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2nd Edition

# Storage Area Networks FOR DUMMIES®

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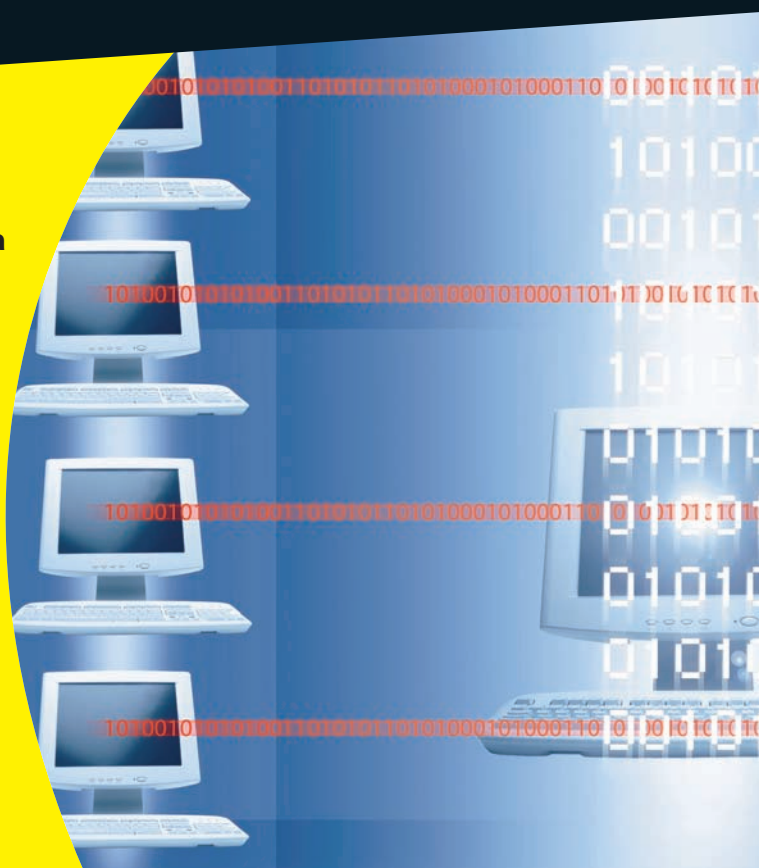
- Maintain and troubleshoot SANs
- Develop SANs that will aid your company's disaster-recovery plan



**Christopher Poelker**
**Alex Nikitin**

# Storage Area Networks FOR DUMMIES®

2ND EDITION

**by Christopher Poelker and Alex Nikitin**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# About the Authors

**Christopher Poelker** has been in the field of computer technology since 1974. Chris was an electronics engineer in the U.S. Army, and tried to stay out of trouble by hiding in tanks while installing laser range finders and computer-aided ballistic trajectory systems. After leaving the service, Chris went to school in New York City at good old Control Data Institute and was hired as a field engineer by Digital Equipment Corporation. In his spare time, Chris started his own software company, developed databases, and became a Microsoft MCSE and instructor. Chris worked for Digital for 18 years until it was bought by Compaq, where he stayed on as a StorageWorks systems engineer until joining Sun Microsystems in 2000. Chris left Sun to become a consulting storage architect for Hitachi Data Systems and became the district storage manager for HDS in New York City. In 2006, Chris left HDS for FalconStor software, where he now works as the Vice President of Enterprise Solutions. Chris has designed and implemented storage networks for many of the Fortune 100 companies in the U.S. and around the world. In his spare time, Chris sometimes speaks at industry forums, writes magazine articles, and has acted as the SAN expert at SearchStorage.com.

**Alex Nikitin,** currently a systems expert at HBO, has logged in 15 years in the Information Technology industry. Alex has worn many hats in this industry, ranging from application programmer and network administrator to the ultimate responsibility over large server farms, and storage and backup solutions for some of the world's top financial and pharmaceutical companies. Alex and Chris worked together at Hitachi Data Systems in New York, where Alex was the "go to" guy for difficult storage designs and implementations. Prior to joining HDS, he also spent time growing the install base of Storage Area Networks as a Professional Services Consultant for EMC Corporation, implementing SAN solutions for various companies, large and small, on Windows NT/2000, Solaris, HP/UX, AIX, and Linux platforms. Seemingly always cast in a storage-centric capacity, his career has focused on caring for and reliably delivering vast amounts of storage to his user community.

# Dedication

**Christopher Poelker:** To my sister Nancy, whose love and friendship meant the world to me.

# Author's Acknowledgments

**Christopher Poelker:** I would have never been given the chance to write this book if it weren't for my friends at TechTarget, who used to run the SearchStorage.com Web site: Michelle Hope and Maryann Tripp. These two wonderful women were the reason I was introduced to Melody Layne and Susan Christophersen of Wiley Publishing, who made the first book possible, along with Teresa Artman, who spent many a long night copy-editing the manuscript and making up for my horrible writing skills. (I should have paid closer attention during eighth-grade English!) For this second edition, I would like to thank Kyle Looper and Kim Darosett for their patience during deadlines when my day job was getting in the way of keeping this edition on track.

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Finally, thanks for the support of my family: Deborah, my wife, for being a single mother again while I was writing the book, and of course, my children Cole, Chris, and Rachel for all their support and being the wonderful people they turned out to be.

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We're proud of this book; please send us your comments through our online registration form located at http://dummies.custhelp.com. For other comments, please contact our Customer Care Department within the U.S. at 877-762-2974, outside the U.S. at 317-572-3993, or fax 317-572-4002.

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# Introduction

Welcome to *Storage Area Networks For Dummies,* 2nd Edition! The first edition was the book we wish was around when *we* were trying to learn about this stuff! We tried to take a fairly mundane topic and make it a fun read so you could get up to speed on storage networking as quickly and painlessly as possible. This second edition is written in the same spirit as the first.

When the first edition was written in 2003, very few books on storage area networks (SANs) were available. The books that were available were very narrow and extremely technical in focus. They were about as fun to read as the directions for setting up a DVD player. Although more books about storage networking are available now, most are still very technical and about as fun to read as the U.S. tax code (nothing against accountants here!).

Over the years, this book has become the standard bearer in keeping the subject concise, simple, and fun, and has now been updated to include all the new cool stuff and changes that have occurred since the original printing. Let's face it — most folks typically look for a fast and easy way to get information; you want the information you *need* to know, and not everything there *is* to know, so this second edition uses that same point of view common to all of us poor slobs who need to make a SAN work with no budget, no training, and no time. So don't worry, be happy — and just have some *fun!*

## About This Book

The mission of this book is to help you find your way around while exploring the topic of storage area networking. The book is dedicated to individuals who, for better or for worse, have been tasked with designing, implementing, configuring, or troubleshooting a storage area network. We hope that the information here will enable both the beginner and the moderately expert storage professional sort through the ins and outs of a SAN. We use familiar language to demystify the technology and translate the jargon as necessary. You'll discover how to choose the right hardware for the job, design a SAN by using the best practices in the industry, connect everything to make it work, and troubleshoot the SAN to fix problems when they occur.

You also get to delve into the hard stuff — the stuff that many companies pay expensive consultants for (who have usually just read a book like this just before they were hired!), so be brave, and we'll do our best to make this painless. If you want to understand what a SAN is and what it does, you've come to the right place. Everything you should need (or want) to know about storage area networks is here in one location.

# Foolish Assumptions

We have one or two foolish assumptions about you, the reader of this book:

- You are responsible for or have worked with computer storage before.
- You might want to continue working in that field of endeavor.
- You want to find an easy way out of your networking storage problems so you can get home and play video games, watch TV, and drink beer with your friends.

We also assume that you don't want to become an instant expert. You want to know just enough to be able to speak intelligently on the subject matter but also know when it's time to call in an expert.

This book tries to you get past all the little details that get in the way of understanding a subject by using a real-world approach. We didn't create the technology; we just know how to make it work because we've been in the field for more years than we care to say. This book tries to impart just enough good info to help you make your stuff work — and to understand enough to know when someone is misleading you or trying to rip you off. The best defense is a good offense.

# Conventions Used in This Book

We want you to understand all the instructions in this book, and in that spirit, we've adopted a few conventions.

When you hit a chapter in which we ask you to do something, you will be prompted by a numbered list. The numbers in the list are the order of the steps that you need to take to accomplish the task at hand. Just follow the steps listed, and everything should be just fine. If you need to enter something on the keyboard, we ask you to *type* it. If you need to use your mouse, we ask you to *click* it. That's all there is to it.

# How This Book Is Organized

This book is designed as a reference, so you don't have to read the book cover to cover. Just look in the Table of Contents to find the topic you're interested in and start reading. If you're unsure of some of the acronyms you've been hearing out there, check out the Cheat Sheet at the front of this book for easy reference.

The book is organized in seven parts.

- **Part I: SAN 101:** This part covers the basics of storage area networks, including what you need to know if you're going to buy a SAN, build one yourself, or have someone build it for you.
- **Part II: Designing and Building a SAN:** This part of the book handles all the fun stuff, such as how to add more storage to your servers and how to connect everything and get it running. It also covers what you need to know if you already have a SAN in place or need to know how to use it or set it up properly.
- **Part III: Using Advanced SAN Features:** If you've always wanted to know what the heck a snapshot copy was, this is the place to find out. This part also covers advanced topics such as backing up your data, which will help you get more bang for your buck out of your SAN.
- **Part IV: SAN Management and Troubleshooting:** Every now and then, something goes bump in the night. This part shows you how to manage and troubleshoot problems when they occur as well as how to avoid having to face those problems in the first place.
- **Part V: Understanding the Cool Stuff:** This part covers the cool new advances in storage area networking since 2003, such as storage virtualization, data de-duplication, and advances in data protection and replication such as Continuous Data Protection (CDP). You find out how to use these technologies to help you save money and become more productive and better prepared when trouble happens.
- **Part VI: The Part of Tens:** This part includes ten reasons to use a SAN and ten reasons *not* to.


We've also provided a bonus chapter titled "Outsourcing SAN Solutions" that you can download from the book's companion Web site at `www.dummies.com/go/sanfd2e`.

# Icons Used in This Book

To help you get the most out of this book, we've placed icons here and there. Here's what the icons mean:


Next to the Tip icon, you can find shortcuts and tricks of the trade to make you more productive without even realizing it.


Where you see the Warning icon, tread softly and carefully. It means that we've been burned by this already and don't want you to have to learn the hard way, as we did.


Stuff marked with the Remember icon is like jotting a note to yourself in a class. Make an effort to bend the ear of the page so that you don't forget it.


Okay, we probably put too many of these icons in the book. But what the heck . . . sometimes trying to explain this stuff is like writing a book on *Brain Surgery For Dummies.* We need to point out the details at times so you don't end up with a migraine.

# Part I

# SAN 101

The 5th Wave By Rich Tennant


"They can predict earthquakes and seizures, why not server failures?"

## In this part . . .

The computer industry is funny. As soon as you get comfortable with the latest technology and become the resident expert, something new comes out, and the whole learning process starts all over again. Some people enjoy the challenge of learning about something new, and some think it just makes life more difficult. This first part of the book tries to make things easier by introducing you to storage area networks, or SANs. Just like in high school shop class, when you were introduced to the drill press, the table saw, and the first aid stations, we introduce you to the various tools that you use to build a SAN. We tell you what each tool does, why it's necessary, and how you can use it in your new SAN project.

# Chapter 1

# The Storage Area Network

### In This Chapter

- Understanding storage area networks (SANs)
- Determining whether a SAN is right for you
- Looking at SAN layers and protocols
- Figuring out which operating systems benefit from SANs
- Discovering which applications can use or require SANs

This chapter is dedicated to helping you get a handle on what a storage area network (SAN) is, the basics of how one works, and whether one is right for your needs. You'll discover all the parts that make up a SAN, the things that make one run, and who actually makes all the different parts that you can buy. Putting a SAN together is somewhat like putting together one of those high-end stereo systems; you have many components and many different manufacturers to choose from. This chapter helps you choose the ones that suit your needs and create something that you can be proud of.

These days, becoming proficient with SANs can mean a major boost to your career. Perhaps you're bored to death in your current position and would like a change of pace. SAN administration is one of the highest-paying jobs in Information Technology (IT) today. If you add storage area networking to your résumé, you may find your phone ringing off the hook as headhunters vie to offer you a six-figure income (hey, might as well dream big).

## Defining a SAN

First, the basics. In today's terms, the technical description of a SAN (Storage Area Network) is a collection of computers and storage devices, connected over a high-speed optical network and dedicated to the task of storing and protecting data.

In a nutshell, you use a SAN to store and protect data. A SAN uses the SCSI (Small Computer Storage Interconnect) and FC (Fibre Channel) protocols to move data over a network and store it directly to disk drives in block format. Today, that high-speed network usually consists of fiber-optic cables and switches that use light waves to transmit data with a connection protocol known as Fibre Channel. (A *protocol* is a set of rules used by the computer devices to define a common communication language.) More and more, regular Internet protocol (IP)–based corporate networks, and even the Internet, are being used as the network part of a SAN. IP networks that are already in place can be used by other storage connection protocols such as iSCSI (internet Small Computer Storage Interconnect) to move and store data.

Using a network to create a shared pool of storage devices is what makes a SAN different. A SAN moves data among various storage devices, allows sharing data between different servers, and provides a fast connection medium for backing up, restoring, archiving, and retrieving data. SAN devices are usually bunched closely in a single room, but they can also be connected over long distances, making a SAN very useful to large companies.

Many of today's SAN components are pretty much plug-and-play. To create a simple SAN, you just connect all the devices together with cables, and off you go. Creating larger SANs with many storage switches can become complex, though, and that's the reason for this book: to give you a handle on what you need to know about large, complex SANs.

# Fiber versus Fibre

No, it isn't just a snooty way of spelling *fiber*. (Well, okay, not *only* that.) Networking geeks use the *fibre* spelling (reversing the *er* to *re*) to refer specifically to fiber-optic cables used in a SAN. The idea is to differentiate SAN cables from the optical cables used in other networks (such as TCP/IP Networks). That's because SAN devices use a different language to communicate with each other than do the devices in other networks. This is why the main protocol used in a SAN (snooty or not) is called *Fibre Channel*.

All network protocols are divided into layers, like a layer cake. All the layers in the cake are logically tied together into a *stack*. Each layer of the stack provides different functionality, and each device in the network uses the stack like a language to communicate with other devices in the network. The bottommost layer of the stack is hardware-based (as opposed to software-based), and thus is referred to as the *physical layer*.

The physical layer consists of tangible hardware stuff such as cables, switches, and connectors. This is where the fiber-optic cables are. On top of the physical layer are the software layers that make up the *protocol stack*. In a Fibre Channel SAN, those layers make up the *Fibre Channel* protocol.

Each type of network uses a different protocol to handle data. The Internet, for example, uses a protocol stack called the Transmission Control Protocol/Internet Protocol (TCP/IP). The physical layers of both Internet and SAN can transmit data as light pulses over fiber-optic cables — which (as you might expect) makes the data move nearly as fast as light. The only difference between regular fiber-optic computer networks such as the Internet and a fiber-optic SAN is the protocol and the switches used by the devices to talk to each other over the network. SANs use the *Fibre Channel* protocol and Fibre Channel switches, and the Internet uses the *TCP/IP* protocol and Ethernet switches. Fibre Channel was developed to move data really fast between computers and disk drives; TCP/IP (or "Internet Protocol") was developed to move files over long distances between computers.

# How a SAN Makes Computing Different

Using a SAN can really change how you think about computing. In the past, there was the *mainframe*, which was a gigantic computer that could run all the programs in a large business. All the computer stuff was gathered in one place called a *data center*. All the storage that the mainframe needed was directly connected to it. Everything was located and managed as a single, large entity.

The PC revolution changed a lot of things. Everything started to spread out. Data was moved off the mainframe and stored in server computers. The servers were then dispersed throughout the enterprise to bring computing power closer to the actual users. The servers became connected by a network, called a *local area network,* or LAN. This was cool because now the computing power was spread out and made more available to end users. Eventually, LANs were connected to create the Internet.

Networks enabled people who used computers in far-flung places to communicate and share information with each other. In business, problems arose when inter-networking finally took off. A great deal of data was now being stored with no effective way to manage it all. Managing all the scattered data dispersed throughout the network became a nightmare.

Because all data storage was located inside each individual server, you had no effective way to efficiently allocate storage space between all the servers. Sure, users could share files over a LAN, but you still needed a way to share access to physical disks, rather than using dedicated disks inside every server. Hence the advent of the SAN.


Since the original TCP/IP network protocols used in a LAN (Local Area Network) were built to move and share files, they had no built-in way to directly access disk drives. As a result, very high-performance applications needed direct access to *block-based* disk drives to move and store data very fast. (Data is stored as blocks on a disk drive.)

Disk drives in a SAN are stored in a dedicated storage device called a *disk array*. All the servers connect to the storage device over a high-speed network using the Fibre Channel protocol, which enables very fast access to disks over a network. Using a SAN gives businesses shared and consolidated access to data storage — available to any server connected to the SAN.

Putting a SAN in place makes individual server computers less important and more peripheral to the data stored in the SAN. After all, the data is what is important to your business. If you lose a server, you can buy a new one. If you lose your data, it's "Adiós, amigo" for your business.

# Understanding the Benefits of a SAN

The typical benefits of using a SAN are a very high return on investment (ROI), a reduction in the total cost of ownership (TCO) of computing capabilities, and a pay-back period (PBP) of months rather than years. Here are some specific ways you can expect a SAN to be beneficial:

- **Removes the distance limits of SCSI-connected disks:** The maximum length of a SCSI bus is around 25 meters. Fibre Channel SANs allow you to connect your disks to your servers over much greater distances.
- **Greater performance:** Current Fibre Channel SANs allow connection to disks at hundreds of megabytes per second; the near future will see speeds in multiple gigabytes to terabytes per second.
- **Increased disk utilization:** SANs enable more than one server to access the same physical disk, which lets you allocate the free space on those disks more effectively.
- **Higher availability to storage by use of multiple access paths:** A SAN allows for multiple physical connections to disks from a single or multiple servers.
- **Deferred disk procurement:** That's business-speak for not having to buy disks as often as you used to before getting a SAN. Because you can use disk space more effectively, no space goes to waste.
- **Reduced data center rack/floor space:** Because you don't need to buy big servers with room for lots of disks, you can buy fewer, smaller servers — an arrangement that takes up less room.
- **New disaster-recovery capabilities:** This is a major benefit. SAN devices can mirror the data on the disks to another location. This thorough backup capability can make your data safe if a disaster occurs.
- **Online recovery:** By using online mirrors of your data in a SAN device, or new continuous data protection solutions, you can instantly recover your data if it becomes lost, damaged, or corrupted.