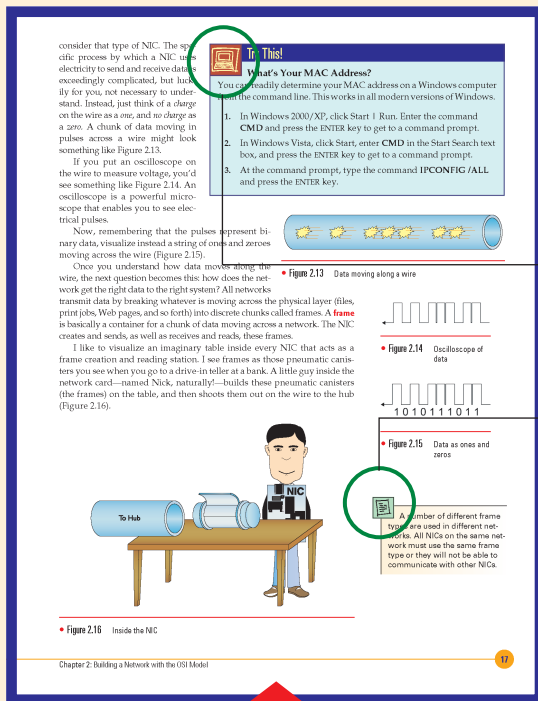
Proven Learning Method Keeps You on Track

Mike Meyers' Network+ Guide to Managing and Troubleshooting Networks is structured to give you comprehensive knowledge of computer skills and technologies. The textbook's active learning methodology guides you beyond mere recall and—through thought-provoking activities, labs, and sidebars—helps you develop critical-thinking, diagnostic, and communication skills.

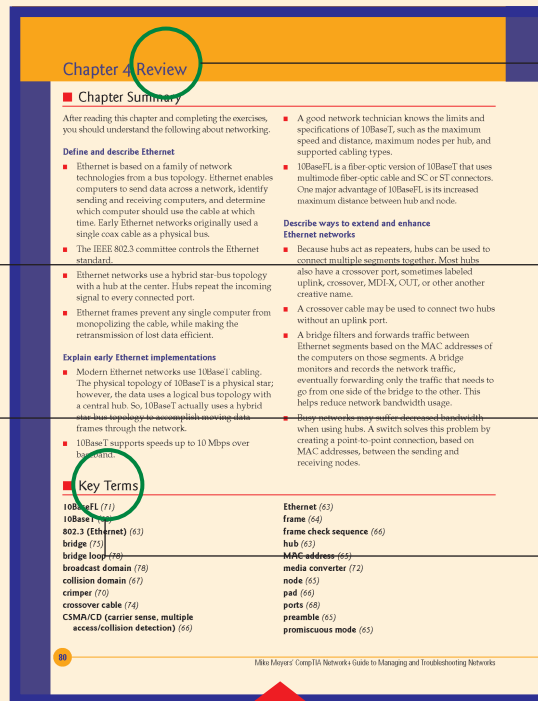
Effective Learning Tools

This pedagogically rich book is designed to make learning easy and enjoyable and to help you develop the skills and critical thinking abilities that will enable you to adapt to different job situations and troubleshoot problems.

Mike Meyers' proven ability to explain concepts in a clear, direct, even humorous way makes this book interesting, motivational, and fun.



Offers Practical Experience —
Tutorials and lab assignments develop essential hands-on skills and put concepts in real-world contexts.



Robust Learning Tools —
Summaries, key term lists, quizzes, essay questions, and lab projects help you practice skills and measure progress.

Chapter Review sections provide concept summaries, key terms lists, and lots of questions and projects.

Try This! exercises apply core skills in a new setting.

Notes, Tips, and Warnings create a road map for success.

Key Terms List presents the important terms identified in the chapter.

Each chapter includes:

- **Learning Objectives** that set measurable goals for chapter-by-chapter progress
- **Illustrations** that give you a clear picture of the technologies
- **Tutorials** that teach you to perform essential tasks and procedures hands-on
- **Try This!, Cross-Check, and Tech Tip** sidebars that encourage you to practice and apply concepts in real-world settings
- **Notes, Tips, and Warnings** that guide you through difficult areas
- **Chapter Summaries** and **Key Terms Lists** that provide you with an easy way to review important concepts and vocabulary
- **Challenging End-of-Chapter Tests** that include vocabulary-building exercises, multiple-choice questions, essay questions, and on-the-job lab projects

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PREFACE

I was a teacher long before I was ever an author. I started writing computer books for the simple reason that no one wrote the kind of books I wanted to read. The books were either too simple (Chapter 1, “Using Your Mouse”) or too complex (Chapter 1, “TTL Logic and Transistors”) and none of them provided a motivation for me to learn the information. I guessed that there were geeky readers just like me who wanted to know *why* they needed to know the information in a computer book.

Good books motivate the reader to learn what he or she is reading. If a book discusses binary arithmetic but doesn’t explain why I need to learn it, for example, that’s not a good book. Tell me that understanding binary makes it easier to understand how an IP address works or why we’re about to run out of IP addresses and how IPv6 can help, then I get excited, no matter how geeky the topic. If I don’t have a good reason, a good motivation to do something, then I’m simply not going to do it (which explains why I haven’t jumped out of an airplane!).

In this book, I teach you why you need to understand the wide world of networking. You’ll learn everything you need to start building, configuring, and supporting networks. In the process, you’ll gain the knowledge you need to pass the CompTIA Network+ certification exam.

Enjoy, my fellow geek.

—Mike Meyers

INSTRUCTOR AND STUDENT WEB SITE

For instructor and student resources, check out <http://novella.mhhe.com/sites/0071628835>. Students will find chapter quizzes that will help them learn more about troubleshooting and fixing networks, and teachers can access support materials.

■ Additional Resources for Teachers

Resources for teachers are provided via an Online Learning Center that maps to the organization of the textbook. This site includes the following:

- Answer keys to the end-of-chapter activities in the textbook
- Answer keys to the lab manual activities
- Access to testbank files and software that allows you to generate a wide array of paper- or network-based tests, and that features automatic grading
- Hundreds of practice questions and a wide variety of question types and difficulty levels, enabling you to customize each test to maximize student progress
- Blackboard cartridges and other formats may also be available upon request; contact your sales representative
- Engaging PowerPoint slides on the lecture topics (include full-color artwork from the book)