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A Beginner's Guide

FIFTH EDITION



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Bruce A. Hallberg



Networking: A Beginner's Guide, Fifth Edition

BRUCE **HALLBERG**



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**For my daughters, Vivian and Maxine,
of whom I am extraordinarily proud.**

About the Author

Bruce Hallberg has been involved in information technology (IT) for more than 25 years and has consulted for Fortune 1000 firms on the implementation of management information and networking systems. He is the best-selling author of more than 20 books.

About the Technical Editor

Bruno Whittle has administered voice and data networks for almost 10 years. He was delighted at the opportunity to be part of a rewarding experience of sharing this knowledge with the many people who are interested in learning more about networking. Bruno is currently an IT systems consultant, and most recently was the IT Systems Manager at Genelabs Technologies, Inc. in Redwood City, California. He is immensely dedicated to continued learning, but he ensures that his wife Reena and his pride and joys—Sonali, Shane, and Stanley—are always his first priority.



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Joya Anthony was the Acquisitions Coordinator for the book. This is a really tough job, and is essentially the project manager for the book. It involves keeping all of the parts of the book moving forward, knowing where all the chapters are at any given time, and occasionally politely reminding authors (ahem) that they need to get cracking on getting some work done and turned in.

The Technical Editor for this fifth edition was Bruno Whittle. Technical editors read the entire book as it's being written, and ensure that it is technically accurate. When there are steps involved, they repeat them to ensure that you, the reader, can also successfully duplicate them. I have worked with Bruno for more than 15 years. He is a remarkable individual and helped improve this book in important ways.

Introduction

I have run into many people over the years who have gained good—even impressive—working knowledge of PCs, operating systems, applications, and common problems and solutions. Many of these people are wizards with desktop computers. However, quite a few of them have been unable to make the transition into working with networks; they have had trouble gaining the requisite knowledge to conceptualize, understand, install, administer, and troubleshoot networks. In many cases, this inability limits their career growth, because most companies believe networking experience is fundamental to holding higher-level information technology (IT) positions. And, in fact, networking experience *is* very important.

Certainly, networks can be complicated beasts. To add to the difficulty, most companies are not willing to let people unskilled with networks experiment and learn about them using the company's production network! This leaves the networking beginner in the difficult position of having to learn about networks in the following ways:

- Reading an endless number of books and articles
- Attending classes
- Building small experimental networks at home, using cobbled-together and/or borrowed parts and software

This book is designed for people who understand computers and the rudiments of computer science, but who want to begin an education about networks and networking. I assume you understand and are comfortable with the following topics:

- How bits and bytes work
- The notion of binary, octal, decimal, and hexadecimal notation
- How basic PC hardware works, and how to install and replace PC peripheral components
- Two or three desktop operating systems in detail, such as Windows, Macintosh, Linux or UNIX, and maybe even DOS (or the Windows command prompt)
- Detailed knowledge of a wide variety of application software

The purpose of this book is both to educate and familiarize. The first part of the book discusses basic networking technology and hardware. Its goal is to help you understand the fundamental components of networking, so you can build a conceptual framework into which you can fit knowledge that is more detailed in your chosen area of expertise. The second part of the book is concerned with familiarizing you with two important network operating systems: Windows Server 2008 and Fedora Linux. In the second part, you learn the basics of setting up and administering these network operating systems.

This book is meant to be a springboard from which you can start pursuing more detailed knowledge in the areas that interest you. Following are some ideas about areas that you may wish to continue exploring, depending on your career goals:

- **Small-to-medium network administrator** If you plan on building and administering networks with 200 or fewer users, you should extend your knowledge by studying the network operating systems you intend to use, server hardware, client PC administration, and network management. You may find more detailed knowledge of network hardware, like routers, bridges, gateways, switches, and the like to be useful, but these may not be an important focus for you.
- **Large network administrator** If you plan on working with networks with more than 200 users, then you need to pursue detailed knowledge about TCP/IP addressing and routing and network hardware, including routers, bridges, gateways, switches, and firewalls. Also, in large networks, administrators tend to specialize in certain areas, so you should consider several areas of particular specialization, such as e-mail servers like Lotus Notes or Microsoft Exchange, or database servers like Oracle or SQL Server.
- **Internet administrator** Many people these days are pursuing specialization in Internet-based technologies. Depending on the area you want to work in, you should learn more about web and FTP servers, HTTP and other application-level Internet protocols, CGI and other web scripting technologies, HTML design, and SMTP mail connections. You may also want to become an expert in TCP/IP and all its related protocols, addressing rules, and routing techniques.

- **End-user support** If your primary job is supporting end users, perhaps with application or client computer support, you may still benefit from a deeper understanding of networking. Client computer applications usually interact with the network, and understanding networks will undoubtedly help you be more effective.

If you are working toward getting a job in the field of networking, I suggest that you find job postings on the Internet and carefully study the job requirements. This can be a useful technique to direct your studies appropriately. When you do this, you will notice that for their most important jobs, most employers ask for people who are certified by Microsoft, Cisco, Novell, or other companies.

You should seriously consider pursuing an appropriate certification. While certifications can never replace experience, they are one way that a person can demonstrate a needed level of knowledge and expertise in a particular area. This difference may be key in getting the best possible job offers and in being able to gain more experience. Often, an appropriate certification can be worth several years' experience in terms of compensation and job responsibilities, so it is an investment in yourself that will usually pay for itself over a fairly short period of time.



Part I

Networking Ins and Outs

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Chapter 1

The Business of Networking

This book is a soup-to-nuts beginner's guide to networking. Before delving into the bits and bytes of networking, which are covered in the rest of the book, you should start by understanding the whys and wherefores of networking.

This chapter discusses networking from a business perspective. You'll learn about the benefits that networking brings a company and the different types of networking jobs available. You'll also discover how networks are supported from the business perspective, and how you can begin a career in networking. Finally, you'll learn about the Sarbanes-Oxley Act of 2002 and how its requirements affect networking professionals.

Understanding Networking: The Corporate Perspective

To be truly effective in the field of networking, you need to start by understanding networking from the corporate perspective. Why are networks important to companies? What do they accomplish for the company? How can networking professionals more clearly meet the needs of the company with the networks that they build and maintain? It's important to realize that there are no single correct answers to these questions. Every company will have different needs and expectations with regard to their network. What is important is that you learn the relevant questions to ask about networking for your company and arrive at the best possible answers to those questions for your particular company. Doing so will ensure that the company's network best meets its needs.

What Does the Company Need?

There are many possible reasons that a company might need or benefit from a network. In order to understand your particular company, you should start by exploring the following questions. You may need to ask a variety of different people in the company their perspective on these questions. Some of the managers that you may need to interview include the chief executive officer or owner, the chief financial officer, and the heads of the various key departments within the company, such as manufacturing, sales and marketing, accounting, purchasing and materials, retail operations, and so forth. The range of managers that you interview will depend on the type of business in which the company is engaged.

It's important that you first start by understanding the business itself and the business-oriented perspectives of these different individuals and the people in their departments. Consider the following questions for each of these key areas of the organization:

- What is their function for the company?
- How do their objectives tie into the company objectives?
- What are the key goals for their function in the coming year? How about in the coming five years?
- What do they see as the chief challenges to overcome in achieving their objectives?

- How might information technology (IT) play a role in supporting their objectives?
- What sorts of automation do they think might help them accomplish their objectives?
- How is the work in their area accomplished? For instance, do most of the employees do mechanical work, like on a production line, or are most of them so-called “knowledge workers” who generate documents, analyze information, and so forth?
- What are the key inputs for the functional area, in terms of information or materials, and what are the key outputs for the functional area? What processes convert the inputs into the outputs?

Your objective in asking these questions, and others that may occur to you, is to get a good understanding of each functional area: what it does and how it does it, as well as what it wants to be able to do in the future. With this knowledge, you can then start to analyze the impact that the network—or improvements to the existing network—might have in those various areas.

Beginning from a business perspective is absolutely essential. Networks are not built and improved “just because.” Instead, any particular network or network upgrade needs to be driven by the needs of the business. Justifications for networks or improvements to existing networks should clearly show how they are necessary to the proper functioning of the business, or how they will play an important role in the company achieving its objectives, consistent with the cost and effort involved.

How Will the Network Benefit the Company?

After getting a good understanding of the company, its objectives, and how it accomplishes its work, you can then analyze different ideas that you may have for the network, and how those ideas will benefit some or all parts of the business. In doing so, you need to consider at least the following areas:

- Are there any areas in which the lack of a network, or some failing of the existing network, is inhibiting the company from realizing its goals or accomplishing its work? For example, if an existing network is undersized and this causes people to waste too much time on routine tasks (such as saving or sending files, or compiling programs), what improvements might address those shortcomings? Or maybe the network and its servers are unreliable, and so people are frequently losing their work or are unproductive while problems are addressed.
- Are there capabilities that you could add to the network that would provide benefits to the business? For example, if many people in the company are constantly sending faxes (for instance, salespeople sending price quotations to customers), would adding a network-based fax system produce significant productivity benefits? What about other network-based applications? (Chapter 3 lists some common network features that you may want to review to help in answering this question.)

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