

## **Abstract**

### **AN INTERNSHIP IN TECHNICAL AND SCIENTIFIC COMMUNICATION WITH DELL INC.**

by Steve Hawkins

In January of 2000, I accepted a full-time position with Dell Inc. (formerly known as Dell Computer Corporation) located in Austin, Texas. This report describes the first 18-months of my tenure at Dell and focuses on a major project I completed during this time. I began this project in January 2001 and completed it in March 2001. The other chapters in this report provide a description of Dell Inc., an overview of my internship and my major and minor writing projects, an analysis of the problem-solving model, and some examples of the technical writing assignments that I developed at Dell.

AN INTERNSHIP IN TECHNICAL AND SCIENTIFIC COMMUNICATION

WITH DELL INC.

An Internship

Submitted to the Faculty of Miami University  
in partial fulfillment  
of the requirements for the degree of  
Masters in Technical and Scientific Communication  
Department of English

by

Steve Hawkins  
Miami University  
Oxford, Ohio  
2003

Advisor \_\_\_\_\_  
Jean Lutz

Reader \_\_\_\_\_  
Paul V. Anderson

Reader \_\_\_\_\_  
David Yen

## Contents

Chapter 1: Description of Dell Inc. and my Role at Dell . . . . .	1
Dell Inc. . . . .	1
Corporate Structure . . . . .	2
Main Headquarters . . . . .	3
Information Development . . . . .	3
Developing Documentation for Enterprise and Client Systems . . . . .	5
My Role as a Technical Writer at Dell . . . . .	5
Chapter 2: Internship Interview . . . . .	9
Major Projects . . . . .	9
Minor Projects . . . . .	13
Conclusion . . . . .	16
Chapter 3: One Major Project—Writing an Installation and Troubleshooting Guide . . . . .	18
Investigate the Background . . . . .	19
Analyze the Problem . . . . .	24
Reviewing the Product Specifications . . . . .	24
Identifying the Audience . . . . .	25
Interviewing the Project Team . . . . .	26
Plan the Solution . . . . .	28
Write and Edit the Solution . . . . .	30
Creating the Illustrations . . . . .	31
Interviewing the Lead Engineer . . . . .	32
Clarifying the Terminology . . . . .	32
Creating the Index . . . . .	33
Test the Solution . . . . .	34
Revise the Solution . . . . .	36
Approve the Solution . . . . .	37
Repackage the Solution . . . . .	38
Implement the Solution . . . . .	38
Evaluate the Solution . . . . .	39

Chapter 4: Analysis of the Problem-Solving Model .....	40
Adapting the Problem Solving Model to Dell Computer Documentation .....	40
Summary .....	43
Appendix A: Master Document List .....	50
Appendix B: Minor Project—Technical Sheet .....	53
Appendix C: Project Timeline .....	56
Appendix D: Section 1—Dell PowerEdge Cluster FE100/FL100 and FE200/FL200.....	60
Appendix E: MTSC Problem-Solving Model .....	79
Appendix F: NAS Cluster Solution Components.....	81
Appendix G: Configuring a Cluster System.....	83
Appendix H: Table of Contents Example—Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 I&T Guide .....	86
Appendix I: Table of Contents Example—Dell PowerVault 75xN NAS Cluster .....	91
Appendix J: Section 1—Dell PowerVault 75xN NAS Systems I&T Guide .....	93
Appendix K: Illustration Changes .....	101
Bibliography .....	105
List of Tables	
Information Development Team Members .....	4
Document Section Titles for Personal and Enterprise System Documents .....	5
Enterprise System Product Lines .....	6
Installation and Troubleshooting Guide .....	10
Storage Area Network (SAN) Guide .....	10
Reference Guide .....	10
User’s Guide .....	11
Rack Installation Guide .....	11
Service Manuals .....	12
Minor Projects .....	14
PowerVault NAS Clusters and PowerEdge Server Clusters .....	22
Heartbeat Commands .....	33
Getting Started Guide .....	51
Platform Guide .....	51

Readme .....	51
Technical Sheets and Technical Books .....	51
Electronic Document (E-Doc) Postings .....	52
Project Timeline .....	57
PowerEdge Cluster FE100/FL100 and FE200/FL200 Configurations .....	65
MSCS Definition .....	67
Storage Management Software .....	69
Required HBAs for SAN-Attached and Direct-Attached Configurations .....	74
MTSC Problem-Solving Model .....	80
NAS Cluster Solution Components .....	82
Configuring a Cluster System .....	84
NAS Cluster Features .....	96

#### List of Figures

Major Documentation Projects .....	12
Minor Documentation Projects .....	16
Direct-Attached Cluster Configuration for a PowerEdge Cluster FE100/FL100 .....	71
Direct-Attached Cluster Configuration for a PowerEdge Cluster FE200/FL200 .....	72
SAN-Attached Cluster Configuration .....	72
Cluster Consolidation Configuration .....	73
SAN-Appliance Attached Cluster Configuration .....	74
PowerVault 750N Cluster Configuration .....	98
PowerVault 755N Cluster Configuration .....	98
Illustration Markup for Figure 3-2 .....	102
Final Illustration for Figure 3-2 .....	103
Illustration Markup for Figure 3-9 .....	104
Final Illustration for Figure 3-9 .....	104

## **Chapter 1: Description of Dell Inc. and My Role at Dell**

In this report for the Master of Technical and Scientific Communication (MTSC) program at Miami University, I describe my first eighteen months as a technical writer in the Information Development (Info Dev) Department for Enterprise systems at Dell. The Information Development Department supports server and storage system products at Dell Inc. (Dell), located in Round Rock, Texas. I was hired as a full-time employee by Dell on February 1, 2000, shortly after completing my coursework in the MTSC program. During my first eighteen months at Dell, I received training as a new hire and a series of increasingly demanding writing assignments that helped me to understand and master Dell's culture and documentation expectations. This report will cover those first 18 months of my tenure at Dell. The following sections provide the reader with a description of my role at Dell, a short history of Dell, Inc. and its founder, Michael Dell.

### **Dell Inc.**

Dell Inc. was founded in 1984 by Michael Dell, who started his company as a student in his dorm room at the University of Texas at Austin. He founded the company on a simple concept: selling a made-to-order product with the latest computer technology directly to the customer. By asking his customers what they needed in a computer system, Dell could best understand his customers' needs and subsequently provide the most effective computing solutions to meet those needs. This concept of selling made-to-order computer systems directly to the customer is called the "Direct Model"—the cornerstone of Dell's success in the computing industry.

Dell's competitors—such as Compaq and Gateway—use resellers to market and distribute their computer systems. These companies must build and maintain up to 50 days or more of inventory to keep their retailers supplied, forcing their customers to pay the additional costs of a middleman. By eliminating the need for retail stores that stock preconfigured systems, Dell can build and configure every computer system to order, incorporate the latest computer technologies, and sell these systems directly to the customer.

Today, Dell is the world's leading direct computer systems company. With company revenue totaling \$39.7 billion in the fiscal year 2003 and more than 44,000 employees worldwide, Dell is the leading manufacturer of computer systems in the United States and is a leading supplier of

PCs to business customers, government agencies, educational institutions, and consumers. Dell continues to apply the Direct Model by integrating the convenience of the Internet to its entire business.

The Dell line of computer systems includes the following:

- Dell Dimension™ and OptiPlex™ desktop computers
- Dell Latitude™ and Inspiron™ notebook computers
- PowerEdge servers
- Network Attached Storage (NAS) systems
- Dell Precision™ workstation products
- PowerVault storage products

Dell computers are manufactured one at a time, as ordered, at facilities in Austin, Texas; Nashville, Tennessee; Eldorado do Sul, Brazil; Limerick, Ireland; Penang, Malaysia; and Xiamen, China.

Dell, Inc. is headquartered in Round Rock, Texas. The corporate facilities are located in Round Rock, with satellite facilities located in Austin.

## Corporate Structure

Dell is divided into two groups that concentrate on the needs of home and business users. These groups are as follows:

- **Personal Systems**—designs, develops, and markets notebook and desktop computers. The desktop computers include Dimension and Inspiron systems for home users and OptiPlex, Precision, and Latitude systems for business users.
- **Enterprise Systems**—designs, develops, and markets business systems for small to large businesses. These systems include PowerEdge servers for corporate computer network operations, and NAS and PowerVault storage systems for storing corporate data.

Integrated into each group are administrative and support subgroups that manage day-to-day affairs. These subgroups include Human Resources, Finance, and Procurement. Corporate

management is led by a board of directors and a group of senior officers, both of which include the founder, Michael Dell. The current list of directors and senior officers can be found in the company's annual report, which can be accessed from the Dell website located at [www.dell.com](http://www.dell.com).

## **Main Headquarters**

The Round Rock site consists of multiple facilities within a half-mile radius, including the corporate headquarters. Each facility houses different lines of business—such as PowerEdge servers, PowerVault storage systems, and Dell OpenManage software. Additional facilities include research, development, and other primary operations.

Additional facilities are located ten miles south of Round Rock in Austin Texas. These facilities includes manufacturing and other product groups. During my internship and now as an employee, I work(ed) in the Info Dev department at the Austin campus.

## **Information Development**

Information Development (Info Dev), where I worked, specializes in developing technical documentation for Dell's worldwide customers. Using established processes and various tools and technologies, Info Dev creates the printed and electronic documents I describe above for a wide variety of deliverables, including print and online documentation, compact disc (CD) art, computer system information labels, and training materials.

Information Development is an integral team of technical writers and technical editors; graphic designers, illustrators and production format specialists; and localization project managers and cultural reviewers. Working together as a team, Information Development designs internal and external customer documentation to support Dell's products and services worldwide. Using established processes and innovative tools and technologies, Information Development creates printed and electronic documents for a variety of deliverables. Additionally, Information Development works with professional translators to provide documentation for Dell's international customers. Individual team members also fulfill roles as information strategists and team leads to coordinate work done in the organization and ensure meeting the requirements of the product development teams.

Table 1-1 lists the individual team members and their roles in Information Development.

**Table 1-1. Information Development Team Members**

<b>Team Member</b>	<b>Role</b>
Technical Writer	Develops technical documentation for personal and business computer systems. Technical writers work closely with the project teams to identify and incorporate important technical information into Dell's customer documentation.
Technical Editor	Provides editorial support for all Dell documentation, including corporate documents. Technical editors ensure that Dell documentation meets and exceeds expectations for technical accuracy and consistency of style and format.
Graphic Designer	Develops the layouts and formats used in Dell printed and online documentation and designs various forms of corporate documentation.
Graphic Illustrator	Develops the technical artwork used in Dell printed and online documentation.
Production Format Specialist	Prepares all document files for printing. After the document files are sent to the printer, he/she archives the files to a network storage system for future retrieval.
Localization Specialist	Ensures that Dell documentation is translated into the required languages and is disseminated to other team members within Info Dev and to the regional documentation coordinators located in Dell business outside of the United States.
Cultural Reviewer	Ensures the accuracy and quality of Japanese documentation for the personal computer systems.
Information Strategist	Manages all documentation projects for a specific system or software product (for example, PowerEdge servers or Dell OpenManage Systems Management software products) and attends meetings with the project teams as a representative of Info Dev. An information strategist also disseminates changes in system hardware, software, or project schedules to team leads.
Team Lead	Manages an individual writing project for a particular system or software product (for example, a PowerEdge 1550 system or Dell OpenManage Systems Administrator software). A team lead "administers" projects, which includes assigning document part numbers to the individual documents (such as a User's Guide or Service Manual); developing the publication plan that lists the documents, part numbers, and Info Dev personnel assigned to each document; and meeting with the engineering manager and lead engineer to discuss schedule deadlines, product specifications, and document status.

As of December 2003, there are 73 Information Development team members employed at Dell.

## Developing Documentation for Enterprise and Client Systems

Info Dev is divided into two separate lines of business: Enterprise systems and Personal systems—also known as “Client” systems. Enterprise systems are developed for corporate computer networks in small and large corporations; personal systems are developed for the home user. The difference between both types of systems is the hardware and software that is incorporated into each system and the type of user who purchases the system. Because Enterprise and Personal systems are configured differently to address two types of users, both types of users only purchase one type of system.

Enterprise system documents are written for system administrators, network administrators, and service technicians who usually have many years of experience developing and managing a corporate enterprise—the sum total of all the computer systems in a corporation. Personal system documents are written for the home user, an audience that ranges from elementary school students to grandparents. Both audiences require different styles of writing because the technical writer must consider his or her audience’s level of expertise when developing documentation.

Table 1-2 provides a comparative list of basic procedures that are included in personal and enterprise system documents.

**Table 1-2. Document Section Titles for Personal and Enterprise System Documents**

<b>Personal Systems</b>	<b>Enterprise Systems</b>
Replacing the Hard Drive	Replacing the System Backplane
Installing a Modem	Installing a RAID controller
Installing the Operating System	Installing the Operating System Using Dell OpenManage System Administrator
Configuring System Settings	Configuring Network Settings

### **My Role as a Technical Writer at Dell**

My official title at Dell is “Technical Writer” in the Info Dev department, which develops all of the user documentation for Dell products. My primary job was (and is still) to write service manuals, installation and troubleshooting guides, user’s guides, technical sheets, and technical books for computer systems that are installed in an enterprise organization.

An enterprise usually implies a large corporation. In the computer world, an enterprise is the sum total of all the computer hardware systems—such as servers, storage systems, and personal computers—that are used in a company for day-to-day business. An enterprise can be as small as the computer systems in one building or the sum total of multiple computer systems in buildings that are located across the United States. An enterprise that is geographically dispersed across a wide area—either across a city or across the world—is usually connected by telephone and fibre optic cables that are leased from a telecommunications company, such as Southwestern Bell Communications (SBC). Most enterprise systems manufactured by Dell are scalable, allowing customers to expand their corporate computer network as their company grows.

During my internship at Dell, I developed documentation for a variety of product lines that comprise enterprise systems. These are listed in Table 1-3.

**Table 1-3. Enterprise System Product Lines**

Product Line	Description
Dell PowerEdge™ servers	Computer systems that provide shared resources to clients attached to a computer network. Servers are usually identified by their function. For example, application servers usually contain one multi-license copy of a software application (such as Microsoft Word) that can be accessed by hundreds of people at a time, thereby saving disk space on a user's computer system. Other types of servers include mail servers, which allow company employees to share e-mail over the Internet; database servers, which store database files that contain a collection of records and information on one or more subjects; and proxy servers, which provide a hardware and software barrier between a corporate network and the Internet.
Dell PowerVault™ storage systems	A collection of one or more hard drives mounted inside a box (or "enclosure") that is used to store single pieces of information called "data." Some storage systems are "just a bunch of (hard) disks" (JBODs) and are known as disk array enclosures (DAEs). Other storage systems contain one or more storage processors that organize the information on the hard drives and are known as disk processor enclosures (DPEs). Both types of storage systems are connected directly to a server through a cable connection (direct-attached), while other storage systems are connected to one or more servers through a storage area network (SAN-attached)—a high-speed subnetwork of one or more shared storage systems.

**Table 1-3. Enterprise System Product Lines (Continued)**

<b>Product Line</b>	<b>Description</b>
PowerEdge Fibre Channel Clusters	A group of servers, storage systems, and software components that work together as a single system. Cluster solutions contain two or more server systems (known as cluster nodes) that are interconnected by using fiber optic cables. Fibre Channel clusters employ Fibre Channel technology—a method of packaging and transmitting the data through a fiber optic cable.
PowerVault Network Attached Storage (NAS) systems	A new generation of storage systems that are designed to install on a network within a short amount of time and store and transfer files on a high-speed network. NAS appliances are, basically, high-speed storage systems. These systems run the Microsoft Windows Powered operating system—a minimized version of the Windows operating system that is dedicated to sharing files with users on a computer network. The systems can be managed by any computer on the network that is running Microsoft Internet Explorer.

The documentation I developed for these products was delivered to the customer in the following formats:

- **Paper manuals**—created in Adobe® FrameMaker, printed and bound by a local printer, and placed inside the system box in a “kit”—a transparent envelope included with a computer system that contains the user manuals, warranty, and other related documentation.
- **On-line documentation**—converted from the FrameMaker documentation files using HTML conversion software or converted into a portable document format (PDF) file. These documents were usually posted online at the Dell Support Web site located at <http://support.dell.com> for access by all Dell customers.

The documentation I wrote (and continue to write) helps customers understand how their system works (User’s Guides), install and troubleshoot their systems (Installation and Troubleshooting Guides), and “correct” their system documentation with updated information (technical sheets and technical books). If the system is under warranty, a Dell service technician is dispatched to the company where he/she services the system and removes or replaces parts by following the procedures in Service Manuals, which I wrote (and continue to write) for various server systems. All service manuals are converted to HTML, which allows the service technicians to read the

manual from their laptop computers and perform the procedures without the cumbersome task of handling both a paper manual and a set of tools.

As shown in Table 1-2, Personal and Enterprise systems contain different types of hardware and software components that support different types of users. Consequently, the technical writer must use a different style of writing and tone for each type of user.

During my first eighteen months at Dell, I developed user documentation for a wide variety of Enterprise systems. Developing these documents provided me with a basic understanding of Enterprise systems and prepared me for developing my major project. The remaining chapters of this report detail the following subjects:

2. Internship Overview
3. Major Project—Writing an Installation and Troubleshooting Guide
4. Analysis of the MTSC Problem Solving Model

## **Chapter 2: Internship Overview**

This chapter provides an overview of the major and minor projects I completed between January 2000 and June 2001, which included my internship period at Dell.

### **Major Projects**

The primary reason Dell hired me was to develop end user documentation for Enterprise systems—computer systems designed for small and large businesses. Most of these documents describe hardware or software components and how they work together. For example, an Installation and Troubleshooting Guide (I&T Guide) provides information for setting up a system, installing peripheral components, such as host bus adapters (HBAs), and troubleshooting the system after installation. These guides are usually printed documents that are included with a system and an HTML document that is available on the Dell support website. Conversely, a Service Manual is targeted at service technicians who perform on-site system troubleshooting. Service technicians carry computer notebooks with them to the site; thus, Service Manuals are created in HTML with hyperlinked cross-references, minimizing the number of reference books service personnel must carry with them to the site.

All of the major documents I completed at Dell required interviewing engineers, researching engineering documents, managing document reviews, and learning tools, such as Adobe FrameMaker and Microsoft® Front Page 2000—tasks that I learned while completing the minor projects.

See Appendix A for a complete list of major and minor projects that I completed in my first eighteen months at Dell.

Table 2-1 through Table 2-6 provides general descriptions, format, length, and development time of the major projects I completed during my first eighteen months at Dell. As shown in these tables, some documents—such as the Dell PowerVault 755N NAS Cluster Installation and Troubleshooting Guide—are very large and were developed in a short amount of time. These documents incorporate text from a previously-written document (also known as a “leveraged” document) with similar system information. In most cases, the leveraged document is about 80% intact. To complete a documentation project using a leveraged document, the technical writer

copies the previous document files to a new directory on the network, updates the document file names, removes text and sections that do not apply to the new system, and adds new system information where needed. This leveraging process minimizes document development time, as well as translation costs.

**Table 2-1. Installation and Troubleshooting Guide**

Provides installation, configuration, and troubleshooting information for a particular server or storage product.

<b>System</b>	<b>Format</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Installation and Troubleshooting Guide	Paper and PDF	90 pages	8 weeks
Dell PowerVault 755N NAS Cluster Installation and Troubleshooting Guide	HTML	225 pages	4 weeks

**Table 2-2. Storage Area Network (SAN) Guide**

Provides supplemental information for the Installation and Troubleshooting Guide, describing how to install and configure a PowerEdge or PowerVault system in a storage area network (SAN).

<b>System</b>	<b>Format</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 SAN Guide	Paper	210 pages	7 weeks

**Table 2-3. Reference Guide**

Used by system administrators to write Simple Network Management Protocol (SNMP) management information base (MIB) applications to monitor enterprise systems on a computer network.

<b>System</b>	<b>Format</b>	<b>Length</b>	<b>Development Time</b>
Dell OpenManage Server Agent SNMP	Paper and PDF	150 pages	4 weeks

**Table 2-4. User's Guide**

Provides information for system administrators to write software applications that assist them with monitoring Dell systems.

<b>System</b>	<b>Format</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 SAN Guide	Paper	210 pages	7 weeks
Dell OpenManage Server Assistant	HTML	65 pages	3 weeks
Dell Inspiron 5000 System	Paper and PDF	150 pages	3 weeks

**Table 2-5. Rack Installation Guide**

Describes how to install a PowerVault or PowerEdge system into a Dell rack—a metal cabinet that stores server and storage systems.

<b>System</b>	<b>Format</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerVault 701 Rack	HTML	31 pages	3 weeks
Dell PowerVault 530F SAN Appliance	HTML	34 pages	3 weeks
Dell PowerVault 56F	Paper and PDF	150 pages	3 weeks
Dell PowerVault 660F and 224F Storage System	Paper and PDF	29 pages	4 weeks
Dell PowerApp 2x50 and PowerApp 200 Appliance	Paper and PDF	32 pages	4 weeks

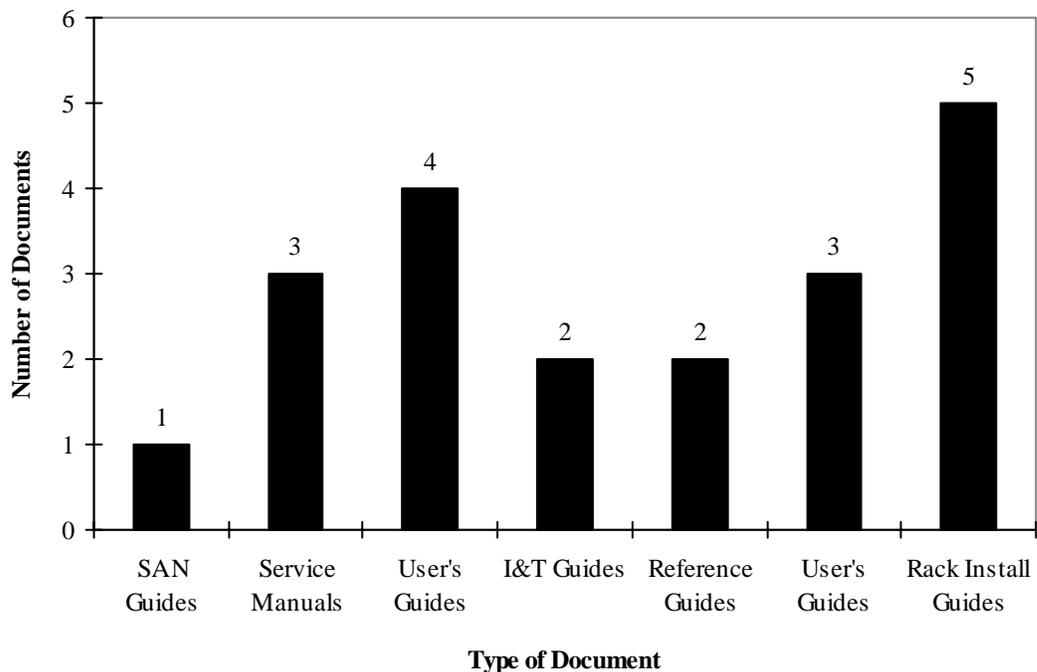
**Table 2-6. Service Manuals**

Provides technical information for servicing and repairing a server system as well as procedures for installing and replacing various peripheral hardware components. These components include expansion cards (such as a host bus adapters) that connect the server system with external systems, power supplies, and internal hard drives.

System	Format	Length	Development Time
Dell PowerVault 530F SAN Appliance	HTML	85 pages	5 weeks
Dell PowerVault 735N NAS Appliance	PDF	53 pages	3.5 weeks
Dell PowerVault 755N NAS Appliance	HTML	62	3.5 weeks

Figure 2-1 provides a breakdown of the major documentation projects that I completed in my first eighteen months at Dell. The numbers above each graph bar and along the left side of the graph represent the total number of documents for each major documentation project that I developed during my first eighteen months at Dell.

**Figure 2-1. Major Documentation Projects**



## **Minor Projects**

During my first few months at Dell, I completed a variety of minor projects that helped me to become acquainted with Dell enterprise products, including server and storage systems. Many of these projects included technical sheets and technical books, which addressed last-minute problems and concerns that were not included in a major document, such as an Installation and Troubleshooting Guide or a Service Manual. These minor documents ranged from one to ten pages, and helped me to understand a wide variety of Dell products in a short amount of time.

Appendix B provides an example of a minor project called a Technical Sheet. In many cases, techsheets address problems received from customers who call the Dell Support help desk. If the help desk engineers receive multiple phone calls for the same problem, the problem and its solution are forwarded to Info Dev, and a technical writer is assigned to document this information in a techsheet. After the document is completed, it is posted in PDF format on the Dell Support website and printed as a paper document for Dell customers worldwide.

Techsheets also provide supplemental information to existing documentation, such as an Installation and Troubleshooting Guide. In most cases, the documentation for a particular system is developed and printed before the computer system is fully developed and tested for problems. If a problem occurs with a system after the technical writer completes the documentation, the problem and solution are documented in a techsheet and included with the documentation that is packaged with the system.

The techsheet in Appendix B describes a communications problem with the PowerVault 530F SAN Appliance, a device that manages network traffic in a SAN. This project was sent to Info Dev by the help desk manager, who documented the problem and solution in a Microsoft Word document. In most cases, the document I receive from a help desk manager or engineering manager is written in “engineering-ese”, a form of communication that assumes the reader is familiar with the technologies associated with the hardware or software component. In this case, after reading the engineering document, I contacted the help desk manager and met with him to better understand the problem. While the completed techsheet was only two pages long, the introductory paragraph required me to spend about an hour with the help desk manager to understand the problem, as well as the asynchronous transfer mode (ATM) protocol and a SAN

appliance. After I understood the problem, I met with another engineer in a computer lab, documented the procedures, and then developed the techsheet.

Some of these minor projects did not require technical writing but coordinating a project from start to finish and practicing the “soft skills” of technical writing, such as multi-tasking, negotiating, and managing a project. For example, all Dell server systems are shipped with Dell OpenManage™ system management software, which provides a set of software tools for managing a PowerEdge server. These software tools are stored on compact disks (CDs) with the title of the CD and a graphic design on the front of the CD that identifies the software tool. Some of my minor projects required me to manage the art/design for these CDs and ensure that they met the requirements of the project team. The management process included interviewing the project planner and lead engineer, communicating their artwork requirements to the illustrator, and sending the illustrator’s artwork to the entire project team for review. Throughout this process, I had to learn how to communicate with a wide variety of personalities and, at the same time, finish the project on time.

Table 2-7 provides a list and description of the types of minor projects I completed during the 18-month internship period. My projects were designed to support Enterprise systems, including PowerEdge servers and PowerVault storage systems.

**Table 2-7. Minor Projects**

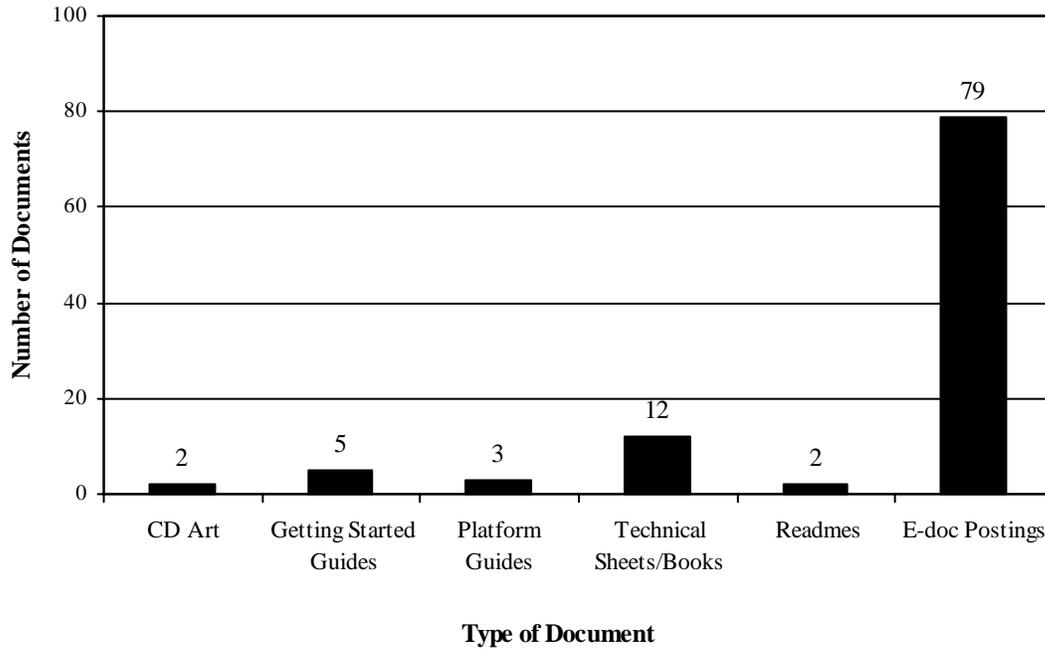
Type of Project	Description
CD art	I managed the artwork changes to system software CDs that are included with PowerEdge servers. These CDs store system software, system utilities, and storage system management software. My role was to obtain a copy of the current CD art for a particular system CD from a project team leader, review the changes to the art and text with the project team, and communicate these changes to the illustrator. When the illustrator completed the artwork, I sent a PDF of the artwork to the project team for review and, when approved, to the production specialist.

**Table 2-7. Minor Projects (Continued)**

Type of Project	Description
Getting Started Guide	I provided instructions on how to connect a monitor and a keyboard to a Dell server system and on how to connect the AC cord to the system and the wall plug. This guide is required by the regulatory departments of some countries in Europe and is included in all Dell Computer systems that are shipped to these countries.
Platform Guide	I listed the supported systems for a particular product line and operating system and provided configuration information for installing components such as network interface controllers (NICs), redundant array of independent disks (RAID) controllers, and any additional peripheral component interconnect (PCI) adapters (cards).
Readme	I provided last-minute information about a software product that was not included in a manual. The Readme was included on a CD, which shipped with the Dell system.
Technical Sheets and Technical Books	I provided supplemental information for troubleshooting and repairing last-minute problems that were not addressed in other guides. A technical sheet is usually shorter than four pages. A technical book is four pages or longer and can be as long as 40 pages.
Posting documentation to the Dell Support Website	I posted my documentation and other system and software documentation to the Dell Documents website located at <a href="http://support.dell.com">http://support.dell.com</a> for use by Dell customers. The e-doc posting process required me to make an index page listing all of the documents for a particular project, copying the documents to a project directory, and transferring the index file(s) and documents to the web server.

Figure 2-2 is a breakdown of the minor documentation projects I completed in my first eighteen months at Dell. The numbers above each bar and along the left side of the graph represent the total number of documents for each minor documentation project that I completed during my first 18-months at Dell.

**Figure 2-2. Minor Documentation Projects**



Appendix C provides a timeline for the major and minor projects that I completed during my first eighteen months at Dell.

## **Conclusion**

The major and minor projects required me to learn nontechnical skills, such as managing my time, dealing with ambiguity, and developing people skills. My manager assigned new projects to me according to my product knowledge. Usually, I would have 25 to 35 major and minor projects assigned to me at any given time for a five-month period. I usually worked on one to two major projects and up to four minor projects at the same time. Most projects overlapped each other, requiring me to prioritize my time to meet deadlines. Some of the minor projects—such as a technical sheet—were completed in five business days and did not overload my work schedule. However, if one project overloaded my work schedule, my manager would reassign some of my projects to other technical writers to balance my workload. Additionally, my manager would assign me projects from other technical writers in Information Development to balance their workload as well.

Overall, the minor projects provided multiple opportunities for incidental learning in various computer technologies. During my first 18 months of employment at Dell, my manager recognized my interest in and understanding with cluster solutions (multiple computer systems that are connected together to work as one system) and asked me to become a subject matter expert (SME) in this technology. However, she also understood my interest in understanding a wide variety of hardware and software technologies and assigned various minor documentation projects to me so that I could broaden my understanding of enterprise systems. In most cases, these projects required me to become an expert in quick study, learning new technologies “on-the-fly” to understand the hardware and/or software components and explain the problem and solution to a broad audience. Through this process, I learned a valuable lesson as a technical writer at Dell: approaching each new documentation project from a computer illiterate perspective can add value to my documentation by allowing me to view the system from a customer’s perspective.

For example, when I was developing Section 1 of the Dell PowerEdge Cluster FE100/FL110 and FE200/FL200 I&T Guide (see Appendix D), I didn’t understand clustering technologies, such as virtual servers and quorum disks. Most of Section 1 required me to conduct informal interviews with the cluster engineers, research clustering technology on the Internet, and ask my Info Dev colleagues about their knowledge (or lack of knowledge) about clusters. Asking questions and researching clustering technology from a novice perspective helped me to identify and document the key cluster hardware and software components so the user could have a basic understanding of PowerEdge clusters.

## Chapter 3: One Major Project—Writing an Installation and Troubleshooting Guide

This chapter describes one of my major projects: researching and writing the Dell PowerVault 75xN NAS Cluster Installation and Troubleshooting Guide (or I&T Guide).

I have chosen to use a modified version of the Masters of Technical and Scientific Communication (MTSC) problem-solving model to describe my activities on this project because, as a heuristic, it served me well in completing this task. A description of the MTSC Problem-Solving Model is located in Appendix E.<sup>1</sup>

In order to adapt the MTSC model to the Dell context, I included additional tasks that ensured the integrity and accuracy of my outcome: I added stages to the MTSC model to parallel my documentation process. My report follows the modified process. Therefore, in addition to a new section entitled “Background” that further explains the writing problem, the following sections are also included as topics in this chapter:

- Investigate the Background
- Analyze the Problem
- Plan the Solution
- Write and Edit the Solution
- Test the Solution
- Verify the Procedures
- Revise the Solution
- Approve the Solution
- Repackage the Solution
- Implement the Solution
- Evaluate the Solution

---

1. Anderson, Paul V. "What Technical and Scientific Communicators Do: A Comprehensive Model for Developing Academic Programs." In Flammia, Madelyn, ed., Perspectives on the Profession of Technical Communication. Arlington, VA: Society for Technical Communication, 1995.

The following subsections describe the details for each task.

## **Investigate the Background**

A system administrator is someone who manages the computer systems for a company. One of the responsibilities of a system administrator is managing storage space on a corporate network. In some cases, this involves asking users to delete old files and provide a little more space on a network server, but the inevitable fact that faces most system administrators is that additional storage space will be required in the future.

Adding an additional storage device is not an easy or inexpensive task. Not only can a storage system be expensive to replace, but installing the storage system can require more than a day and can inhibit users from accessing their critical data. Hence, replacing a storage device is expensive, complicated, and troublesome for both an organization and its network clients.<sup>2</sup> Further, when storage devices become overloaded, they can fail—or they can simply fail as a routine matter. When a company experiences excessive system downtime (the span of time when a computer is not functioning correctly due to a hardware or software failure), the resulting loss of productivity can also be very expensive.

To solve these problems, the PowerVault NAS Cluster engineering team developed a specialized storage system powered by a Microsoft Windows®-based operating system that provides a systematic solution to the storage problem: The Dell PowerVault 75xN NAS Cluster solution.

The Dell PowerVault 75xN NAS Cluster combines two types of technologies: A NAS hardware system and the clustering software built into specific versions of the Windows 2000 operating system.

A NAS system is a storage system that is streamlined to perform one task: share and distribute computer files and documents with network clients. The system runs the Windows Powered operating system, a stripped-down version of the Windows 2000 operating system. Because the Windows Powered operating system is dedicated to performing one task, the storage system can quickly move data to and from the system to the network client faster than a standard storage system.

---

2. Blizinski, Dan. Selecting the right NAS appliance for your workgroup LAN. Dell Power Solutions. ([http://www.dell.com/us/en/esg/topics/power\\_ps4q00-blizin.htm](http://www.dell.com/us/en/esg/topics/power_ps4q00-blizin.htm)).

Clustering is the process of combining two or more systems together so they work together as a single system. Using the clustering software component built into the Windows Powered operating system, the system's clusters provide an automatic failover solution for a potentially failed NAS system. By combining two storage systems together in a cluster, a company can minimize their downtime and ensure that their network clients will always be able to access their data.

Appendix F lists the hardware and software components in a NAS cluster solution.

In a client/server environment, a network client (or user) connects to a physical server on the company network with a unique Internet Protocol (IP) address and network name. If the storage system crashes or fails for any reason, the users will not be able to access their data. In a PowerVault 75xN NAS cluster, however, the user does not access a physical server but a virtual server—a network resource managed by the Microsoft Cluster Service (MSCS) that is not associated with a physical server. If one of the cluster nodes fails for any reason, the Cluster Service moves (or “fails over”) the virtual servers from the failed node to another node in the cluster. The process is transparent to the user, and the user experiences only a momentary delay in data access.

This failover capability ensures that the user's data is always available while the network or system administrator repairs or replaces the failed cluster node. When the failed cluster node is repaired, the Cluster Service “fails back” the responsibilities to the “failed” node. Maintaining a high level of access to user resources is called high availability, one of the primary concerns in today's business environments, as Erik Ottem of Gadzoox Networks explains:

Given twenty-four hour, seven-day week a utilization, 99% availability translates to data being unavailable the equivalent of 3.9 days per year. Critical applications would generally not accept this amount of downtime, whereas some applications would find this acceptable. Think of your manufacturing management application not available for almost 4 days a year. Could your business afford it? Probably not.<sup>3</sup>

---

3. Ottem, Erik. (2001). Availability. Fibre Channel Focus, Issue 5, 67-69.

While most companies today cannot afford days—or even hours—of downtime, the question is, how much guaranteed data availability can they afford? The answer: it depends. Erik Ottem explains:

Moving to 99.99% availability translates to a more acceptable 8.8 hours of downtime in a year. But it might also cost ten times as much for such a system. Is it worth it? The reason an application is important to a business is the economic value per hour it has to that business. For example, at a major financial center it might cost \$2 million per hour for such downtime, but non-critical applications may cost only \$10,000 per hour or less. Thus there is a gradient of trade-offs that must be assessed. This, in turn, has led to a gradient of High Availability options, each with its own cost/benefit ratio.<sup>4</sup>

Because the need for high availability storage is a critical concern in business today, Dell created the PowerVault 75xN NAS Cluster solution as an affordable, high availability data storage solution that is relatively easy to install into a corporate network. This solution is one of many high availability PowerVault NAS Cluster solutions currently being offered by Dell.

I was chosen to create the I&T Guide for the PowerVault NAS Cluster because I had already gained experience in documenting PowerEdge Fibre Channel Clusters—cluster solutions that store application software ranging from Microsoft SQL (Simple Query Language) Server to Microsoft Office. The clustering technology implemented into PowerVault and PowerEdge clusters is exactly the same. The main difference between the types of cluster configurations is the function of the cluster on the network: PowerEdge Clusters provide high availability for software applications, and PowerVault Clusters provide high availability for data files that are generated by software applications.

Table 3-1 describes the features of both PowerVault NAS clusters and PowerEdge clusters.

---

4. Ottem, Erik. (2001). Availability. Fibre Channel Focus, Issue 5, 67-69.

**Table 3-1. PowerVault NAS Clusters and PowerEdge Server Clusters**

<b>PowerVault NAS Cluster</b>	<b>PowerEdge Server Cluster</b>
Provides high-availability for document files	Provides high-availability for software applications
Distributes document files to network clients that are stored on the cluster nodes	Runs applications for network clients and stores document files on attached storage devices
Clustered NAS systems run the Windows-Powered operating system—a minimized version of Windows 2000—with Cluster Service	Clustered servers run Windows 2000 Advanced Server with Cluster Service

My major goal in the documentation project was to assemble, within forty-five days, an I&T Guide for network administrators that would provide the necessary installation and troubleshooting procedures for implementing a PowerVault 75xN Cluster in a corporate network. Normally, an I&T guide requires about three weeks of research and development and another three weeks for reviews, production, and printing. Since the timeline on this project was about six weeks, the project engineers provided me with an initial document markup of an I&T Guide from a previous PowerEdge Cluster project that highlighted the changes in the new cluster solution.

A document markup is created from a “leveraged” document—a manual or guide that contains the basic components, structure, and content for a new computer system. Since Dell designs computer systems based on customer needs, many of these systems are updated with new components to address multiple customers—for example, the addition of larger storage systems, faster servers, or updated hardware components that develop into an entirely new system. Rather than creating a new document from scratch, Info Dev technical writers update existing documents with new information, thereby reusing existing content and artwork and saving them hundreds of hours in research and development.

Configuring a cluster system—whether it is a PowerEdge or PowerVault cluster system—requires an engineer to follow a specific order of events in order to install and configure the cluster properly into a corporate network. Appendix G lists these events in the order that they are performed by an engineer configuring a cluster system.

Since PowerEdge cluster documentation includes all of these procedures, the PowerVault strategist in charge of this project selected an existing PowerEdge cluster document: The

PowerEdge Cluster FE100/FL100 and FE200/FL200 Installation and Troubleshooting Guide—a guide that I had written six months prior to writing the PowerVault 75xN NAS I&T Guide as the basis for the markup document.

Organizing a “leveraged” document (an existing document that is used as a starting point for a new document) involved a process of elimination and addition. Using the Table of Contents (TOC) as a guide, the PowerVault strategist and lead engineer reviewed the subsections in the TOC and crossed-out the headers that didn’t apply to the NAS system. Next, they added header titles to the TOC where new information needed to be added to the guide. Finally, using the edited TOC, they reviewed the entire document—using the TOC as a guide—and noted where information needed to be added or removed in the document. This “markup” provided me with a starting point to begin the writing process and identify sections where I needed to research the system and add new information. PowerEdge and PowerVault NAS clusters have similar components and configuration. However, some of the text in the PowerEdge cluster document was not applicable to a PowerVault cluster. Hence, for many chapters, the markup simply provided me and the project team with a starting point, an awareness that we would need to provide information for the user on how to install and troubleshoot a PowerVault NAS cluster.

Appendix H provides a Table of Contents for the PowerEdge Cluster FE100/FL100 and FE200/FL200 Installation and Troubleshooting Guide. Appendix I provides the Table of Contents for the PowerVault 75xN NAS Cluster I&T Guide.

Both I&T Guides were developed in an identical manner. Both I&T Guides provide a general overview of clustering, detailed procedures on installing the required hardware and software components, information on how to configure the MSCS software that provides the cluster failover capabilities, and details on how to troubleshoot the system. However, both guides have been developed for two different sets of users.

PowerEdge clusters are installed in a corporate enterprise and require complex hardware and software configurations. When a customer purchases a PowerEdge cluster, the cluster solution—which may cost the customer well over \$100,000—is installed in the customer’s enterprise by trained Dell engineers. Hence, the PowerEdge Cluster I&T Guide is an owner’s manual that describes how to perform maintenance procedures and how to install additional hardware

components to the cluster solution. Additionally, since PowerEdge clusters were a relatively new product when I developed the I&T Guide, I provided the user with a detailed overview of clustering technologies and processes in the introductory section.

PowerVault NAS clusters are also installed for a corporate enterprise, but require less complex hardware and software configurations. A PowerVault cluster—which costs thousands of dollars less than a PowerEdge cluster—uses the same type of clustering technology as PowerEdge clusters, but on a smaller scale. PowerEdge clusters provide failover for running applications, such as Microsoft Word or Adobe FrameMaker. PowerVault clusters provide failover for documents and files, such as Word or FrameMaker documents. Hence, the PowerVault 75xN NAS Cluster I&T Guide is also an owners manual on how to perform maintenance procedures and install hardware and software components, but in a smaller and simpler context.

My goal was to develop the I&T Guide for the PowerVault 75xN NAS cluster using the guidelines provided by the project engineers. To complete this goal, I needed to add additional material that was specific to the PowerVault 75xN systems by performing the following tasks:

- testing the installation procedures in the NAS Clusters computer lab
- interviewing the project engineers
- researching the hardware and software components using the company intranet and the Microsoft knowledge base located on Microsoft's website at <http://www.microsoft.com>

### **Analyze the Problem**

My first task was to ask some basic questions about the purpose of the I&T Guide. What is the purpose of the document? Who are the users that will be reading the document? What kind of tone should I use in the document text? What is the typical educational level of the end users? What do they know about NAS and clustered systems?

### **Reviewing the Product Specs**

To answer some of these questions, I studied all of the engineering documentation associated with the PowerVault 75xN NAS Cluster solution. One of the engineering documents provided me with information about installing, configuring, and troubleshooting the PowerVault 75xN Cluster and

hardware components. Basically, the I&T Guide that I would create would be an all-inclusive handbook on how to install, operate, and troubleshoot the cluster solution.

## Identifying the Audience

I studied the demographics of the customers who would purchase a PowerVault 75xN NAS Cluster. Since the PowerVault 75xN NAS Cluster is a relatively inexpensive cluster solution that is easy to install and implement into any corporate network, both small and large companies would purchase this product. Additionally, a NAS cluster connects to a corporate network using an Ethernet connection and can be installed and configured by computer novice, as well as an experienced system administrator. Hence, I needed to address both novice and experienced users in the document by briefly explaining complicated hardware and software technologies as needed.

Next, I reviewed the I&T guide's translation requirements. I learned that the guide would be translated into French, German, Spanish, and Japanese, and delivered outside of the United States to regional Dell distributors in both Europe and Asia. To address the wide variety of audiences and cultures reading this document, I had to use clear and succinct language throughout the document so the translators could translate the text into the appropriate language. Additionally, I have to review a "word list" that is posted on our corporate network to conform to Dell standards and not confuse the translators, as well as the audience.

In some cases, there are certain English words and phrases that can easily be misunderstood by the translators. For example, when I completed my first cluster document and sent the document to translation, the translator asked me for a definition of a "quorum disk"—a hard drive in the cluster's storage system that stores cluster configuration data. Since I did not provide a description of the quorum disk in the document, the translator believed that the quorum disk was a floppy disk that the user inserts into the floppy disk drive. Consequently, I had to provide him with an explanation: I should have explained the term in the document.

Next, I studied the marketing documentation for the cluster solution most of which discussed the business problem and how the cluster solution would solve that problem. These documents helped me to understand the size and type of organization that might purchase the cluster solution.

I studied the types of people who might read the I&T guide by attempting to understand the complexity of a NAS cluster solution. PowerVault NAS systems can be installed and configured into a corporate network in just a few minutes by someone with minimal computer skills. However, a PowerVault 75xN NAS Cluster solution—a group of file servers that work together with failover capabilities—is much more involved and must be configured by someone with experience in computer network systems, usually a systems administrator. Hence, the reading audience for the I&T guide ranged from intermediate to advanced.

### Interviewing the Project Team

To analyze the expectations of the project team, I interviewed each member of the team, asking them for their requirements. Their responses were as follows:

- **Marketing Manager**—explain clustering technology and how this technology could benefit the users and their organizations
- **Lead Engineer**—incorporate a user-friendly tone and explain any complicated or new technologies
- **Customer Service**—explain everything in detail to minimize customer calls to the Help Desk

The project team’s requirements were (and are) standard goals that all technical writers must incorporate into their documentation, so the team members’ requirements were a significant part of my project objectives.

I read through some of the existing system documentation for PowerVault storage systems to identify the tone and voice that my colleagues used in their PowerVault documentation.

Unfortunately, each of the documents I read had a different tone—ranging from authoritative to user-friendly. For example, in reading one of the user guides for a PowerVault system, however, I noticed that the procedures in the guide walked the user through the steps as if the guide were an actual Dell engineer helping the readers solve their problems. The voice was authoritative, stating that the user “must perform” certain procedures in order to solve a problem. However, because clustering technology is difficult to understand, I didn’t want to discourage the readers by talking down to them.

To address this issue, I replaced the “must perform” statements with a reason that explained why a user should perform a particular action; I wanted to be sure so they would understand its importance to proper cluster configuration. For example, I replaced the statement “You must configure node 1 before you configure node 2” with “To ensure that MSCS is installed properly, configure node 1 before you configure node 2.”

Another concern involved the political implications of modifying the document itself. The original text was written by the strategist in charge of cluster documentation. As a new employee with little experience in the computer industry, I did not want to challenge another writer who had more experience writing about computer systems. However, while attending new-hire classes during my first few months at Dell, managers encouraged me to become an individual thinker, to make suggestions where I thought changes were needed in the organization, and to strive to change processes and methodologies to improve the customer experience. Hence, I decided to ignore the current writing style of my peers and suggest a friendlier writing style to the project team.

According to Dan Jones, author of Technical Writing Style:

Although many technical documents have an impersonal tone, many impersonal technical documents would achieve their purpose far more effectively if they were written in a less impersonal tone. Writers of technical prose can use first- and second-person pronouns in many types of technical documents, and they can use analogies, examples, details, and even personal anecdotal information people can relate to. And often writers of technical prose can avoid the institutional passive and write in a straightforward active voice style. One of the major reasons for the virtual renaissance of science writing in the 1970s, ‘80s, and ‘90s, is the ability of so many gifted scientists and science journalists to humanize their subjects for their readers. Lewis Thomas, Oliver Sacks, Stephen Jay Gould, Paul Davies, Stephen Hawking, Peter Medawar, Loren Eisely, and numerous others have found just the right balance of scientific and technical information and a personable tone. Tone is, in part, a matter of attitude and emotion, the attitudes and emotions you want to convey about your subject and audience.<sup>5</sup>

---

5. Jones, Dan. Technical Writing Style. Needham Heights, MA: Allyn & Bacon, 1998.

I explained to the project team that while this guide would be directed to experienced system administrators, additional readers might include new system administrators or system technicians who would require elementary training in clustering technology. To address this issue, I added an “overview” section in the guide that explained complicated technologies and components in a PowerVault 75xN NAS Cluster, thereby providing the users with a general understanding of the NAS Cluster solution and understand how this solution could be implemented in a corporate network. The project team agreed with my explanation, and I chose a user-friendly style of writing for the guide.

For example, when I wrote the PowerVault 75xN NAS Cluster I&T Guide, I included a section entitled, “Overview of NAS Clusters,” which provided a description of the system, the basic components of the system, and a short overview of how clusters failover open applications to another NAS appliance. Since the PowerVault 75xN NAS Cluster was the first clustering solution for a NAS appliance, I provided the following explanation:

As an integrated system, the PowerVault 75xN NAS Cluster is designed to dynamically handle most hardware failures and downtime. In the event that one of the cluster nodes fails for any reason, the processing workload of the failed node switches over (or fails over) to the remaining node in the cluster. This failover capability enables the cluster system to keep network resources and application programs up and running on the network while the failed node is taken offline, repaired, and brought back online. The failover process is transparent and network clients experience only a momentary delay in accessing their resources. After the failed node is repaired, the network resources can be transferred back to the original node, if desired.<sup>6</sup>

Appendix D provides a sample of Section 1 from the leveraged PowerEdge Cluster I&T Guide.

Appendix J provides an example of Section 1 from the PowerVault NAS Cluster I&T Guide.

## **Plan the Solution**

After I analyzed the purpose of the document and selected the appropriate voice and tone, I began to plan my strategy for developing the document.

---

6. [Dell PowerVault 75xN NAS Cluster Installation and Troubleshooting Guide](http://docs.us.dell.com/docs/stor-sys/spv75xn/en/cls_it/3k064c10.htm) ([http://docs.us.dell.com/docs/stor-sys/spv75xn/en/cls\\_it/3k064c10.htm](http://docs.us.dell.com/docs/stor-sys/spv75xn/en/cls_it/3k064c10.htm))

In planning the solution, I encountered two problems. The first problem I encountered was time. The project required me to research, write, and edit the document, go through the review and approval process, repackage the document in HTML/PDF format, administer all of the tasks involved in these procedures, and then send the document to print using a minimized schedule. Managing each stage in the documentation process, a normal requirement of technical writers in Info Dev, requires a technical writer to learn a variety of “soft skills,” such as multitasking, interviewing, and managing people. Consequently, I learned throughout this project and through weekly meetings with my manager that Dell expects everyone, including technical writers, to excel beyond their limitations and learn how to perform a variety of tasks throughout their career at Dell. The turnaround time for this document, from start to finish as I stated before, was about forty-five days, compared to the average requirement of 60 to 70 days to research, write, and complete an I&T Guide. In order to complete the I&T guide in the shortest amount of time, the Info Dev strategist for PowerVault documentation projects interceded by meeting with the project team to discuss the time factor and negotiate additional time in the schedule. As a result, the project team provided Info Dev with two additional weeks to complete the I&T Guide, which provided me with the additional time I needed to complete the I&T Guide in a timely manner.

The second problem I encountered during the planning phase of the I&T Guide was deciding how many illustrations were appropriate for the guide. PowerVault Clusters are complicated systems that require complex cabling configurations, most of which are difficult to describe in text. Balancing the number of illustrations with the text in the document required a lot of thought and consideration.

According to Karen Shriver, author of Dynamics in Document Design: Creating Text for Readers:

It is important for document designers to plan carefully how a supplementary prose and graphic combination should function within the structure of a document. Unneeded additions can be distracting and unsystematic additions can be confusing. Moreover, randomly added pictures may inappropriately lead readers to believe that the topics with pictures are more important than those without pictures.

Words and pictures that complement one another employ different visual and verbal content and both modes are designed to work together in order to help the reader understand the same

main idea (the same referent). Together, the two modes render the idea more fully than either does alone because each provides different information about the idea.<sup>7</sup>

I reviewed my concerns with the lead engineer, and we decided to create illustrations that highlighted the cable connections to the cluster components. We also added an additional illustration for the small computer system interface (SCSI) expander management module, which is required to enable the clustering functionality in the shared storage systems.

### **Write and Edit the Solution**

After I studied the problem and planned the solution, I created a project directory on the corporate network—a simulated file folder on a shared Info Dev storage system that contains the documentation files for the project. Next, I moved the PowerEdge Cluster FrameMaker files into the project directory and assembled the FrameMaker files into a book. Next, I printed the PowerEdge Cluster document and created a markup of the illustrations for the document. Finally, using the information I gathered while analyzing the problem, I developed a set of objectives for this document project and included the list in a project folder for quick reference. These objectives included:

- Use clear and succinct language
- Ensure that the content is accurate and verified by the project team
- Incorporate illustrations that clarify the text in the guide
- Describe complicated components and technologies (for example, quorum disk) in detail to minimize calls to the Help Desk
- Explain clustering technology and how this technology could benefit the users and their organizations
- Incorporate a user-friendly tone

---

7. Shriver, Karen A. *Dynamics in Document Design: Creating Text for Readers*. New York: (John) Wiley Computer Publishing, 1999.

## Creating the Illustrations

Many of the basic illustrations I needed for the I&T guide were in the PowerEdge Cluster I&T Guide, but I also needed to add new illustrations that were unique to a PowerVault NAS Cluster. The illustrator requires at least three weeks' lead time to create the illustrations and place them in the document. My main concern here was ensuring that the illustrations were correct before I gave them to the illustrator, thereby preventing any delays between document reviews. Some of my colleagues use a pencil or pen and draw the changes in the illustration, but this process can be problematic. Since an illustrator is visually oriented, it seemed to me that I should create the illustrations exactly as they should appear in the document, thereby minimizing the number of reviews and the illustrator's time.

To begin, I created a rough draft of the I&T guide so the illustrator could have an overall view of the document. Next, I reviewed each illustration currently in the document, making notes of illustration changes and additions that needed to be made using the markup given to me by the lead engineer. Since I needed illustrations of the PowerVault 750N and 755N cluster nodes, I asked the illustrator to print out the front and back illustrations of each system. I minimized the illustrations so they would be a workable size in the copying machine. Next, I located rear view illustrations of the PowerVault 210S and 211S storage systems and a PowerEdge RAID Controller (PERC), minimized the images accordingly in the copying machine so they would fit inside the master illustration, and printed out about 10 copies of each image. Using a pair of scissors and some transparent tape, I assembled the minimized copies of the cluster nodes and the PERC into one illustration, using the markup project provided for me as a guide. I repeated this process for each new illustration in the I&T guide.

After I created and modified the illustrations, I drew the cable connections, labeled each change or addition with a number, and listed the numbers and their relative procedures at the bottom of the page.

To ensure that the illustrations were correct up to this point in time, I asked the lead engineer to review the illustrations for accuracy before I gave them to the illustrator. He noted a last-minute change in the system configuration, causing minor changes to two of the illustrations. I corrected the illustrations, verified them with the lead engineer, and gave the I&T guide with the corrections

to the illustrator. Appendix K provides examples of the illustration markups that I gave to the illustrator and the final illustrations.

Next, I read through the additional material given to me by the lead engineer, added the hardware and software specifications from the engineering and marketing documents, modified the text so it would have a user friendly tone, and placed the text in the appropriate sections of the document. Most of the material provided by the lead engineer included specific procedures on configuring the NAS Cluster configuration, which I placed into Section 5, “Installing and Configuring the NAS Cluster Configuration.” Since the I&T guide was missing information that explained some of the main components in clustering technology, I added additional text for failover and failback, the quorum resource (the cluster database used for failover and failback), and cluster nodes into Section 8, “Using MSCS.”

### Interviewing the Lead Engineer

In the process of researching and writing the I&T Guide, I had a lot of questions about some of the cluster components. Rather than calling up the lead engineer every few minutes with my questions, I collected my questions, prepared for an interview, and met with him in person. Since I had experience documenting Fibre Channel Cluster solutions, I had a basic understanding of clustering terminology and could speak with the lead engineer as a knowledgeable technical writer.

In his book, Information in Action: A Guide to Technical Communication, M. Jimmie Killingsworth explains one of the guidelines for conducting interviews:

Be prepared when you enter the interview. Never go in cold; never “wing it.” You should be as thoroughly informed as possible when you talk to others about your topic. Don’t waste their time by asking them to explain something that you could have learned from a quick reading.<sup>8</sup>

### Clarifying the Terminology

Some of the cluster terminology was inconsistent throughout the document. For example, the private network that connects both cluster nodes together was referred to throughout the

---

8. Killingsworth, M. Jimmie. Information in Action: A Guide to Technical Communication. Needham Heights, Massachusetts: Simon and Schuster, 1999.

document as “cluster interconnect,” “private network,” and “crossover cable.” The private network is a dedicated network that isn’t linked to the local area network (LAN) and is used by the Cluster Service to transmit “heartbeat” information between the cluster nodes.

A heartbeat is periodic conversation (or “query”) between the Cluster Service—the clustering software in the operating system—and the cluster nodes, verifying that each node in the cluster is running properly. These queries include two specific commands, both of which are sent to the cluster nodes at preconfigured time intervals. Table 3-2 lists the heartbeat commands with a definition and an English translation of each command.

**Table 3-2. Heartbeat Commands**

<b>Command</b>	<b>Definition</b>	<b>English Translation</b>
Looks Alive	A general check of the cluster node	“What’s up?”
Is Alive	A detailed check of the cluster node	“How are you? Are you OK?”

These queries occur each second, causing the hard drive indicator light on each cluster node to blink once every second, similar to a heartbeat. Hence, these query transmissions are called “heartbeats.”

After checking the PowerEdge Cluster documentation, I found that “public network (cluster interconnect)” was used in sections containing networking information; “cluster interconnect” and “crossover cable” was used in illustration call outs to identify the 10BaseT Ethernet crossover cable attached to the network interface controller (NIC) in both cluster nodes. The problem I found with these terms is that system administrators and hardware technicians use different terms that refer to the same thing. To clarify, I used “private network” when referring to network connections and “crossover cable (cluster interconnect)” when referring to physical connections.

## Creating the Index

Creating a user-friendly index required a lot of thought and preparation. According to Nancy Mulvany, author of Indexing Books, creating an index is not a step-by-step process:

Indexing cannot be reduced to a set of steps that can be followed! It is not a mechanical process. Indexing books is a form of writing. Like other types of writing, it is a mixture of art and craft, judgment and selection.<sup>9</sup>

To create the index, I read through the entire document and highlighted words and phrases that users might access while they configured their cluster. For example, the quorum resource is a vital part of the cluster, but the definition is not easy to find in the I&T Guide. As a result, I included the quorum resource in the index. Next, I placed index markers in front of the highlighted words and phrases so FrameMaker would include these words in the index. Finally, I regenerated the book, printed the index, and reviewed the index to ensure that it was clear and concise.

### **Test the Solution**

Because Section 5 contained new procedures provided by the lead engineer, I needed to test the procedures in the subsection, “Installing and Configuring the NAS Cluster Configuration” to ensure that they were correct. While the procedures in the remaining sections were somewhat generic to PowerEdge and PowerVault clusters and required minimal changes, the information in this section was specific to the PowerVault 750N and 755N systems. The procedures in this section involved setting up and configuring the PowerVault 750N and 755N systems as cluster nodes—installing the operating system and storage management software and configuring the Cluster Service, the software that provides the failover and failback support for the cluster nodes. Testing these procedures, as well as the remaining procedures in the I&T Guide required about five hours in the NAS Clusters lab. Since the procedures were common to both PowerVault 750N and 755N clusters, I didn’t need to test these procedures on a PowerVault 755N cluster.

Section 5 of the I&T Guide also explains how to configure each cluster node, create the network resources, and bring the cluster nodes online using the procedures written by the lead engineer. My goal was to ensure that the procedures were correct. I tested the procedures in Section 5 with a PowerVault NAS cluster engineer. The lead engineer was also present for most of the testing. To test the procedures in Section 5, the NAS cluster engineer and I performed the following tasks on a PowerVault 750N cluster: we cabled the storage systems to the server systems, assigned IP

---

9. Mulvany, Nancy C. *Indexing Books*. Chicago: The University of Chicago Press, 1993.

network addresses to both server systems, configured the hard disks in the storage systems, configured the server systems as cluster nodes, and brought the cluster nodes online.

One of the main problems I found when performing the procedures was the lack of reference points after each step. For example, in the subsection, “Creating an IP Address,” the user is instructed to select a new resource from the File menu and then fill in the appropriate fields. But after clicking “Next,” the procedures state to add or remove dependencies by clicking items in a new window that was not identified in the text. Since the documentation did not include screen shots as a rule, I needed to tell the user what he/she would see on the screen. Therefore, I added statements after each user action that described what the user would see, such as “The Possible Owners window appears.” If the user had to step away from the task for a moment, he or she could find the name of the open window in the text and start from there.

Making these notes was very time consuming, so while I was testing the procedures, one of the engineers became impatient with me, encouraging me to move on to the next step before I had a chance to make corrections in the previous step. Many of the steps in the procedures required me to read the information boxes in the graphical user interface (GUI) and ask the engineer for clarification, which in some cases took up to five minutes for each step. The engineer asked repeatedly if he could continue following the procedures in the manual while I was making the needed corrections. To ensure that I was documenting the procedures correctly, I had to calmly ask him to wait while I recorded the procedure. Since he had other work to do, he located another engineer returning from a break who worked with me to complete the procedures in the document.

It could have been very easy for me—or another technical writer in my position—to be intimidated by the engineers and capitulate. However, over the course of my employment at Dell, I have learned that being a technical writer requires standing up for not only the user, but for myself as well. In most cases, a Dell technical writer has to be both a politician and a “roaring lamb:” cordial and polite, but firm and vocal when needed. In fact, being assertive seems to be expected by Info Dev management in order to keep deadlines and get the job done. However, since I would be working with this engineer during the project, I needed to find a balance between being friendly and moving forward to get the information I needed to complete my document.

In her article, “The Interviewing Conundrum,” Kelly Boyer Sagert suggests that interviewing is more like a balancing act than a procedure:

Here's the interviewing conundrum. The writer must ask all the pertinent questions and ensure the accuracy of the answers. But a good interviewer is also willing to veer off the subject if a more engaging one surfaces—and so begins the balancing act. My personal solution is this: I research the subject of the interview and jot down thoughts in preparation, but I never create a hard and fast set of questions. I want my interviews to have the flavor of a pleasant yet professional conversation.<sup>10</sup>

Luckily, since I had a working relationship with the lead engineer, he intervened and allowed me the time required to make the needed changes for each step. When I was finished, I thanked both engineers for their time and drove back to my office to update Section 5.

### **Revise the Solution**

I revised the I&T Guide based on the test procedures and any additional comments I received from the lead engineer. I ran the spell check utility in FrameMaker, printed out the document, and, using Microsoft Outlook (an e-mail and scheduling software application used by every Dell employee), I made a two-hour “appointment for myself” to proofread the document in the cafeteria adjacent to my work area. Moving away from the distractions of my work area helped me to give my undivided attention to the document, review each chapter and make notes where I needed to add, modify, or delete text.

After I proofread the document, I created a PDF of the I&T Guide and sent a copy to the editor, the project team, and a list of assigned reviewers that I generated from a corporate review list. I gave the reviewers five working days to review the I&T Guide. On the fifth working day of the document review period, I received editorial comments from the document’s editor, the project team, and a few people from the corporate review list. Using their comments, I modified the document, updated the index, and gave a second copy to the editor for review. When she finished reviewing the document and provided comments to me, I modified the document according to her comments and then sent out the document for a second review to the project team.

---

10. Sagert, Kelly Boyer. The Interviewing Conundrum. (<http://www.poewar.com/articles/interviewing.htm>)

## **Approve the Solution**

After I received comments from all of the document reviewers, I scheduled a two-hour final review meeting with the project team through Microsoft Outlook. The document was about 150 pages long, and two hours is usually the appropriate amount of time to cover this amount of material, even though some documents can be 75 pages long and require more than two hours of review time. The key to having a successful two-hour final review, however, is to ensure that the project team is comfortable with the document prior to final review and that each member of the project team stays focused on the document during the meeting. Since I scheduled the meeting, it was my responsibility to lead and manage the meeting.

As required for every major document that I write in Info Dev, I sent an invitation to the editor, lead engineer, technical reviewers in engineering assigned to review the document, engineering manager, marketing manager, customer service manager, and the PowerVault Strategist in charge of PowerVault documentation. To prepare for the meeting, I verified that all comments sent to me by the project team were included in the final version of the document. Next, I printed out a copy of the document for every member of the project team. Finally, I drove to the Round Rock facility, located the conference room, and ensured that the room was not double-booked by another project team. If two people reserve a room in Outlook at the same time, the software program can sometimes get confused and reserve the room for both people. If this problem occurs, I have to locate another conference room or alternative meeting location (such as the cafeteria) to conduct the meeting. This problem is one example where a technical writer must practice some management skills to ensure that the meeting occurs on time.

On the day of the final review, we spent two hours reading every page of the I&T guide, ensuring that the information in each section was correct. As the technical writer for this document, it was my responsibility to manage the final review and ensure that everyone maintained a steady pace so we could complete the review within two hours. To do this, I identified the slowest team member in the room and used his reading speed as the norm. For example, when the slowest team member finished page 25, I asked everyone in the room if there were any comments for page 25. If everyone said no, then we proceeded. I continued this process until we finished the entire guide.

When the meeting was over, I updated the I&T Guide with the reviewers' comments and sent a final copy to all of the reviewers. If additional changes were required, the reviewers sent them to

me via e-mail, I modified the document accordingly, and sent the document out for final review. If the reviewers were content with the final version, they approved the document by replying to the final review e-mail with the word “approved.” The e-mail reply I received from each reviewer was considered their formal signoff on the I&T Guide.

After I received approval from the reviewers, I sent the document to the Info Dev managers for final approval. In this review, managers reviewed the illustrations, document structure, and grammar to ensure that the document met Info Dev standards. After they completed the review (they did not find any errors in the document), I notified the production specialist who then sent the document files to the printer.

### **Repackage the Solution**

Most system documentation at Dell is distributed to Dell customers in three formats: printed manuals, PDF, and HTML. The PDF and HTML versions are posted to the Dell Support Web site located at <http://support.dell.com>. In order to post the FrameMaker documents to the Dell Support Web site, I converted the FrameMaker documents to HTML.

Converting the I&T Guide to HTML requires Quadralay Webworks Publisher—a specialized FrameMaker-to-HTML conversion software—and a production specialist who performs the conversion. After the document received final approval by Info Dev management, I notified the production specialist who performs the FrameMaker-to-HTML conversion for our department. After he converted the document to HTML, I reviewed the document and then notified the I&T Guide’s editor, who performed a final review of the HTML to ensure that the conversion process didn’t modify the document in any way.

### **Implement the Solution**

After the document was converted to HTML and approved by the editor, another technical writer created an HTML index page for the PowerVault 75xN Cluster documentation and posted the documents to the Dell Support Web site. On some document projects, the same technical writer who creates the documentation posts the documents to the Web site. Since I wasn’t the assigned writer for this task, it was my job to ensure that the HTML docs were placed in a project subdirectory on the internal Web site labeled “ready to post” so the technical writer who posted

the I&T guide could locate the document in the project directory. I created and labeled the directory and then notified the writer assigned to post the I&T guide to the Dell Support Web site.

### **Evaluate the Solution**

When all of the PowerVault 75xN Cluster system documentation was completed, the PowerVault strategist scheduled a meeting with all of the Info Dev personnel involved with this project.

During the meeting, the strategist asked everyone about the problems and successes they experienced with their portion of the project and how the problems could be avoided in future document projects. The PowerVault strategist noted everyone's comments in a standardized form that listed the problems, solutions, and the lessons learned for each document.

For example, I met with the lead engineer and project team three weeks before first review to verify the scope of the document—including the content, additional procedures, and illustration requirements—so I could begin my research and give the illustrator accurate illustration markups. The strategist noted the project team's availability in the form, stating that this meeting helped me and Info Dev personnel understand the requirements for the doc and create an accurate document for first review.

After the strategist completes the form, he/she presents the form to his/her manager. After the meeting, the form is submitted to the engineering manager on the project team to evaluate for future projects.

## **Chapter 4: Analysis of the Problem-Solving Model**

This chapter of my report is an analysis of the problem-solving approach that I employed in my major project.

In this chapter, I focus my attention on adapting the problem-solving model to Dell documentation. Additionally, I provide a summary of the documentation process and discuss some lessons I learned while working with computer engineers.

### **Adapting the Problem Solving Model to Dell Documentation**

The MTSC Problem-Solving Model provides a generic (or “elegant”) method to solve a communication problem using a structured and itemized heuristic: the model provides an overview of the many facets involved with solving a communication problem. However, because all communication problems are not alike, the model must be modified to apply to each situation outside of the classroom. When I used the problem-solving model as a guide for my major project and my other documentation projects, it provided me with an overall structure for developing Dell documentation that was unavailable during my initial training as a technical writer at Dell.

During my first few weeks at Dell, I learned that the Info Dev department does not provide a technical writer with a formal process that describes how to research, develop, and complete a technical document. All of the technical writers in Info Dev learned the process of developing Dell system documentation through on-the-job training from their coworkers. I received similar training in my first few months at Dell. However, to help me understand each phase of the document development process and to implement the problem-solving model into my daily activities, I posted the model above my desk and used it as a checklist of activities and responsibilities that I needed to perform for each stage in the document development process.

To complete my documentation assignments, I compared the problem-solving model with the tasks that are specific to developing Dell Computer documentation in Information Development. For example, when I worked on my major project, I was familiar with PowerVault NAS systems, but I didn’t understand why Dell was developing the PowerVault 75xN NAS system. To begin this project, I defined the problem—the first activity in the problem-solving model. I read the marketing research and engineering specifications documents that explained the system’s purpose

and function in a corporate enterprise, as well as the specific hardware and software components that would be built into the system. Next, I designed the solution. Since Info Dev uses FrameMaker templates that incorporate specific styles, fonts, and formatting, I didn't have to make preliminary decisions about medium, form, and style. Using a leveraged document as a guide, I assembled each document section, added new system information from the marketing and system specification documents, tested the solution by verifying the procedures in the document on a NAS system in the computer lab, and sent a preliminary copy of the document to the project team for first review.

A technical writer at Dell tests the solution by designing procedures, gathering responses, and analyzing the responses after the project team assembles a working hardware system or working software application. During this time, the engineers may add and remove hardware and software components and features for various reasons. As a result, I revised the document and tested the solution several times before the document content was stable and ready for a final review.

In many cases, the activities in the problem-solving model overlapped each other when compared to the Info Dev milestone process. For example, during second and final reviews, I gathered and verified new system information and then revised the document accordingly. During final review, the project team verified that the content in the document was correct, provided me with final comments, and approved the solution. I couldn't package the solution until it was approved by the project team. Consequently, I repeated the activities for testing the solution and packaging the solution in the problem-solving model to coincide with the documentation development process in Info Dev.

After I completed the document, I implemented the solution. After I received approval from the project team, I sent the document files to the production specialist, who prepared and sent the files to the printer. Next, I sent the document to the translation coordinator, who sent the document files to a translation agency to be translated into French, German, Spanish, Japanese, Simplified Chinese, and Korean.

A week after the document was sent to print, I participated in evaluating the solution. The Info Dev project team lead scheduled a meeting with me (the assigned technical writer), the editor, the production specialist, and the translation coordinator who was assigned to the PowerVault 75xN

NAS Installation and Troubleshooting Guide. As a team, we discussed the problems that we encountered during the documentation development cycle, identified lessons that we learned from those problems, and recorded this information on a form that was submitted to Info Dev management. Info Dev management did and does use the information in this form to avoid similar problems with documentation projects.

The MTSC Problem-Solving Model provided me with a basic outline for developing Dell system documentation, guided me through the transition from Miami University to Dell, and provided me with the necessary activities and responsibilities that are required to complete a documentation project. Because Dell does not have a formal process for technical writers that explains how to develop computer documentation, I relied on the problem-solving model to provide me with the information I needed to complete my major project and other computer documentation at Dell.

However, because the problem-solving model is a generic method for solving a communication problem, a technical writer may be required to adjust the activities and responsibilities in the model to apply to his or her communication problem. For example, a technical writer develops system and software documentation during the late stages of system development. If the engineers add or delete features to the system, the technical writer must update the document and retest the procedures.

Additionally, if the technical writer receives a documentation project for a computer system that incorporates unfamiliar hardware components or technologies (such as a NAS system), he or she must spend some time with a subject matter expert (SME) to understand how the system works, develop new procedures, and validate these procedures with an SME to ensure that they are correct.

Therefore, to make the problem-solving model more useful for Dell system documentation projects, I suggest the following changes:

- **Add “Retest and Finalize the Solution” to the model.** Large document projects require multiple sets of eyes to review the structure and content of a document. In some cases, technical writers can be overwhelmed by the amount of information and training required to understand and document a computer system that they cannot see. Multiple reviews allow the

technical communicator and the project team to review the document, walk away from it, and then review it again with a new perspective.

- **Add SME lab time and writer training to the model.** Incorporate time in Step 2 of the model, “Design the Solution” to provide face time with the SMEs or engineers who have designed the product and include additional time for the technical communicator to learn how to use the writing tools necessary to create a document. For example, while working on my major project, I wasn’t familiar with a host bus adapter (HBA), cluster node or Cluster Service, nor with how all of these hardware and software components work together in a PowerVault Cluster solution. After spending time with the lead engineer in the NAS Clusters lab, I learned how to use these components, which reduced my writing time and helped me to add additional information in the guide that was overlooked by the engineer. In addition, technical writers must train themselves, seek help from co-workers, or sign up for training in their company’s training facility or at a local college or facility. While working on my major project, Info Dev changed their document template, which required me to learn how to strip the formatting in the FrameMaker files and import a new format into the document.

## Summary

During my MTSC training at Miami University, I enrolled in a variety of computer courses to complete the computer class requirements for the MTSC degree. During one of my class sessions, a professor asked me—as well as other students in the class—if I considered myself a left-brained or right-brained thinker. Almost all of the Computer Science and Accounting majors in the class (I was the only English major) identified themselves as left-brained, analytical-thinkers. To answer his question, I replied that I was a both-brained thinker because a technical writer must understand analytical computer systems and develop creative computer documentation. While my answer may have been sarcastic, I believe that technical writers must be analytical and creative thinkers in order to develop user documentation for a specific user audience.

Throughout my tenure at Dell, I have learned that this premise is important when working with computer engineers. Generally, most Dell hardware and software engineers that I have met at Dell are passionate about their work and enjoy explaining how their systems or software work inside a computer system. However, some computer engineers may seem to speak another language—

commonly referred to as “engineeringese” in Info Dev—that may confuse a new computer technical writer. In most cases, researching the terminology by using engineering documents or the Internet can help.

For example, when I interviewed an engineer for information about a system techsheet, he told me that the system supports “out-of-band management.” Apparently, the system supported both in-band and out-of-band management, but I didn’t understand what he meant by these terms. He was working towards a deadline, so he didn’t have time to provide me with an explanation. After I researched these terms on the Internet, I learned that some computer systems can be accessed remotely using Terminal Services—a character-based communication method where a system administrator types commands into a command prompt or a management console—a graphic-based communication method where an administrator uses a mouse to select items on a graphical user interface (GUI). Managing a computer system through a local area network (LAN) or wide area network (WAN) is known as in-band management. However, if the LAN or WAN that connects the system administrator’s system to the remote system is down for any reason, the administrator can use a dial-up connection and access a remote access card (RAC) that is installed in the remote system. Since a dial-up connection uses an outside network (the telephone lines), it is called an out-of-band connection. To ensure that both novice and professional users understand the terminology, I stated in the techsheet that the system could be managed remotely using an out-of-band dial-up connection.

I encountered other issues with computer engineers, most of which are outside the scope of this report. However, after eighteen months as a technical writer at Dell, I have learned through trial and error that the following suggestions have helped me to communicate effectively with computer engineers at Dell:

- **Be assertive.** Computer engineers and technical writers usually work in a fast-paced environment with project deadlines. Sometimes these deadlines occur at the same time. If we are working towards a deadline and the engineer is not available, it’s best to be proactive. If we are unable to contact an engineer by phone or e-mail, we visit his or her office, cubicle, or computer lab. If we cannot locate the engineer, we seek help from the engineering manager or another engineer who is assigned to the hardware or software project. I have learned to

always take the initiative and find the information I need rather than waiting for the information to come to me.

- **Be prepared.** Before I approached an engineer for information, I did my homework. Is the information I needed available in another document? All computer systems and software applications that are developed at Dell have a product specifications guide—similar to the owner’s manual that is included with an automobile—that provides a basic overview of the system or application and detailed information about its hardware and/or software components. These documents are usually written by the lead engineer in engineering language, which required me to sequester myself in a quiet room and read through the document. If I cannot locate the information I needed, then I approached the engineer.
- **Be calm.** One of the most important lessons I learned in my first eighteen months at Dell is to maintain control of my emotions by remaining calm in stressful situations. For example, when I was working on my major project, I needed to contact the lead engineer regarding a particular illustration in the document. When I tried to locate the engineer, he was unavailable. In desperation, I searched for and located another engineer who provided me with the information I needed to complete the document and send it to the printer. The next day, I learned that the missing engineer had to leave the office because his wife was in labor. If I allowed my frustrations to surface in anger, I would have damaged my rapport with the project team.

Another important lesson I learned in my first eighteen months at Dell involves documentation projects that require minimized time schedules. When I am developing documentation against a deadline, I don’t forget the basics. If necessary, I keep a copy of the problem-solving model at my desk to remind me about the activities and responsibilities that are required for each stage in the document development process.

Sometimes, a minimized time schedule may influence a technical writer to ignore the basics of technical writing—such as specifying a purpose and analyzing an audience—and develop carbon-copy documentation from leveraged text with an updated computer name, illustrations, and system specifications. During my initial research for my major project, I read a story in Dell’s weekly e-mail newsletter that helped me understand the importance of developing accurate and

user-friendly documentation. The story explained how Dell maintains constant communications with its customers so it can provide relevant computer hardware and software solutions that addresses their needs. Using customer input, Dell designs computer systems that targets specific user audiences—for example, small businesses, college universities, and large corporations. Consequently, a computer system designed for a small business may not use identical hardware and software that is used in a large corporate enterprise—such as a host bus adapter, storage systems, high-capacity memory modules, or systems management software. Additionally, the writing style, illustrations, and content may vary between a computer systems designed for small businesses and a large corporations. It is the technical writers' responsibility to understand the user audience and develop user documentation that is comprehensible for their particular audience. In essence, if users read the documentation and cannot understand how to use their computer, their system is worthless. After I understood my role as a user advocate, I realized that my job as a technical writer is just as important as the engineer who designed the system.

The MTSC program and the first eighteen months of my employment with Dell Inc. have prepared me for a new career in technical communication. The theory and initial practice in the MTSC program provided me with the basic skills I needed to work for Dell. The training and experience I have received at Dell have helped me to strengthen my writing skills and have taught me the “soft skills” of technical writing, such as interviewing engineers, working together with my colleagues, and respecting the differences between others and me at Dell. While the MTSC Problem-Solving Model provides a basic framework for planning how to complete a technical communication project, a technical communicator may need to modify this basic model depending on the size of the project, the subject matter, and the number of people required to approve the document. If aspiring technical writers plan to use the model for a communication problem, my best advice would be to review as much technical documentation as they can, compare the documentation with the model, and devise a solution that is appropriate to the problem. The modifications I made to the MTSC model represent the path that was appropriate for my documentation project in my context.

Additionally, the MTSC program and my experience at Dell have taught me that becoming a computer technical writer does not require having a background in computers, but simply the desire and capacity to learn. While I was developing the PowerEdge Cluster I&T Guide that was

used as the leveraged document for my major project, the marketing manager for this project asked me to define my audience. I thought for a moment, and then replied, “Auto mechanics who need to understand clustering technology.” While he looked puzzled at my reply, he didn’t understand that my career prior to working at Dell was in the automotive sector.

Even so, I need to stress in this report that computer technology is not reserved for computer science majors or someone who grew up understanding computers. Computer technology—including clustering technology—is available to anyone who desires to understand and learn, including a former auto mechanic like myself. Understanding this concept and choosing to pursue a college education in “the art of explanation”—despite the comments I received from my former employer—provided me with a new career as a Technical Writer for Dell, Inc.

When I was considering a new career as a Technical Writer, I read a wide variety of books written by technical writers and career gurus who encapsulated a career change into a step-by-step formula. Some of their advice seemed rather vague to me: conducting informational interviews, knowing who you are, and “doing your homework.” Perhaps this advice may work for you. However, based on my own experience, here is my advice on how to become a technical writer:

- **Enroll in a Critical Thinking or Technical Writing course at a community college.**

When I was employed as an Auto Mechanic and was interested in changing careers, I recorded my thoughts and concerns in a journal. I maintained a journal for almost ten years and never thought that journaling would help me redefine my career. I enjoyed the art of writing and wondered if I could financially support myself as a writer. To validate my writing skills and explore a new career as a writer, I enrolled in a Critical Thinking and Writing course at a community college. Shortly before the end of the course, my writing professor complimented me on my writing skills and asked me if I had considered a career in writing. I explained to her that I was an Auto Mechanic and that I wasn’t sure if I could combine mechanical and writing skills into a new career. She smiled and asked me, “Have ever considered a career as a Technical Writer?” Through this conversation and her encouragement, I decided to go back to school and pursue a degree in Technical Communication. The universities near my home didn’t offer a Bachelors degree program in Technical Communication. Consequently, I transferred to the University of Redlands and

received a Bachelors degree in Business and Management, and then I enrolled in the MTSC program at Miami University.

- **Attend an STC conference.** The Society for Technical Communication (STC) is a non-profit organization that supports technical communicators around the world. With local chapters in almost every major city in the United States, the STC is a great way to not only learn more about technical communication, but also to network and locate a job. For example, in the Summer of 1999, the national STC conference was held in downtown Cincinnati, about an hour from the Miami University campus. I attended the conference through a scholarship that was provided to me by the STC Southwest Ohio Chapter. At the conference, I spoke with technical writers, editors, and graphical illustrators who provided me with practical information about the technical communication profession and the types of jobs that are available in their particular cities. I attended a wide variety of classes that provided me with an overview of the technical writing profession, such as writing proposals, managing large documentation projects, and using technical writing software applications, such as Adobe FrameMaker. Additionally, I visited the “employment booth,” which provided job seekers with a list of job openings in various states, as well as a list of officers and presidents at regional STC chapters throughout the United States. I e-mailed an STC officer who volunteered at the STC Austin Texas chapter and worked at Dell Inc. He submitted my resume to Dell management and I was hired by Dell one month before the end of my MTSC program.
- **Follow your heart.** As I stated earlier, my former employer discouraged me from seeking a new career. I was employed as an Automobile Help Desk Technician and provided technical support to auto mechanics located at dealerships throughout the United States. However, after many years of managing a Help Desk and answering a phone, I wanted to do something else with my life. Occasionally, my co-workers had problems with their computers, and through a little research and persistence, I helped them solve their computing problems. With a new interest in computer technology, I wanted to transfer into the company’s Data Processing department and learn more about computers. However, because management couldn’t afford to hire and train someone else to perform my job function and because no one else in the company wanted to answer the Help Desk phone, I was stuck in a dead-end job. However, I

didn't give up. For the next six months, I attended the New Horizons Computer Learning Center on Saturdays and learned how computers "talked" to each other in a Windows NT network. I studied every weekend, passed the appropriate tests, and eventually obtained a Microsoft Certified Professional (MCP) certificate. Additionally, through the encouragement of my writing professor, I went back to school, completed my bachelors degree in Business and Management, and eventually enrolled in the MTSC program at Miami University. My former employer wasn't amused with my resignation, and I didn't receive any "high-fives" or congratulations on my last day of employment. Even so, despite all the adversity and time I spent in pursuing my interests, I'm a much happier man because I'm doing what I love to do: explaining how to use a computer.

Perhaps you are reading this report and are wondering whether or not you should choose a career as a Computer Technical Writer. Perhaps you have family and friends who are telling you to pursue a career in another field. My advice to you: choose a career that challenges you every day. What I enjoy the most about my career as a Computer Technical Writer is that computer technology is never stagnant; it evolves into something new everyday. And because computer technology changes every day, I am forced to change as well.

In the words of Gail Sheehy:

How, if we don't march ourselves out to the end of a limb and jump in new directions now and then, shall we continue to learn? And if we don't continue to learn, how shall we continue to develop? Because children are repeatedly faced with novel and challenging experiences, they are constantly developing the plasticity to deal with them. The quickest way to learn, in my experience, is to interrupt your everyday, predictable experience. Put yourself on the line. Introduce a new task or adventure of the heart, and in that one domain give up some control. The intrinsic reward for putting oneself back into the wobbly-kneed state of a learner is the return of a sense of playfulness and curiosity and the sharp edge of uncertainty. One is simply forced to stop taking oneself so seriously.

If every day is an awakening, you will never grow old. You will just keep growing.<sup>11</sup>

---

11. Sheehy, Gail. *New Passages: Mapping Your Life Across Time*. New York, NY: Random House, 1995.

**Appendix A: Master Document List**

**Table A-1. Getting Started Guide**

<b>Hardware System</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge 1400 SC	6 pages	3 weeks
Dell PowerEdge 300 SC	6 pages	3.5 weeks
Dell PowerApp 100 Appliance	6 pages	3.5 weeks
Dell PowerEdge 2400 Server	6 pages	3 weeks
Dell PowerEdge 7150 Server	6 pages	4 weeks
Dell PowerApp.cache 100 Appliance	6 pages	3.5 weeks

**Table A-2. Platform Guide**

<b>Hardware System</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 (SAN 4.0) Version 1	56 pages	4 weeks
Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 (SAN 4.06) Version 2	20 pages	3.5 weeks

**Table A-3. Readme**

<b>Hardware System</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerVault 650F Storage System	15 pages	2 weeks
Dell PowerVault 50F and 51F Fibre Channel Switch	25 pages	1.5 weeks
Dell OpenManage Server Agent Version 4.4.0	4 pages	1.5 weeks
Dell OpenManage Server Agent Version 5.0	5 pages	1 week

**Table A-4. Technical Sheets and Technical Books**

<b>Document Title</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge 8450 Systems: Installing 1 GB DIMMS Information Update	9 pages	3 weeks
Dell PowerVault 136T Tape Library Information Update	4 pages	3 days
Dell PowerEdge 1550 and Dell PowerApp 120 System: PERC 3/DC Cable Installation	2 pages	2 weeks
Dell PowerApp.cache 200 Systems-Configuring and Using the Dell OpenManage Remote Assistant Card Version 2	8 pages	3 weeks

**Table A-4. Technical Sheets and Technical Books (Continued)**

<b>Document Title</b>	<b>Length</b>	<b>Development Time</b>
Dell PowerEdge 1550 and Dell PowerApp 120 Systems: Installing VersaRails	6 pages	5 weeks
Resetting the Health Timeout Parameter for Asynchronous IP Mirroring in the Dell PowerVault 530F SAN Appliance	2 pages	2 weeks
Accessing the Event Log with the Dell PowerApp Event Log Viewer	5 pages	3 weeks
Installing the Replacement Keyboard in a Dell 2U Rack Mount Keyboard Mouse Monitor Tray	4 pages	2 weeks
Dell PowerEdge Systems: Coupling Two Dell PowerEdge 4210 Racks	6 pages	2 weeks
Guidelines for Leveling Your Dell PowerEdge 4210 Rack	1 page	1 week
Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Information Update	2 pages	2 weeks
Dell PowerEdge Systems Storage Area Network (SAN) Fabric Switch Zoning	18 pages	4 weeks
Dell PowerEdge 440, 63xx, and 64xx Systems: Using the Hot-Plug PCI Application with Microsoft Windows NT Server 4.0	20 pages	4.5 weeks

**Table A-5. Electronic Document (E-Doc) Postings**

<b>Number of E-Doc Postings</b>	<b>Development Time</b>
79	2 weeks

**Appendix B: Minor Project—Technical Sheet**

# Resetting the Health Timeout Parameter for Asynchronous IP Mirroring in the Dell™ PowerVault™ 530F SAN Appliance Software

This document provides instructions for resetting the health timeout parameter in the Dell PowerVault 530F SAN appliance software.

When the PowerVault 530F is configured in an internet protocol (IP) mirror network using the asynchronous transfer mode (ATM) protocol, the IP mirror link may experience intermittent breaks, interrupting the asynchronous data transfer between PowerVault 530F systems. To correct this problem, reset the health timeout parameter in the PowerVault 530F storage area network (SAN) appliances configured for remote mirroring. This may include redundant primary systems and secondary failover systems, if applicable to your configuration. An extended timeout provides these systems additional tolerance for intermittent breaks in the IP mirror link without interrupting the asynchronous data transfer between systems.

*NOTE: For more information about asynchronous IP mirroring, see the Dell PowerVault 530F SAN Appliance System Administrator's Guide.*

To set the health timeout parameter in the PowerVault 530F SAN appliance software, perform the following steps:

1. Open a Java-enabled Web browser.

*NOTE: Be sure to use Microsoft® Internet Explorer version 4.01 or greater or Netscape Communicator version 4.7 or greater.*

2. Enter the IP address or name of the PowerVault 530F system in the **Address** or **URL** field and press <Enter>.

*NOTE: If the PowerVault 530F system is configured in a redundant pair, enter the IP address of the redundant primary system.*

The PowerVault 530F SAN Appliance software program appears on the screen containing the data for the redundant primary system. The left frame contains a graphical list of systems in the configuration with the redundant primary system at the top of the list. The right side of the screen contains a series of function tabs that display the configuration data for the system.

3. Click on the **CLI** (command line interface) tab.

The CLI screen appears in the center of the graphical user interface (GUI) with a command box at the bottom of the screen.

4. In the command box, enter the following:

```
SetNodeParam 2 6
```

*Note: Include a character space between SetNodeParam, 2, and 6.*

5. Press <Enter>.

The CLI reports `setNodeParam SUCCEEDED`.

6. In the command box, enter `NodeParams` and press <Enter>.

The system parameters appear on the screen, including the health timeout parameter.

7. Verify that the **Health Timeout** value is **6**.

8. If the local configuration is a redundant pair, click the icon for the redundant failover PowerVault 530F system.

The PowerVault 530F SAN Appliance software refreshes and displays the redundant failover system information in the CLI.

9. Repeat steps 3 through 7.

10. Click the icon for the remote PowerVault 530F system.

The PowerVault 530F SAN Appliance software refreshes and displays the remote system information in the CLI.

11. Repeat steps 3 through 7.

12. If the remote configuration is a redundant pair, repeat steps 3 through 7 for the remaining remote system.

13. Close your browser to end your session with the PowerVault 530F SAN Appliance software.

---

**Information in this document is subject to change without notice.**

**© 2000 Dell Computer Corporation. All rights reserved. Printed in Ireland.**

Trademarks used in this text: *Dell*, the *DELL E COM* logo, and *PowerVault* are trademarks of Dell Computer Corporation; *Microsoft* is a registered trademark of the Microsoft Corporation. Other trademarks and trade names may be used in this document to refer to either the entities claiming the marks and names or their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own.

August 2000 P/N 58CXH Rev. A00

**Appendix C: Project Timeline**

**Table C-1. Project Timeline**

<b>Month/Year</b>	<b>Project</b>
February 2000	Dell OpenManage Server Assistant CD art Dell PowerApp 100 Appliance Getting Started Guide Dell Inspiron 5000 Notebook Reference Guide Post 1 document to the Dell Documents website Attend college new hire classes
March 2000	Dell PowerApp.cache 100 Appliance Getting Started Guide Dell PowerVault 530F SAN Appliance Rack Installation Guide Dell PowerVault 56F Rack Installation Guide Installing the Replacement Keyboard in a Dell 2U Rack Mount Keyboard Mouse Monitor Tray Tech Sheet Attend college new hire classes
April 2000	Dell PowerApp 2x50 and PowerApp 200 Appliance Rack Installation Guide Dell PowerEdge 8450 Systems: Installing 1 GB DIMMs Information Update Tech Book Attend college new hire classes
May 2000	Dell PowerVault 740 Server CD art Dell PowerVault 660F and 224F Storage System Rack Installation Guide Dell PowerVault 650F Storage System Readme Dell PowerVault Systems Storage Area Network (SAN) Fabric Switch Zoning Post 6 documents to the Dell Documents website Attend college new hire classes
June 2000	Dell PowerVault 50F and 51F Fibre Channel Switch Readme Dell PowerEdge 440, 63xx, and 64xx Systems: Using the Hot-Plug PCI Application with Microsoft Windows NT Server 4.0 Tech Book Post 7 documents to the Dell Documents website
July 2000	Dell PowerVault 530F SAN Appliance CD art Dell PowerEdge 1400 SC Server Getting Started Guide Dell PowerEdge 300 SC Server Getting Started Guide Dell PowerVault 701 Rack Installation Guide Resetting the Health Timeout Parameter for Asynchronous IP Mirroring in the Dell PowerVault SAN Appliance Tech Sheet Post 2 documents to the Dell Documents website
August 2000	Dell PowerVault 701 Rack Installation Guide (continued) Post 1 document to the Dell Documents website

**Table C-1. Project Timeline (Continued)**

<b>Month/Year</b>	<b>Project</b>
September 2000	Dell PowerEdge 2400 Server Getting Started Guide Post 5 documents to the Dell Documents website Dell PowerEdge Clusters FE100/FL100 and FE200/FL200 Version 1 Installation and Troubleshooting Guide
October 2000	Microsoft Windows 2000 Datacenter Server CD art Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 (SAN 4.0) Version 1 Platform Guide Dell PowerVault 735N NAS Appliance Service Manual Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 (SAN 4.0) SAN Guide Post 2 documents to the Dell Documents website
November 2000	Dell PowerEdge Clusters FE100/FL100 and FE200/FL200 Version 1 Installation and Troubleshooting Guide (continued) Post 4 documents to the Dell Documents website
December 2000	Dell PowerEdge 7150 Server Getting Started Guide Post 7 documents to the Dell Documents website
January 2001	Dell PowerEdge 1550 and Dell PowerApp 120 Systems—PERC 3/DC Cable Installation Tech Sheet Dell PowerEdge Clusters FE100/FL100 and FE200/FL200—Information Update Tech Sheet Post 5 documents to the Dell Documents website
February 2001	Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 (SAN 4.06) Version 2 Platform Guide Dell PowerEdge Systems—Coupling Two Dell PowerEdge 4210 Racks Tech Sheet Post 9 documents to the Dell Documents website
March 2001	Dell PowerVault 755N NAS Appliance Service Manual Post 3 documents to the Dell Documents website
April 2001	Dell PowerApp.cache 200 Systems—Configuring and Using the Dell OpenManage Remote Assistant Card Tech Sheet Post 2 documents to the Dell Documents website

**Table C-1. Project Timeline (Continued)**

<b>Month/Year</b>	<b>Project</b>
May 2001	Dell PowerVault 530F SAN Appliance Service Manual Dell OpenManage Server Agent SNMP Reference Guide Dell OpenManage Server Assistant (Microsoft Operating System) User's Guide Dell OpenManage Server Assistant (Microsoft Operating System) User's Guide Dell OpenManage Server Agent Version 4.4.0 Readme Post 5 documents to the Dell Documents website
June 2001	Dell OpenManage Server Agent Version 5.0 Readme Dell PowerVault 136T Tape Library Information Update Tech Sheet Post 7 documents to the Dell Documents website
July 2001	Dell PowerVault 755N NAS Cluster Installation and Troubleshooting Guide Accessing the Event Log with the Dell PowerApp Event Log Viewer Tech Sheet Dell PowerEdge 1550 and Dell PowerApp 120 Systems—Installing VersaRails Tech Sheet Post 11 documents to the Dell Documents website

**Appendix D: Section 1—Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Installation and Troubleshooting Guide**

This guide provides information for installing a Dell™ PowerEdge™ Cluster FE100/FL1000 and FE200/FL200 solution in a corporate enterprise. This guide provides an overview of clustering technology and includes procedures for preparing server and storage systems for clustering, cabling the cluster configurations, configuring the peripherals, installing the operating system, and troubleshooting and maintenance procedures.

The information in this guide includes:

- Basic Fibre Channel cluster installation procedures, which include:
  - Preparing server and storage systems for clustering
  - Cabling the cluster configuration
  - Configuring the cluster peripherals, including the HBA and RAID controllers
- Installation procedures for installing the Microsoft® Windows NT® Server 4.0, Enterprise Edition and Windows® 2000 Advanced Server operating system in your cluster configuration
- Installation procedures for installing a direct-attached, SAN attached, cluster consolidation, and SAN appliance-attached cluster configuration in your corporate network
- Cluster upgrading and maintenance procedures
- Troubleshooting procedures
- Data sheets for recording critical cluster configuration information

## Intended Audience

This guide was developed for experienced IT professionals who need to install, cable, and configure a PowerEdge Cluster FE100/FL100 or FE200/FL200 in an enterprise environment, as well as trained service technicians who perform cluster upgrade and maintenance procedures. This guide also addresses readers who are new to clustering technology.

### Obtaining More Information

See "Overview" and "Hardware and Software Technologies" for a general description of PowerEdge clusters and clustering technology.

See "Using MSCS" for an overview of the clustering software built into the Windows NT Server 4.0, Enterprise Edition and Windows 2000 Advanced Server operating systems.

## Obtaining Technical Assistance

Dell Enterprise Training and Certification is available now; see [www.dell.com/training](http://www.dell.com/training) for more information. This service may not be offered in all locations.

## Other Documents You May Need

 The *System Information Guide* provides important safety and regulatory information. Warranty information may be included within this document or as a separate document.

- The *Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Platform Guide*, which provides information on the platforms that support FE100/FL100 and FE200/FL200 cluster configurations.
- The *Dell PowerEdge Cluster Applications Guide for Microsoft Windows 2000 Advanced Server*, which provides information on the applications for Windows 2000 configurations.

- The *Dell PowerEdge Cluster Microsoft Windows NT 4.0 Applications Guide*, which provides information on the applications for Windows NT 4.0 configurations.
  - The *Dell PowerVault 530F SAN Appliance User's Guide*, which provides an overview, technical specifications, and preventative maintenance procedures for your PowerVault SAN appliance.
  - The *Dell PowerVault 530F SAN Appliance System Administrator's Guide*, which provides instructions for installing, configuring, and troubleshooting your SAN appliance.
  - The Dell PowerVault™ SAN documentation for more information on storage area networks.
  - The Dell OpenManage™ Storage Consolidation documentation for information on storage consolidation configurations.
  - The *Dell OpenManage Managed Node (Data Agent) Installation and Operation Guide*, the *Dell OpenManage Data Supervisor Installation and Operation Guide*, the *Dell OpenManage Data Administrator Installation and Operation Guide*, the *Dell OpenManage Array Manager User Guide*, and the *Dell OpenManage ATF Installation and Operation Guide*, which provide installation instructions for the Dell OpenManage Data Agent, Dell OpenManage Data Supervisor, Dell OpenManage Data Administrator, Dell OpenManage Array Manager, and the Dell OpenManage ATF.
  - The *Microsoft Cluster Server Administrator's Guide* for Windows NT and the Windows 2000 Cluster Service documentation describes the clustering software used on PowerEdge Cluster FE100/FL100 and FE200/FL200.
  - The tape library documentation, which provides information for installing, troubleshooting, and upgrading the tape library.
  - The HBA documentation, which provides installation instructions for the HBAs.
  - The *Rack Installation Guide* included with your rack solution describes how to install your system into a rack.
  - The *Setting Up Your System* document provides an overview of initially setting up your system.
  - The *User's Guide* provides information about system features and technical specifications.
  - The *Installation and Troubleshooting Guide* describes how to troubleshoot the system and install or replace system components.
  - The RAID documentation, which provides information for installing and configuring a PERC card.
  - Systems management software documentation describes the features, requirements, installation, and basic operation of the software.
  - Operating system documentation describes how to install (if necessary), configure, and use the operating system software.
  - Documentation for any components you purchased separately provides information to configure and install these options.
  - Updates are sometimes included with the system to describe changes to the system, software, and/or documentation.
-  **NOTE:** Always read the updates first because they often supersede information in other documents.
- Release notes or readme files may be included to provide last-minute updates to the system or documentation or advanced technical reference material intended for experienced users or technicians.

## Overview

This section provides an overview of clustering and the major cluster components used in Windows NT Server 4.0, Enterprise Edition and Windows 2000 Advanced Server.

 **NOTE:** In this guide and in other cluster documentation, Microsoft Cluster Server (for Windows NT Server 4.0, Enterprise Edition) and Microsoft Cluster Service (for Windows 2000 Advanced Server) are also referred to as MSCS.

## Clustering

Clustering is the process of joining multiple Dell PowerEdge systems together to function as a single system. Using specific hardware and software that is interconnected to work as a single entity, clustering provides an automatic failover solution to hardware or software failures. If one of the clustered systems (also known as cluster nodes) fail for any reason, the user resources running on the failed system are moved (or failed over) to another system in the cluster by the MSCS software—the failover software component in specific versions of the Microsoft Windows operating system. When the failed system is repaired and brought back online, user resources automatically transfer back to the repaired system or remain on the failover system, depending on how MSCS is configured.

The availability of network services is critical to applications in a client/server environment. Clustering reduces the amount of downtime caused by unexpected failures, providing maximum uptime of mission critical applications—also known as high availability—that surpasses the capabilities of a stand-alone system. Using MSCS, clustering ensures that applications on a failed cluster node continue on the other node by migrating and managing the required resource to another node in the cluster. Clusters that reduce the amount of system downtime are known as high availability clusters.

## Virtual Servers and Resource Groups

In a standard client/server environment, a user accesses a network resource by connecting to a physical server (such as a PowerEdge system) with a unique IP address and network name. If the server fails for any reason, the user will no longer be able to access the resource. In a cluster environment, a user does not access a physical server, but a virtual server—a network resource managed by MSCS that is not associated with a physical server. MSCS manages the virtual server as a resource group, which contains a list of the cluster resources. Virtual servers and resource groups are transparent to the network client.

Virtual servers are designed to dynamically reconfigure user resources during a connection or hardware failure, providing a higher availability of network resources as compared to a nonclustered PowerEdge system. When MSCS detects a failed cluster node or failed application, MSCS moves the entire virtual server resource group to another cluster node and remaps the virtual server to the new network connection. The network client attached to an application in the virtual server will only experience a momentary delay in accessing their resources while MSCS re-establishes a network connection to the virtual server. This process of moving and restarting a virtual server on a healthy cluster node is called failover.

## Failover and Failback

Virtual servers and MSCS are two cluster components that provide the failover capabilities of the cluster. If one of the cluster nodes should fail for any reason, MSCS moves (or fails over) the virtual server to another cluster node. Once the cluster node is repaired and brought online, MSCS moves (or fails back) the virtual server to the original cluster node, if required. This failover capability enables the cluster configuration to keep network resources and application programs running on the network while the failed node is taken off-line, repaired, and brought back online. The overall impact of a node failure to network operation is minimal.

See "Failover and Failback" in "Using MSCS" for more information.

## Quorum Disk (Quorum Resource)

In every PowerEdge cluster, a single resource is designated as the quorum disk. This disk maintains the configuration data necessary for cluster recovery when a cluster node fails. The quorum disk contains the details of all the changes that have been applied to the cluster database.

The quorum disk can be any resource with the following attributes:

- Enables a single node to gain and defend its physical control of the quorum disk. For example, SCSI disks use their reserve and release commands for persistent arbitration.
- Provides physical storage that is accessible by any node in the cluster.
- Uses the NTFS file system.

See "Quorum Disk" in "Using MSCS" and the MSCS online documentation for more information.

## PowerEdge Cluster FE100/FL100 and FE200/FL200 Solutions

The PowerEdge Cluster FE100/FL100 and FE200/FL200 solutions implement two-node clustering technology based on the MSCS software incorporated within the Windows NT Server 4.0, Enterprise Edition and Windows 2000 Advanced Server operating systems.

PowerEdge Clusters FE100/FL100 and FE200/FL200 solutions provide the following benefits in meeting the needs of mission-critical network application programs:

- High availability of system services and resources to network clients
- Redundant storage for application program data
- Failure recovery for cluster application programs
- Flexible maintenance capabilities, allowing you to repair, maintain, or upgrade a cluster node without taking the entire cluster offline

Each cluster node is configured with software, storage, and network resources that enable it to monitor and interact with the other nodes to provide mutually redundant operation. If a cluster node fails for any reason, virtual servers and resources groups running client resources are failed over to a healthy cluster node. When the failed node is repaired and brought back online, the virtual servers and resource groups are failed back to the repaired node (if desired).

The cluster nodes, therefore, operate as a single resource, rather than a collection of individual systems. Because the cluster nodes interact in this way, they appear as a single system to the network clients.

## Features and Enhancements

The PowerEdge Cluster FE100/FL100 and FE200/FL200 solutions also include the following features and enhancements:

- **Support for Dell™ PowerVault™ 650F/651F Fibre Channel disk array (FE100/FL100 only)** — The PowerVault 650F and 651F Fibre Channel disk array provide a total storage capacity of up to 8 TB per disk array. As your performance requirements increase, you can add up to 11 PowerVault 630F disk expansion units for additional storage space. The PowerVault 650F is a rack mount disk array that installs in a 42U rack. The PowerVault 651F disk array enclosure is a deskside system.

- **Support for PowerVault 660F/224F Fibre Channel disk array enclosures (FE200/FL200 only)** — The PowerVault 660F Fibre Channel disk array enclosure provides up to 8 TB of storage capacity in a rack-mount chassis. As your performance requirements increase, you can attach up to 7 PowerVault 224F expansion enclosures for additional storage space in a standard 42U rack. The PowerVault 224F disk array is an expansion disk array that provides additional storage for the PowerVault 660F.
- **Support for the PowerVault 530F SAN appliance** — The PowerVault 530F is a 4U SAN appliance that provides enhanced storage management features between host systems (cluster nodes) and storage subsystems. The appliance provides the features listed in the previous section, and provides storage virtualization for the cluster nodes in a SAN appliance-attached cluster configuration.

See your Dell PowerVault 530F SAN appliance documentation for more information.

For SAN appliance-attached configurations that include the PowerVault 530F for storage virtualization, the FE100/FL100 and FE200/FL200 provides the following additional functionalities:

- **Local mirroring over Fibre Channel** — Backups of your data are mirrored locally through Fibre Channel to storage arrays.
- **Remote mirroring over IP** — Backups of your data can be mirrored remotely between sites over IP.
- **Three-way mirroring** — A third mirror set of a LUN can be created using both Fibre Channel protocol and IP mirrors and used by the cluster nodes.
- **Boot from SAN** — In SAN-attached cluster configurations, the cluster nodes can be restarted and brought online from a Fibre Channel disk array in the SAN.
- **Storage virtualization** — Storage resources can be allocated as needed without reconfiguring the entire SAN. Virtualization provides the flexibility of assigning storage to any PowerEdge system connected to the SAN.

See "Installing a Cluster in a SAN Environment" for more information on SAN appliance-attached configurations.

 **NOTE:** The PowerVault 530F is not used in a direct-attached configuration.

## Cluster Identification

PowerEdge Fibre Channel clusters are configured and identified by the private network connection (also known as the cluster interconnect) that connects the cluster nodes together-Fibre Channel, Ethernet (FE) and Fibre Channel, Low Latency (FL)-and the type of storage devices in the cluster configuration.

Table 1-2 provides an overview of the differences between the FE100/FL100 and FE200/FL200 configurations.

See the *Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Platform Guide* for specific hardware information.

**Table 1-2. PowerEdge Cluster FE100/FL100 and FE200/FL200 Configurations**

Cluster Solution	Cluster Interconnect Type	Cluster Interconnect NIC Card	Attached Storage Devices
PowerEdge Cluster FE100	Ethernet	Any Ethernet NIC supported by the system platform	PowerVault 650F PowerVault 651F/630F
PowerEdge Cluster FL100	Emulex	Emulex cLAN 1000	PowerVault 650F PowerVault 651F/630F

**Table 1-2. PowerEdge Cluster FE100/FL100 and FE200/FL200 Configurations**

<b>Cluster Solution</b>	<b>Cluster Interconnect Type</b>	<b>Cluster Interconnect NIC Card</b>	<b>Attached Storage Devices</b>
PowerEdge Cluster FE200	Ethernet	Any Ethernet NIC supported by the system platform <b>NOTE:</b> Both cluster nodes must use homogeneous (identical) Ethernet NICs for the cluster interconnect.	PowerVault 660F PowerVault 224F
PowerEdge Cluster FL200	Emulex	Emulex cLAN 1000	PowerVault 660F PowerVault 224F

### Hardware and Software Technologies

PowerEdge Clusters FE100/FL100 and FE200/FL200 implement the following hardware and software technologies:

- Clustering technology based on the MSCS software in Windows NT Server 4.0, Enterprise Edition and the Microsoft Cluster Service in the Microsoft Windows 2000 Advanced Server operating system.
- Fibre Channel protocol
- Fibre Channel switch fabric
- Zones
- PowerVault SAN components
- Storage management software

The following subsections provide a description of these hardware and software technologies.

#### Clustering Technology

Clustering is the process of connecting multiple servers together in order to achieve higher availability and performance. Clustering technology used in PowerEdge Clusters FE100/FL100 and FE200/FL200 is built into two Windows operating systems:

- **Windows NT Server 4.0, Enterprise Edition** — Includes MSCS software, which manages the activity on the cluster nodes, and provides the failover and failback for applications running on the cluster nodes.  
See "Using MSCS" for more information on the Cluster Server.
- **Windows 2000 Advanced Server** — Includes MSCS and Network Load Balancing. Network load balancing ensures that the incoming IP traffic from the public network is balanced across the cluster nodes, and provides high availability for the applications running on each cluster node.  
See "Using MSCS" for more information on the Cluster Service.

 **NOTE:** The Cluster Service and Network Load Balancing features cannot co-exist on the same cluster node, but can be used together in a multi-tiered cluster configuration. For more information, see the Microsoft website located at [www.microsoft.com](http://www.microsoft.com).

MSCS, the clustering technology built into both versions of the Windows operating system is identical, but is referred to by different names in both operating systems:

**Table 1-3. MSCS Definition**

<b>Operating System</b>	<b>MSCS Definition</b>
Windows NT Server 4.0, Enterprise Edition	Microsoft Cluster Server
Windows 2000 Advanced Server	Microsoft Cluster Service

In this guide and in other cluster documentation, Microsoft Cluster Server and Cluster Service is referred to as MSCS.

### **Fibre Channel Protocol**

Fibre Channel is a scalable, high-performance data communications technology that provides high-speed data transmission between the PowerEdge cluster nodes and the storage systems. Fibre Channel provides long-distance connectivity and the higher bandwidth needed for transferring data between the cluster nodes and the storage devices in a PowerEdge Cluster. By employing long-wave fiber-optic cable between cascaded switches, systems up to 10 km from the shared storage array can access data as if they are directly attached.

Implementing Fibre Channel technology in the PowerEdge Cluster provides you with the following advantages:

- **Flexibility** — Fibre Channel implements both copper and optical cabling, allowing a distance of up to 10 kilometers between switches without signal degradation.
- **Availability** — Fibre Channel components implement dual redundant connections, providing multiple data paths and greater availability for network clients.
- **Connectivity** — Since Fibre Channel devices are hot-plugable, you can add or remove devices from the cluster without bringing down the cluster.

### **Fibre Channel Switch Fabric**

A Fibre Channel switch fabric is a private connection of one or more fibre channel switches that provide high-speed, point-to-point connections between servers and storage devices. Using instructions that are programmed into the switch, the switches in a Fibre Channel fabric provide point-to-point connection through inbound and outbound points from one device (sender) to another device or switch (receiver) on the network. If the data is sent to another switch, the process repeats itself until a connection is established between the sender and the receiver. One or more PowerVault Fibre Channel switches make up a Fibre Channel fabric.

Fibre Channel switches are linked together using ISLs. These ISLs use two Fibre Channel ports to connect the switches. Each ISL is considered a "hop." While a Fibre Channel fabric can support up to seven hops without performance degradation, a typical Dell SAN implementation usually includes fewer than seven hops.

One of the advantages of Fibre Channel fabrics over other types of networks is the ability to set up barriers between different devices and operating environments. These barriers create logical fabric subsets with minimal software and hardware intervention. Similar to subnets in the client/server network, logical fabric subsets divide a fabric into similar groups or components, regardless of their proximity to one another. The logical subsets that form these barriers are called zones.

### **Zones**

Zones help to segment a SAN into logical fabric subsets by setting up barriers between different operating environments (or between a cluster and other servers or clusters) with minimal software and hardware intervention. Similar to VLANs in the client/server network, these logical fabric subsets, or zones, divide a fabric into similar groups or components, regardless of their proximity to one another. By implementing switch zoning in conjunction with storage consolidation (StorageC), you can attach multiple clusters to a SAN.

Zones automatically and transparently enforce information access to the zone devices. More than one PowerEdge Cluster configuration can share a PowerVault SAN in a switched fabric using Fibre Channel switch zoning. If you implement zoning by using PowerVault Fibre Channel switches, you can arrange Fibre Channel switch fabric-connected devices into logical groups over the physical switch fabric configuration. Also, you can segment the SANs by setting up zones between different clusters.

See the *Dell PowerVault 5xF Switches Zoning Guide* located on the Dell | Support website at [support.dell.com](http://support.dell.com) for information on zoning concepts and implementations.

## PowerVault SAN

PowerEdge cluster nodes can be connected to external storage systems through a direct connection (using a direct-attached configuration) or through a SAN—a high performance network solution, similar to a LAN, that is used to move data between heterogeneous server and storage resources. Using a specific collection of hardware and software releases set to specific version levels, a SAN bypasses traditional network bottlenecks and provides a high-speed, highly available data consolidation solution for PowerEdge systems running Microsoft Windows and other supported operating systems. In a PowerEdge Cluster FE100/FL100 and FE200/FL200 solution, the PowerVault SAN provides a high-speed storage resource for your PowerEdge Cluster nodes.

PowerVault SAN software and hardware releases are bundled and given a specific version number that identifies the hardware and software components for a storage solution, with each configuration providing a solution for a particular need or function. Most of the SAN configurations are tested and certified for implementation on specific PowerEdge Cluster solutions. Because PowerEdge cluster solutions implement different versions of SAN, ensure that your cluster meets the SAN requirements for your particular cluster solution.

See the *Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Platform Guide* for the SAN version required for your cluster solution.

## PowerVault SAN Components

The key components in a SAN include the following components:

- **HBA** — An I/O adapter that connects the server's PCI bus to the storage components. One or two HBAs must be installed in each server in the SAN to manage the I/O data transfer from the server to the storage system.
- **Interconnects** — The connections between the server and the storage systems. These connections include:
  - *PowerVault switch* — Functions as a director, mapping requests and responses between the interconnected devices and provides a dedicated point-to-point interconnection between the server and storage system.
  - *PowerVault bridge* — Provides the interconnection between the switch and the tape libraries.
- **Storage system** — Provides external storage for the host system (cluster nodes). Supported storage systems include tape libraries, disk array enclosures, and disk processor enclosures.
- **SAN storage system management software** — Provides centralized control of the SAN for easier management. These software management tools include:
  - QMSJ
  - QLogic QLogicDirect
  - Dell OpenManage™ Managed Node (Data Agent)
  - Dell OpenManage Data Supervisor
  - Dell OpenManage Data Administrator
  - Dell OpenManage ATF

See "Software Components" for a description of these software management tools.

- **(Optional) Fabric** — A set of switches that shares ISLs—two or more Fibre Channel switches connected together—with their attached devices, such as servers and storage systems.
- **(Optional) SAN appliance** — Provides enhanced storage management features between the cluster nodes and the storage systems.

See "Software Components" for a description of the SAN management software applications.

 **NOTE:** Your SAN may require additional hardware and software components that are not listed above. See your PowerVault SAN documentation for information on SAN compliant hardware and software components.

### PowerVault SAN Benefits

The PowerVault SAN provides the following advantages for a PowerEdge Cluster:

- **Higher availability** — Redundant connections between the SAN components provide continuous access to your shared storage systems in the event of a hardware or cable failure.
- **Consolidated storage** — The PowerVault SAN enables customers to consolidate and centralize their storage systems, allowing two or more cluster nodes to share a single storage array and more efficient use of storage resources.
- **Lower management costs** — Fewer storage arrays and centralized storage deployment helps to simplify storage management, reducing the time and effort needed to manage the devices.
- **Faster backups at lower cost** — Because data throughput on a SAN is significantly greater than the speed of network backup, backup windows will be significantly shorter.
- **Greater scalability** — Using a PowerVault switch, the PowerVault SAN enables scalable storage solutions that can grow as a customer's requirements evolve.

### Storage Management Software

PowerEdge Clusters require additional software components to manage the communications between the cluster nodes and the storage systems in a SAN environment.

Table 1-4 provides a list of QLogic and Dell OpenManage™ software packages that are used in PowerEdge Clusters FE100/FL100 and FE200/FL200 configurations.

See "Minimum System Requirements" for the storage management software required for your particular cluster configuration.

**Table 1-4. Storage Management Software**

Software	Function
QMSJ	Management software for controlling, configuring, and managing QLogic HBAs
QLogic QLDirect	A filter driver that enables host failover. The driver must be installed on every host system connected to the PowerVault 530F SAN appliance or a SAN-attached PowerVault 660F storage system. Specific primary and secondary failover paths are configured using the QLogic Management Suite Java (QMSJ) software.

**Table 1-4. Storage Management Software (Continued)**

<b>Software</b>	<b>Function</b>
Dell OpenManage Array Manager	Provides a comprehensive storage management solution in an integrated graphical view. From a single location, Array Manager enables you to configure and manage local and remote storage attached to a server while the server is online and continuing to process requests.
Dell OpenManage Managed Node (Data Agent)	Provides connectivity from the cluster node (host) to the PowerVault 65xF storage system, allowing Dell OpenManage Data Supervisor or Data Administrator to send and receive information to and from the PowerVault 65xF storage system connected to a cluster node.
Dell OpenManage Data Supervisor	Provides storage management and configuration using GUI. Data Supervisor allows you to configure and manage the disks and components in a single PowerVault 65xF storage system, as well as bind and unbind LUNs.
Dell OpenManage Data Administrator	Provides the same capabilities as Data Supervisor, but also allows you to configure and manage multiple storage systems in a single window.
Dell OpenManage ATF	Reestablishes a failed connection to a PowerVault 65xF caused by a communication failure, such as a failed storage processor, HBA, Fibre Channel switch, or Fibre Channel cable. Without human intervention, ATF can reroute the I/O through a secondary path to the PowerVault 65xF to provide connectivity for running applications.
Dell OpenManage Storage Consolidation (StorageC)	<p>Enables servers to share the same external storage system.</p> <p>StorageC is required if you share the cluster storage system(s) with other cluster(s) and/or non-clustered PowerEdge system(s).</p> <p>StorageC is not required if your cluster configuration is a direct attached configuration, a two-node cluster that uses SAN-attached storage systems, or uses a PowerVault 530F for storage virtualization.</p>
Dell OpenManage Cluster Assistant with ClusterX™ (Optional)	<p>Provides additional cluster management features not available with Cluster Administrator-a management component in MSCS. These features include:</p> <ul style="list-style-type: none"><li>• Enterprise-wide status of clusters and applications</li><li>• Cluster uptime statistics</li><li>• Physical network hierarchy and application hierarchy of the clusters</li><li>• Load balancing across cluster nodes</li><li>• Automatic application setup and migration</li></ul>

# Optional Cluster Configurations

The following options are available for PowerEdge Cluster FE100/FL100 and FE200/FL200 configurations:

- Direct-attached cluster
- SAN-attached cluster
- Cluster consolidation
- SAN appliance-attached cluster

The following sections provide detailed information and examples for these options.

## Direct-Attached Cluster

In a direct-attached cluster configuration, both nodes of the cluster are directly attached to a single storage system.

 **NOTE:** A direct-attached cluster configuration does not require a SAN.

Figure 1-1 shows a basic direct-attached cluster configuration for a PowerEdge Cluster FE100/FL100.

**Figure 1-1. Direct-Attached Cluster Configuration for a PowerEdge Cluster FE100/FL100**

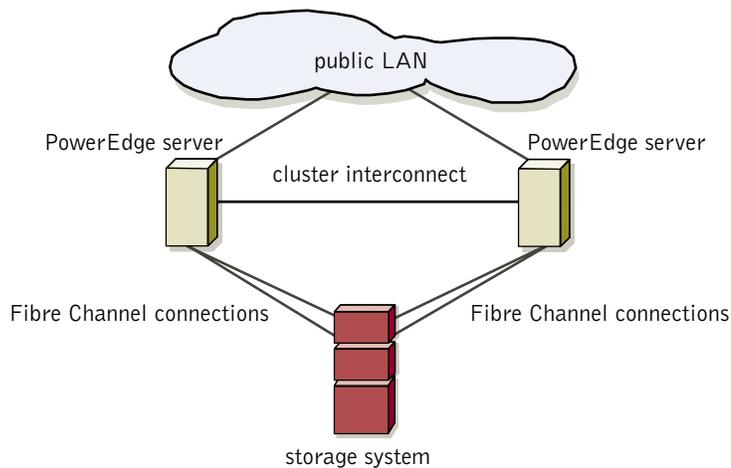
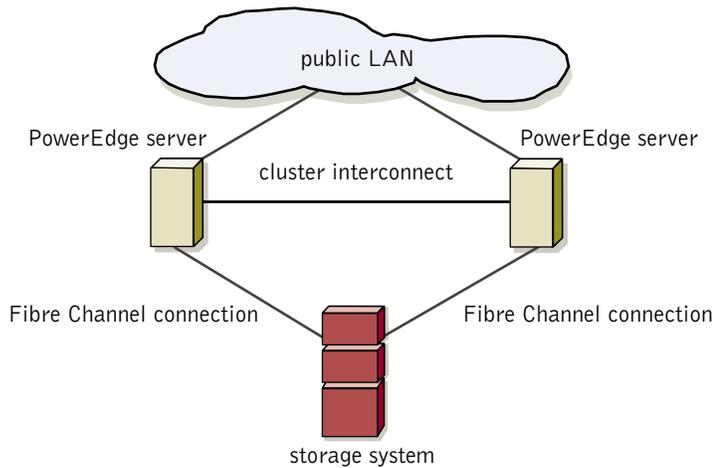


Figure 1-2 shows a basic direct-attached cluster configuration for a PowerEdge Cluster FE200/FL200.

**Figure 1-2. Direct-Attached Cluster Configuration for a PowerEdge Cluster FE200/FL200**



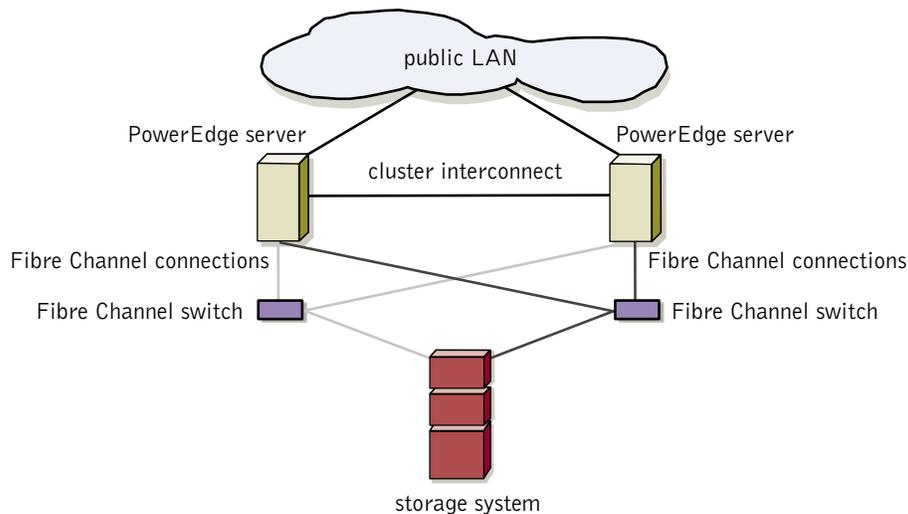
### **SAN-Attached Cluster**

In a SAN-attached cluster configuration, both cluster nodes are attached to a single storage system or to multiple storage systems through a PowerVault SAN using a redundant Fibre Channel switch fabric.

See "Fibre Channel Switch Fabric" for more information.

Figure 1-3 shows a SAN-attached cluster configuration.

**Figure 1-3. SAN-Attached Cluster Configuration**



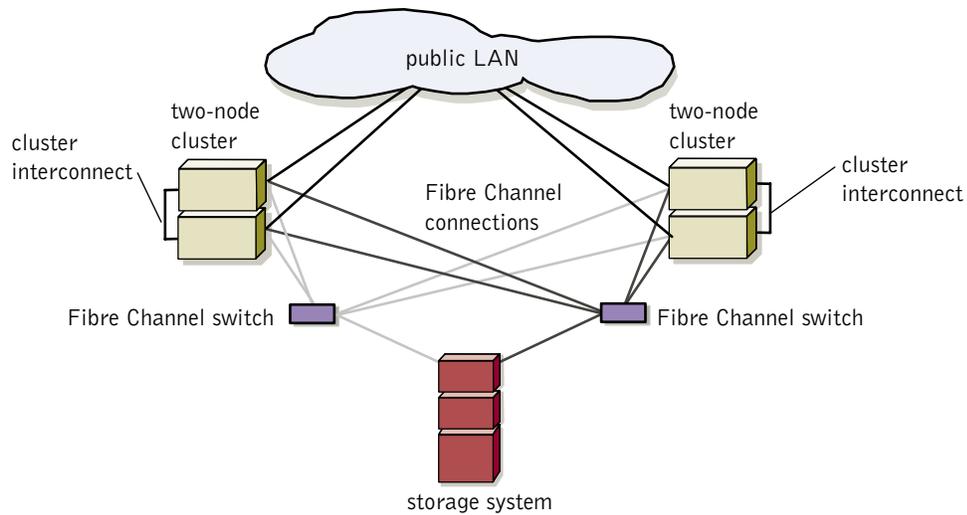
### **Cluster Consolidation**

In a cluster consolidation configuration, multiple clusters and stand-alone servers are attached to a single storage system through a PowerVault SAN using a redundant Fibre Channel switch fabric, switch zoning, and Dell OpenManage Storage Consolidation (StorageC) software.

See "Fibre Channel Switch Fabric" and "Zones" for more information.

Figure 1-4 shows a cluster consolidation configuration.

**Figure 1-4. Cluster Consolidation Configuration**

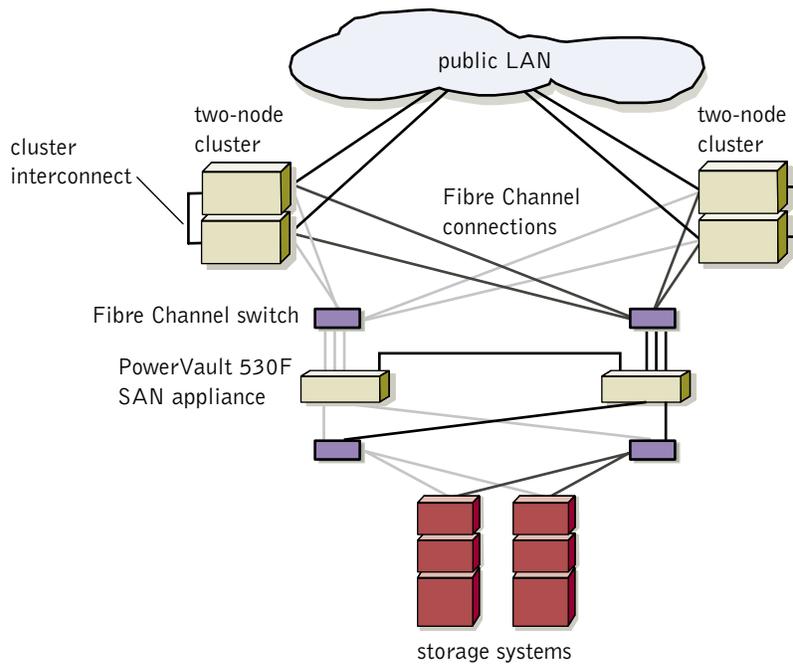


### **SAN Appliance-Attached Clusters**

In a SAN appliance-attached cluster, one or more two-node clusters are attached to a redundant pair of SAN appliances through a SAN using a redundant Fibre Channel switch fabric. This configuration uses one or more storage systems attached to a PowerVault 530F SAN appliance and supports many of the features integrated into the SAN-attached cluster and cluster consolidation configurations.

Figure 1-5 shows a SAN appliance-attached configuration.

**Figure 1-5. SAN-Appliance Attached Cluster Configuration**



## Minimum System Requirements

PowerEdge Cluster FE100/FL100 and FE200/FL200 configurations require the following components:

- Cluster nodes
- Cluster storage
- Cluster interconnect
- Software components

The following sections describe the minimum system requirements for each component.

### Cluster Nodes

Two cluster nodes are required for each cluster. Both nodes require the following hardware resources:

- **PowerEdge systems** — Two supported PowerEdge systems with at least two microprocessors are required for each cluster.
- **RAM** — A minimum of 256 MB RAM.
- **HBAs** — One or two Fibre Channel HBAs are required for each PowerEdge system.

Table 1-5 provides the number of required HBAs per cluster node for each configuration.

**Table 1-5. Required HBAs for SAN-Attached and Direct-Attached Configurations**

Cluster Type	Cluster Configuration	Number of Required HBAs
FE100 and FL100	Direct attached	2
FE100 and FL100	SAN attached	2

**Table 1-5. Required HBAs for SAN-Attached and Direct-Attached Configurations**

Cluster Type	Cluster Configuration	Number of Required HBAs
FE200 and FL200	Direct attached	1
FE200 and FL200	SAN attached	2

For dual HBA configurations, Dell recommends placing Fibre Channel HBAs on separate PCI buses to improve availability and performance.

See the *Dell PowerEdge Cluster FE100/FL100 and FE200/FL200 Platform Guide* for more information about supported servers, supported cluster pairs (homogeneous pairs and heterogeneous pairs), specific HBA models supported by the system, and PCI slot configuration guidelines.

- **NIC cards** — Each cluster node requires at least two NIC cards: one NIC for the public network (client LAN connections) and another NIC for the private network (cluster interconnect). The NICs installed in each cluster node for the private network must be identical and supported by the system.
- **RAID or SCSI controller** — At least two internal hard drives connected to a PowerEdge RAID controller or integrated SCSI controller for each server. For the internal drives, you can use any RAID controller or SCSI adapter supported by the system.

Two disk drives are required for mirroring (RAID 1) and at least three disk drives are required for disk striping with parity (RAID 5).

 **NOTE:** Dell strongly recommends using hardware-based RAID or software-based disk-fault tolerance for the internal drives to prevent a single point of failure in the server system.

## Cluster Storage

Cluster storage requires the following components:

- **Storage system(s)** — At least one storage system must be attached to the cluster nodes for each cluster. The type of storage system varies, depending on your cluster configuration:
  - *PowerEdge Cluster FE100/FL100:* One or more PowerVault 65xF/630F storage systems
  - *PowerEdge Cluster FE200/FL200:* One or more PowerVault 660F/224F storage systems

Multiple two-node clusters can share one or more storage system with Storage Consolidation (StorageC) software.

- **Hard drives** — At least ten hard drives and dual SPSs are required for each PowerVault 65xF disk processor enclosure.

At least two hard drives are required for each PowerVault 660F/224F storage system.

 **NOTE:** If you implement a PowerVault SAN in your cluster configuration, two-node clusters and stand-alone servers can share a single PowerVault 65xF storage system.

## Cluster Interconnect

The cluster interconnect provides the private network connection for sharing cluster health and status information between the cluster nodes. The cluster interconnect requirements vary, depending on your cluster configuration.

### PowerEdge Cluster FE100 and FE200

- **NICs** — Any Ethernet NIC supported by the system platform or the system's integrated Ethernet NIC (if available) for each cluster node. The NICs for the private network must be identical and supported by the system.

- **Ethernet cables** — One Ethernet crossover cable for the private network connection (cluster interconnect) between two Fast Ethernet (100Base-TX) NICs or one standard Ethernet cable for the private network between two Gigabit Ethernet (1000Base-T) NICs.

 **NOTE:** Dual-port Fast Ethernet NICs are not recommended for simultaneous cluster connections to the public and private networks. The public network can provide redundancy for node-to-node traffic in the case of a failure in the private network segment.

- **Ethernet Switch (optional)** — One Ethernet switch (not included) for the cluster interconnect.
- **Ethernet switch cabling (optional)** — Additional Ethernet cables (not included) attached to an Ethernet switch for the private network (cluster interconnect).

### PowerEdge Cluster FL100 and FL200

- **NICs** — One Emulex cLAN host adapter for each server
- **Cabling** — One Emulex cLAN high-speed serial data cable for each two-node cluster
- **Switch (optional)**— One or more Emulex cLAN cluster switches

If you use the optional Emulex switch to connect the systems, one Emulex cLAN cable is required for each cluster node. The same HSSDC cable can also be used for non-switched configurations.

## Software Components

The software component requirements for your PowerEdge Cluster varies, depending on your cluster configuration.

### PowerEdge Cluster FE100/FL100

- **Operating system** — Windows NT Server 4.0, Enterprise Edition or Windows 2000 Advanced Server using NTFS for external cluster storage
- **Network protocol** — TCP/IP

 **NOTE:** NetBEUI and NWLINK IPX/SPX protocols are not supported on the cluster nodes.

- **Storage management software** — The following management software must be installed on your PowerEdge cluster:
  - QMSJ
  - Dell OpenManage Managed Node
  - Dell OpenManage Data Supervisor or Data Administrator
  - Dell OpenManage ATF (required when sharing the storage system[s] with other cluster[s] and/or nonclustered system[s])
  - Dell OpenManage Storage Consolidation (StorageC)
  - Dell OpenManage Cluster Assistant with ClusterX (optional)
  - QLogic QLogicDirect (optional)

 **NOTE:** QLogicDirect is required only if your cluster configuration includes a PowerVault 530F SAN appliance.

See "Storage Management Software" for a description of each storage management software component.

### PowerEdge Cluster FE200/FL200

- **Operating system** — Windows NT Server 4.0, Enterprise Edition or Windows 2000 Advanced Server using NTFS for external cluster storage

- Network protocol — TCP/IP

 **NOTE:** NetBEUI and NWLINK IPX/SPX are not supported on the cluster nodes.

- Storage management software — The following management software must be installed on your PowerEdge cluster:

- QMSJ
- Dell OpenManage Array Manager (required in a SAN configuration with dual HBAs)
- QLDirect (required when sharing storage system[s] with other cluster[s] and/or non-clustered system[s])
- Dell OpenManage Storage Consolidation (StorageC) software
- Dell OpenManage Cluster Assistant with ClusterX (optional)

See "Storage Management Software" for a description of each storage management software component.



## **Appendix E: MTSC Problem-Solving Model**

**Table E-1. MTSC Problem-Solving Model**

Activities and Responsibilities	Create System	Manage System	Perform Activity Within System
<b>Define the Problem</b> <ul style="list-style-type: none"> <li>• Specify purpose</li> <li>• Analyze context</li> <li>• Analyze audience</li> </ul>			
<b>Design the Solution</b> <ul style="list-style-type: none"> <li>• Make preliminary decisions about medium, form, style, production, distribution, etc.</li> <li>• Gather information</li> <li>• Draft solution</li> <li>• Design finished product</li> </ul>			
<b>Test the Solution</b> <ul style="list-style-type: none"> <li>• Design procedures for testing or review present pilot version or review copy to a sample audience or reviewers</li> <li>• Gather responses</li> <li>• Analyze them</li> </ul>			
<b>Implement the Solution</b> <ul style="list-style-type: none"> <li>• Revise the solution</li> <li>• Produce it</li> <li>• Package it</li> <li>• Deliver it</li> </ul>			
<b>Evaluate the Solution</b> <ul style="list-style-type: none"> <li>• Design an evaluation method</li> <li>• Use the method</li> <li>• Analyze the results</li> </ul>			

The context for problem solving is the particular situation in which a communicator works. Major features of context are: kind of employer (research center, electronics firm, etc.), subject matter, medium, audience, culture (Western, Eastern), etc.

**Appendix F: NAS Cluster Solution Components**

**Table F-1. NAS Cluster Solution Components**

<b>Hardware/Software Component</b>	<b>Description</b>
NAS server system	A single-purpose PowerVault 750N or 755N (75xN) storage device that uses the Microsoft Windows Powered operating system to provide dedicated file service to network clients.
Microsoft Windows Powered operating system	A stripped-down version of the Windows 2000 operating system dedicated to file service on a corporate network.
Microsoft Cluster Service (MSCS)	The clustering software component built into the Windows Powered operating system that controls application failover operations, forcing another node in the cluster to accept responsibility for the failed node's operations, thereby providing high availability for user data access.
Private network	A communications network consisting of two network interface cards (NICs) and a 10BaseT Ethernet crossover cable that connects both NAS systems together. This isolated network is used by the NAS systems (or cluster nodes) in the cluster to monitor each other, ensuring that each cluster node is running properly.
Public network	The client network consisting of a NIC installed in each NAS system and a 10BaseT crossover cable connected to the corporate network that connects the NAS systems with the network clients.

# Appendix G: Configuring a Cluster System

**Table G-2. Configuring a Cluster System**

<b>Event</b>	<b>Description</b>
Install the cluster components into a computer hardware rack	The computer hardware rack is either a two-post or four-post rack. Two-post racks consist of two metal posts that mount onto a platform, which is bolted to the floor. A four-post rack—the most popular choice for computer hardware storage—consists of four metal posts mounted onto a square metal platform with casters on the bottom corners of the platform. The front of the rack includes a locking metal door to secure the computer systems from unauthorized personnel. The components stored in the rack include the server systems, NAS systems, and or storage systems.
Cable the components together using fiber optic or SCSI cables	The fibre optic and SCSI cables provide a communications link between the computer systems. Computer systems that are connected in a direct-attached configuration incorporate SCSI cables. Computer systems that are connected to each other through a SAN or in a cluster configuration use fiber optic cables to maximize the data transfer rate between the systems.
Configure the hard drive space on the storage systems into multiple storage areas	This process isolates the data and protects it from being accessed by unauthorized users.
Connect the cluster nodes to the corporate network	This process allows the network users to connect to the nodes through the corporate network.
Install the operating system and systems management software on the cluster nodes	The operating system runs the cluster hardware systems. The systems management software allows the engineer to monitor, troubleshoot, and repair cluster system problems from a distance on the corporate network.

<b>Hardware/Software Component</b>	<b>Description</b>
NAS server system	A single-purpose PowerVault 750N or 755N (75xN) storage device that uses the Microsoft Windows Powered operating system to provide dedicated file service to network clients.
Microsoft Windows Powered operating system	A stripped-down version of the Windows 2000 operating system dedicated to file service on a corporate network.
Microsoft Cluster Service (MSCS)	The clustering software component built into the Windows Powered operating system that controls application failover operations, forcing another node in the cluster to accept responsibility for the failed node's operations, thereby providing high availability for user data access.
Private network	A communications network consisting of two network interface cards (NICs) and a 10BaseT Ethernet crossover cable that connects both NAS systems together. This isolated network is used by the NAS systems (or cluster nodes) in the cluster to monitor each other, ensuring that each cluster node is running properly.
Public network	The client network consisting of a NIC installed in each NAS system and a 10BaseT crossover cable connected to the corporate network that connects the NAS systems with the network clients.

**Appendix H: Table of Contents Example—Dell PowerEdge Cluster  
FE100/FL100 and FE200/FL200 I&T Guide**

# Contents

## 1 Introduction

- Intended Audience . . . . . 1-2**
- Obtaining Technical Assistance . . . . . 1-3**
- Other Documents You May Need. . . . . 1-3**
- Overview . . . . . 1-4**
  - Clustering . . . . . 1-5
  - Virtual Servers and Resource Groups . . . . . 1-5
  - Failover and Failback. . . . . 1-6
  - Quorum Disk (Quorum Resource) . . . . . 1-6
- PowerEdge Cluster FE100/FL100 and FE200/FL200 Solutions . . . . . 1-7**
  - Features and Enhancements . . . . . 1-7
  - Cluster Identification . . . . . 1-8
  - Hardware and Software Technologies . . . . . 1-9
    - Clustering Technology . . . . . 1-10
    - Fibre Channel Protocol . . . . . 1-11
    - Fibre Channel Switch Fabric. . . . . 1-11
    - Zones . . . . . 1-12
    - PowerVault SAN . . . . . 1-12
    - PowerVault SAN Components . . . . . 1-13
    - PowerVault SAN Benefits . . . . . 1-14
    - Storage Management Software . . . . . 1-14
- Optional Cluster Configurations . . . . . 1-16**
  - Direct-Attached Cluster. . . . . 1-16
  - SAN-Attached Cluster . . . . . 1-18
  - Cluster Consolidation . . . . . 1-18
  - SAN Appliance-Attached Clusters . . . . . 1-19
- Minimum System Requirements . . . . . 1-20**
  - Cluster Nodes. . . . . 1-20
  - Cluster Storage. . . . . 1-22
  - Cluster Interconnect . . . . . 1-22
    - PowerEdge Cluster FE100 and FE200. . . . . 1-22
    - PowerEdge Cluster FL100 and FL200. . . . . 1-23
  - Software Components. . . . . 1-23
    - PowerEdge Cluster FE100/FL100 . . . . . 1-23
    - PowerEdge Cluster FE200/FL200 . . . . . 1-24

## 2 Cabling the Cluster Hardware

<b>Cabling Your Cluster Components</b> . . . . .	<b>2-2</b>
Copper Fibre Channel Cables Connectors . . . . .	2-2
DB-9 Connector . . . . .	2-2
HSSDC Connector . . . . .	2-3
Optical Fibre Channel Cable Connectors . . . . .	2-4
<b>Cabling the Storage Systems</b> . . . . .	<b>2-4</b>
Direct-Attached Cluster . . . . .	2-4
Cabling the PowerVault 65xF (for PowerEdge Clusters FE100/FL100) . . . . .	2-5
Cabling the PowerVault 660F/224F (for PowerEdge Clusters FE200/FL200) . . . . .	2-6
SAN-Attached Cluster . . . . .	2-7
Cluster Consolidation . . . . .	2-8
<b>Cabling the Public and Private Networks</b> . . . . .	<b>2-9</b>
Cabling the Public Network . . . . .	2-10
Using Dual-Port NICs for the Private Network . . . . .	2-10
Connecting to the Public Network . . . . .	2-11
Cabling the Private Network . . . . .	2-11
Using Ethernet for the Private Network (PowerEdge Cluster FE100/FE200) . . . . .	2-11
Using Dual-Port NICs for the Private Network . . . . .	2-14
Using Emulex cLAN for the Private Network (PowerEdge Cluster FL100/FL200) . . . . .	2-14
Using Emulex cLAN Switches in Your Cluster Configuration . . . . .	2-14
Using Emulex cLAN HBAs for the Private Network . . . . .	2-14
Emulex cLAN Cluster Switch (8 or 30-port Versions Only) . . . . .	2-15
<b>Cabling the Power Supplies</b> . . . . .	<b>2-16</b>
Connecting Standby Power Supplies in the PowerVault 65xF System . . . . .	2-16
<b>Cabling the Mouse, Keyboard, and Monitor</b> . . . . .	<b>2-17</b>

## 3 Preparing Your Systems for Clustering

<b>Before You Begin</b> . . . . .	<b>3-2</b>
<b>Installation Overview</b> . . . . .	<b>3-3</b>
<b>Selecting a Domain Model</b> . . . . .	<b>3-5</b>
Windows NT Server 4.0, Enterprise Edition Clusters . . . . .	3-5
Configuring the Cluster Nodes as Domain Controllers . . . . .	3-5

Windows 2000 Advanced Server Clusters. . . . .	3-6
Configuring the Cluster Nodes as Domain Controllers . . . . .	3-6
<b>Assigning Static IP Addresses to Your Cluster Resources and Components</b>	<b>3-6</b>
Configuring IP Addresses for the Public Network . . . . .	3-7
Configuring IP Addresses for the Private Network . . . . .	3-8
Creating Separate Subnets for the Public and Private Networks . . . . .	3-9
<b>Configuring the Internal Drives in Your Cluster Nodes</b> . . . . .	<b>3-9</b>
Configuring the Cluster Nodes in a RAID Configuration. . . . .	3-9
Configuring the RAID Level for the Internal Hard Drives (Optional) . . . . .	3-9
<b>Installing and Configuring the Windows Operating System.</b> . . . .	<b>3-10</b>
Windows NT Server 4.0, Enterprise Edition Clusters . . . . .	3-10
Installing and Updating the Intel NIC Drivers . . . . .	3-10
Using Windows NT Software-Based Fault Tolerance . . . . .	3-11
Configuring Windows NT Networking . . . . .	3-11
Windows 2000 Advanced Server Clusters. . . . .	3-11
Installing Windows 2000 Cluster Service . . . . .	3-11
Configuring Windows 2000 Networking . . . . .	3-12
<b>Installing the HBA Drivers</b> . . . . .	<b>3-12</b>
Installing HBA Drivers in Windows NT Server 4.0, Enterprise Edition Clusters . . . . .	3-12
Configuring the Fibre Channel HBAs. . . . .	3-12
Installing HBA Drivers in Windows 2000 Advanced Server Clusters . . . . .	3-12
Configuring the Fibre Channel HBAs. . . . .	3-13
<b>Installing and Configuring the Storage Management Software</b> . . . . .	<b>3-13</b>
Configuring the Dell OpenManage Managed Node (Data Agent) . . . . .	3-13
Configuring Data Agent for a Cluster Environment (FE100/FL100 Only)	3-14
Configuring Data Agent for Cluster Failover (FE100/FL100 Only) . . . . .	3-14
Using Cluster Administrator to Stop Data Agent. . . . .	3-15
Installing the QLogic Management Suite Java (QMSJ) Software . . . . .	3-15
Installing QLogicDirect . . . . .	3-16
<b>Configuring the Hard Drives on the PowerVault Shared Storage System(s)</b>	<b>3-16</b>
Connecting a Cluster to a Shared Storage System. . . . .	3-16
Configuring Enclosure Addresses . . . . .	3-17
Configuring and Managing LUNs . . . . .	3-17
Configuring and Managing LUNs and Virtual Disks on a PowerVault 650F . . . . .	3-17

Creating Virtual Disks for a PowerVault 660F . . . . .	3-18
Installing Dell OpenManage Software for a PowerVault 65xF Storage System . . . . .	3-18
Installing Dell OpenManage Software for a PowerVault 660F/224F Storage System . . . . .	3-18
Naming and Formatting Drives on the Shared Storage System. . . . .	3-19
Assigning Drive Letters . . . . .	3-19
Configuring Hard Drive Letters When Using Multiple Shared Storage Systems . . . . .	3-20
Configuring Shared Drives Using the Dell OpenManage Array Manager Software . . . . .	3-22
Using the Windows 2000 Dynamic Disks and Volumes. . . . .	3-22
Configuring the RAID Level for the Shared Storage Subsystem . . . . .	3-22
Assigning Drive Letters and Formatting Drives on the Shared Storage Subsystem. . . . .	3-22
Upgrading a PowerVault 65xF/660F Storage System for Clustering . . . . .	3-24
<b>Installing and Configuring MSCS . . . . .</b>	<b>3-25</b>
Overview . . . . .	3-25
Verifying Cluster Readiness. . . . .	3-25
Installing the Quorum Disk (Quorum Resource) . . . . .	3-25
Storing Applications and Data on the Quorum Disk. . . . .	3-26
Preventing Quorum Disk Failure . . . . .	3-26
Configuring Cluster Networks. . . . .	3-26
Verifying MSCS Operation . . . . .	3-27
Windows NT Server 4.0, Enterprise Edition . . . . .	3-27
Windows 2000 Advanced Server. . . . .	3-27
Windows NT Server 4.0, Enterprise Edition Clusters . . . . .	3-27
Windows NT Service Pack . . . . .	3-27
Windows NT Software-Based Fault Tolerance . . . . .	3-28
Windows 2000 Advanced Server Clusters. . . . .	3-28
Installing and Configuring the Windows 2000 Two-Node Cluster Service . . . . .	3-28
<b>Verifying Cluster Functionality . . . . .</b>	<b>3-28</b>
Verifying Cluster Network Communications. . . . .	3-29
Verifying MSCS Operation . . . . .	3-29
<b>Verifying Cluster Resource Availability . . . . .</b>	<b>3-29</b>
Troubleshooting Failed Resources . . . . .	3-30

**Appendix I: Table of Contents Example—Dell PowerVault 75xN  
NAS Cluster Installation and Troubleshooting Guide**

## 1 Getting Started

<b>Other Documents You May Need</b> . . . . .	<b>1-2</b>
<b>Overview of NAS Clusters</b> . . . . .	<b>1-4</b>
<b>NAS Cluster Features</b> . . . . .	<b>1-5</b>
<b>NAS Cluster Components</b> . . . . .	<b>1-6</b>
PowerVault 75xN-Specific Components . . . . .	1-6
PowerVault 75xN-Specific Network Components . . . . .	1-7
<b>Minimum System Requirements</b> . . . . .	<b>1-9</b>
PowerVault 75xN NAS Cluster Minimum System Requirements . . . . .	1-9
<b>Basic Installation Procedures</b> . . . . .	<b>1-11</b>

## 2 Preparing Your System Components for Clustering

<b>Adding the System Components</b> . . . . .	<b>2-2</b>
<b>Installing a PERC 3/DC RAID Controller</b> . . . . .	<b>2-2</b>
<b>Installing a DRAC II</b> . . . . .	<b>2-3</b>
<b>Upgrading Your PowerVault Storage Systems</b> . . . . .	<b>2-3</b>
Installing Upgrades for Enclosure Services Modules or SCSI Management Modules . . . . .	2-3
Configuring the SEMMs for Forced Joined Mode . . . . .	2-4

## 3 Cabling the Cluster Hardware

<b>Cabling the PowerVault 75xN Cluster</b> . . . . .	<b>3-2</b>
Cabling One PowerVault 21xS Shared Storage System to a PowerVault 75xN NAS Cluster . . . . .	3-3
Cabling Two PowerVault 21xS Storage Systems to a PowerVault 75xN Cluster . . . . .	3-6
Cabling Three or Four PowerVault 21xS Storage Systems to a PowerVault 75xN Cluster . . . . .	3-8
NIC Cabling . . . . .	3-9
Cabling the Private Network (Cluster Interconnect) . . . . .	3-11
<b>Power Cabling for PowerVault 75xN Clusters</b> . . . . .	<b>3-12</b>
<b>Mouse, Keyboard, and Monitor Cabling for PowerVault 75xN Clusters</b> . . . . .	<b>3-15</b>

**Appendix J: Section 1—Dell PowerVault 75xN NAS Systems  
Installation and Troubleshooting Guide**

This guide provides information about installing, configuring, and troubleshooting the Dell™ PowerVault™ 75xN Cluster hardware and software components. This document addresses the use of PowerVault storage systems in the following cluster configuration:

- Two PowerVault systems with PERC 3/DC RAID controllers, and up to four PowerVault 21xS storage systems

See the *Dell PowerVault 75xN NAS Cluster Platform Guide* for information about supported configurations.

 **NOTE:** Dell or Microsoft can support only the specific configurations described in the *Dell PowerVault 75xN NAS Cluster Platform Guide*.

This guide addresses two audience levels:

- Users and system installers who will perform general setup, cabling, and configuration of the PowerVault 75xN Cluster components
- Trained service technicians who will perform more extensive installations, such as firmware upgrades and installation of required expansion cards

## Other Documents You May Need

You may need to reference the following documentation when performing the procedures in this guide:

- The *Dell PowerVault 75xN NAS Cluster Platform Guide*, which provides information for the PowerVault 750N and 755N systems supported in a PowerVault 75xN Cluster.
- The *Dell PowerVault 750N and 755N NAS Appliance System Administrator's Guide*, which provides information for installing, configuring, and operating the PowerVault 750N and 755N NAS appliances.
- The *Dell PowerVault 750N NAS Appliance Installation and Troubleshooting Guide*, which provides information for upgrading and troubleshooting your Dell PowerVault 750N NAS appliance.
- The *Dell PowerVault 755N NAS Appliance Installation and Troubleshooting Guide*, which provides information for upgrading and troubleshooting your Dell PowerVault 755N NAS appliance.
- The *User's Guide* for your PowerVault 750N and 755N systems, which describes system features and technical specifications, small computer system interface (SCSI) device drivers, the System Setup program, software support, and the system configuration utility.
- The *Dell PowerVault 200S, 201S, 210S, and 211S Storage Systems Installation and Service Guide*, which provides installation and operation instructions for the PowerVault 21xS storage system and the SCSI expander management module (SEMM). This module is required to enable cluster functionality in the shared storage system.
- The Dell PowerEdge™ RAID Controller 3/Dual Channel (PERC 3/DC) documentation, which includes information on the SCSI RAID controller.
- The *System Information* document that came with your system for important safety information.

You may also have one or more of the following documentation sources:

- The Dell OpenManage™ Cluster Assistant With ClusterX® documentation, which provides instructions for using Dell OpenManage™ Cluster Assistant With ClusterX for monitoring, administering, and configuring cluster solutions.
- The Dell OpenManage Server Assistant documentation.
- The Dell OpenManage Array Manager documentation which provides instructions for using Dell OpenManage Array Manager. Dell OpenManage software is used to configure RAID systems.
- Microsoft® Windows® Cluster Service online documentation.

Documentation is included with any options you purchase separately from the system. This documentation includes information that you need to configure and install these options in your system.

This section introduces the PowerVault 75xN network-attached storage (NAS) Cluster and provides the following information:

- Overview of NAS Clusters
- NAS Cluster features
- NAS Cluster components
- Minimum system requirements
- Basic installation procedures

## Overview of NAS Clusters

The PowerVault 75xN NAS Cluster implements clustering technology on PowerVault 75xN NAS appliances based on the Microsoft Windows Powered operating system software. PowerVault 75xN clusters provide the following benefits in meeting the needs of mission-critical network application programs:

- High availability of system services and resources to network clients
- Redundant storage of application program data
- Failure recovery for cluster shares
- Capability to repair, maintain, or upgrade a cluster node without taking the entire cluster offline

PowerVault 75xN NAS appliances provide an easy-to-install solution for ensuring high-availability of your network storage resources. However, if the system experiences a catastrophic failure, such as a hard drive or power supply failure, network users will be unable to access their applications and resources while the system is being repaired and brought back online.

A NAS Cluster provides a failover solution for the NAS appliances, thereby ensuring a higher availability of network resources than a nonclustered NAS appliance. The NAS cluster consists of the following components:

- Two homogeneous (identical) PowerVault 75xN systems (referred to as cluster nodes)
- An Ethernet crossover cable (cluster interconnect) connected to a network interface controller (NIC) in both systems
- One or more PowerVault 21xS storage systems
- Clustering and operating system software

These components provide the NAS cluster with a single point of continuous access to network resources, including file services. Each cluster node is configured with software and network resources that enable it to interact with the other node to provide a mutual redundancy of operation and application program processing. Because the systems interact in this way, they appear as a single system to the network clients.

As an integrated system, the PowerVault 75xN NAS Cluster is designed to dynamically handle most hardware failures and downtime. In the event that one of the cluster nodes fails for any reason, the processing workload of the failed node switches over (or *fails over*) to the remaining node in the cluster. This failover capability enables the cluster system to keep network resources and application programs up and running on the network while the failed node is taken offline, repaired, and brought back online. The failover process is transparent and network clients experience only a momentary delay in accessing their resources. After the failed node is repaired, the network resources can be transferred back to the original node, if desired.

## NAS Cluster Features

The PowerVault NAS Clusters configuration provides a higher level of availability that is not available in nonclustered PowerVault NAS appliances. Because of the differences between clustered and nonclustered systems, compare the features in the clustered PowerVault NAS systems to ensure that they meet your specific needs.

Table 1-1 provides a comparison of the features in both a clustered and nonclustered PowerVault NAS system.

**Table 1-1. NAS Cluster Features**

Features	Clustered PowerVault NAS Systems	Nonclustered PowerVault NAS Systems
Failover capability	Yes	No
Common Internet File System (CIFS) shares	Yes	Yes
CIFS share failover	Yes	No
Dell OpenManage Array Manager management	Yes	Yes
Monitor and keyboard required	Yes	No
Failover SCSI storage	Yes	No
Failover internal SCSI storage	No	No
Network File System (NFS) shares	No	Yes
Novell® NetWare® shares	No	Yes
Apple shares	No	Yes
Snapshot functionality	No	Yes
Simplified disk and volume management	No	Yes
Online volume expansion	No	Yes

## NAS Cluster Components

The following subsections describe the components that are common to the PowerVault 75xN Cluster, as well as the components that are specific to each cluster system.

The PowerVault 75xN Cluster includes the following common components:

- Two PowerVault 75xN systems in homogeneous pairs.



**NOTE:** Dell or Microsoft supports only the specific configurations described in the *Dell PowerVault 75xN NAS Cluster Platform Guide*.

- PowerVault 21xS storage systems, each with dual SCSI expander management modules (SEMMs).
- Supported NICs for the public LAN.
- (Optional) Dell OpenManage Cluster Assistant With ClusterX installed on your systems management console for cluster management. For more information about Dell OpenManage Cluster Assistant With ClusterX, see the *Dell OpenManage Cluster Assistant With ClusterX Getting Started Guide*.

## PowerVault 75xN-Specific Components

The PowerVault 75xN system requires the following components:

- Support for redundant array of independent disks (RAID) 1, 5, and 1+0 levels
- Support for hot spare drives

 **NOTE:** RAID 1+0 is supported in a single enclosure or spanning two enclosures with hot spare drives.

 **NOTE:** RAID 0 and independent drive configurations can be installed in a PowerVault 75xN NAS cluster. Because they offer no data redundancy in the event of a disk failure, they are not recommended for a high-availability system.

- PERC 3/DC RAID controller(s) installed in each PowerVault 75xN for the cluster's shared storage
- Up to four PowerVault 21xS storage systems
- Two or more NICs installed in each PowerVault 75xN for the node-to-node cluster interconnect

 **NOTE:** The PowerVault 750N and 755N is preconfigured with one and two onboard NICs, respectively.

- One Ethernet crossover cable for the node-to-node cluster interconnect (private network)
- Keyboard and monitor

## PowerVault 75xN-Specific Network Components

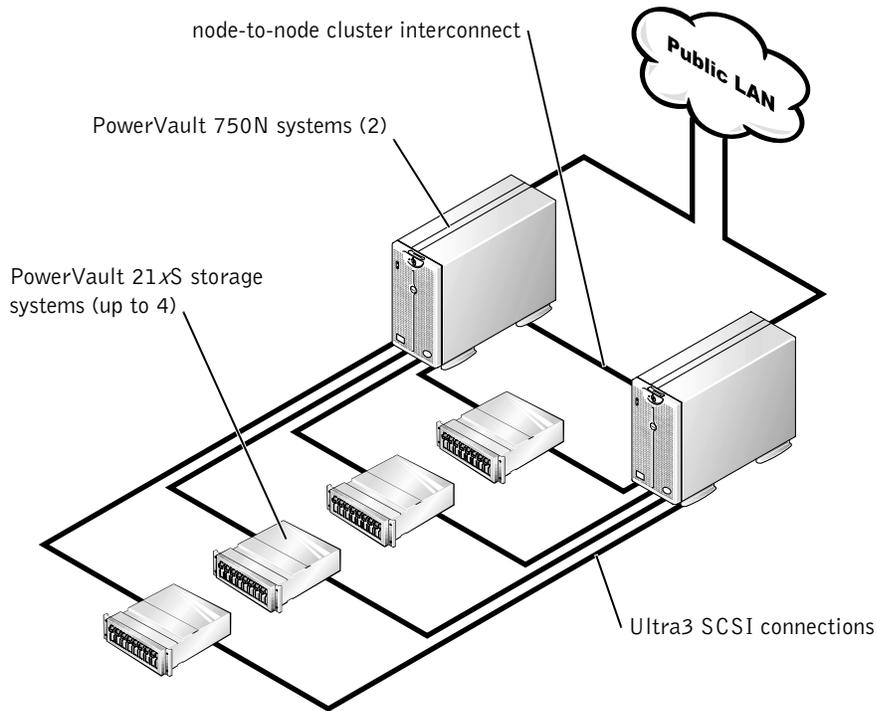
The PowerVault 75xN requires the following network components:

- At least one Windows Domain Controller with Active Directory
- Ethernet LAN

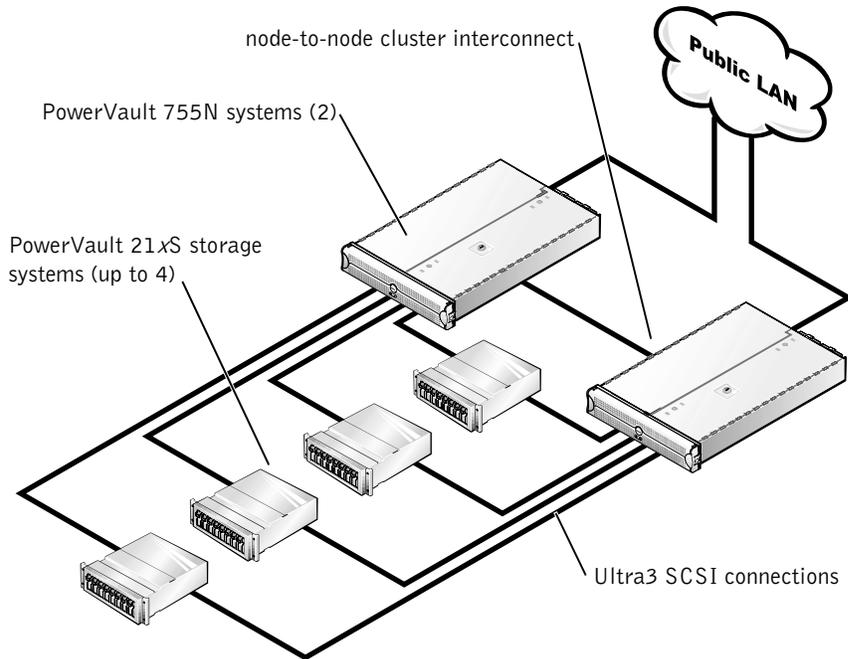
Figure 1-1 shows a sample configuration of the PowerVault 750N Cluster components and cabling. Figure 1-2 shows a similar sample configuration for the PowerVault 755N.

See the *Dell PowerVault 75xN NAS Cluster Platform Guide* for system-specific configuration information.

**Figure 1-1. PowerVault 750N Cluster Configuration**



**Figure 1-2. PowerVault 755N Cluster Configuration**



# Minimum System Requirements

If you are installing a new PowerVault 75xN NAS Cluster or upgrading an existing system to a PowerVault 75xN NAS Cluster, review the previous subsections to ensure that your hardware components meet the minimum system requirements listed in the following section.

## PowerVault 75xN NAS Cluster Minimum System Requirements

The PowerVault 75xN NAS Cluster requires the following minimum system hardware components:

- Two homogeneous (identical) PowerVault systems with a minimum of 512 MB of random access memory (RAM). See the *Dell PowerVault 75xN NAS Cluster Platform Guide* for system-specific configuration information.

 **NOTE:** Dell or Microsoft supports only the specific configurations described in the *Dell PowerVault 75xN NAS Cluster Platform Guide*.

- One PERC 3/DC RAID controller installed in each system is required for the cluster's shared storage. Up to two PERC 3/DCs may be used for the cluster's shared storage. One additional RAID controller, supported by the platform, may be used for the internal drives.

 **NOTE:** A shared storage system is a storage system or disk array (such as PowerVault 21xS) that can be used in a cluster environment. The cluster software controls access to the data on the shared storage system and allows only one system at a time to access the data.

 **NOTE:** See the *Dell PowerVault 75xN Cluster Platform Guide* for system-specific configuration information.

- A minimum of two identical NICs installed in each system for the following networks:
  - Public network (public LAN): one or more of any NIC supported in the system or the system's integrated Fast Ethernet NIC
  - Private network (node-to-node cluster interconnect): one of the supported NICs, such as the Intel® 10/100 NIC.
- An Ethernet crossover cable for private network communications (heartbeat connection). Dell will supply one crossover cable in each cluster kit.
- If you have an existing Ethernet switch, you can interconnect the private network NICs through the switch using two standard Ethernet cables. The Ethernet switch configuration has been tested on the PowerVault 75xN cluster, but Dell does not provide Ethernet switches or standard Ethernet cables in the cluster kit.

For information on the required power cabling and distribution components, see “Cabling the Cluster Hardware.”

- Up to four PowerVault 21xS storage systems (for the shared disk resource) with the following configuration:
  - Two SEMMs for each PowerVault 21xS enclosure
  - Redundant power supplies connected to separate power sources
  - At least two SCSI hard drives in each PowerVault 21xS enclosure to support hardware-based RAID functionality

 **NOTE:** Currently, MSCS supports only the Microsoft Windows NT® File System (NTFS) format for the shared storage system.

- Two volumes are the minimum requirement for an active/active cluster configuration.
- Two 1-, 4-, 8-, or 20-m SCSI cables for each PowerVault 21xS storage system in the cluster.

In addition to the preceding hardware components, the following software is required:

- Windows Domain Controller with Active Directory

- TCP/IP running on the public network (LAN)

## Basic Installation Procedures

 **NOTICE:** Before installing the PowerVault 75xN NAS Cluster, ensure that your power sources are adequate to handle the cluster's power requirements. See the PowerVault storage system documentation for power requirements.

Installing and configuring your PowerVault 75xN Cluster might involve a new installation or an upgrade of existing systems. In some cases, the Windows Powered operating system and some application programs might currently be installed on your system. If you are installing your PowerVault 75xN NAS Cluster in an existing system configuration, ensure that the following items are configured properly:

- Hardware and software components
- Hardware and cabling
- Configuration options
- Network IP address

If you are upgrading an existing system configuration, install the following components and software:

- Additional NICs
- Additional PERC 3/DC RAID controllers
- Windows Powered operating system
- Cluster software on each cluster node

 **NOTICE:** See “When Working Inside Your Computer” and “Protecting Against Electrostatic Discharge” in the safety instructions in your *System Information* document before performing any procedure which requires you to open the cover.

 **WARNING: The power supplies in your computer or storage system may produce high voltages and energy hazards, which can cause bodily harm. Only trained service technicians are authorized to remove the computer covers and access any of the components inside the computer.**

## Appendix K: Illustration Changes

Figure K-1. Illustration Markup for Figure 3-2

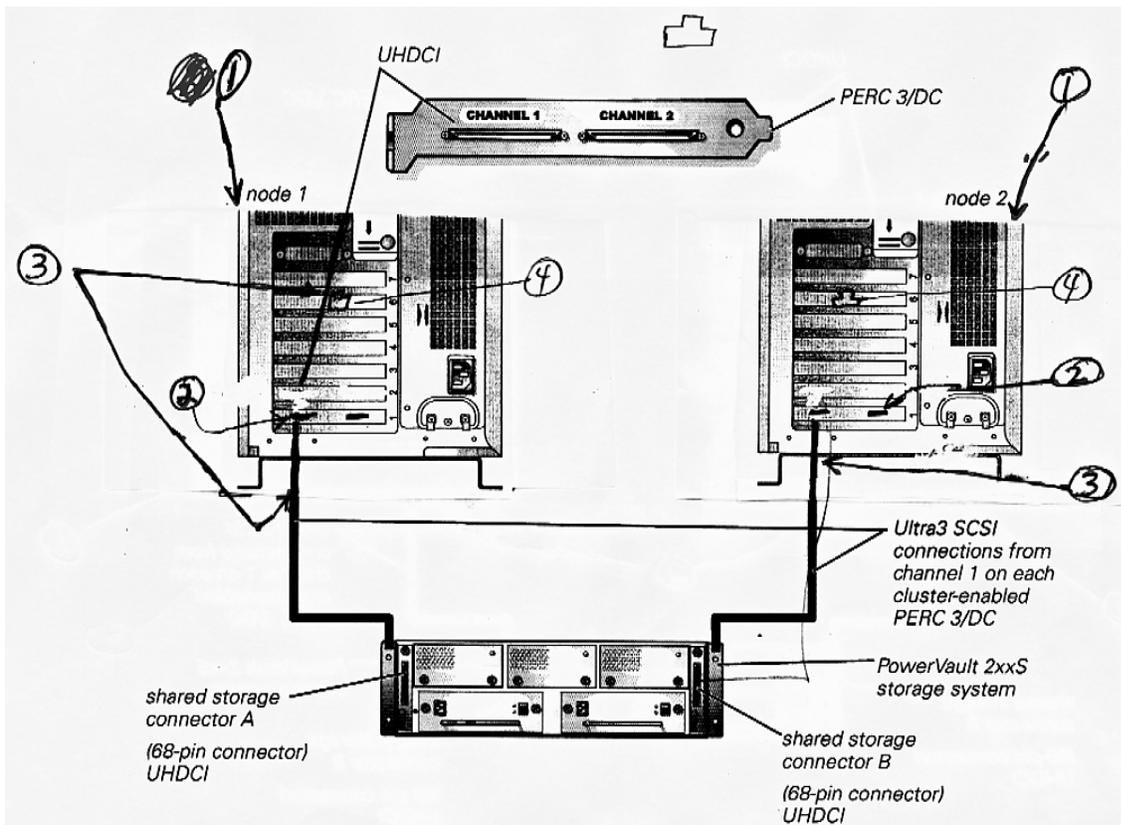


Figure 3-2. Cabling a PowerVault 750N With One PowerVault 2xxS Cluster

- ① Replace current illustration with rear view of a 750N.
- ② Add PERC 3/DC PCI card to slot #2 on back of system.
- ③ Add callout line that points to channel 1 on PERC 3/DC.
- ④ Add Intel 10/100 NIC connector to slot #6

Note to me: Slots 1+2 are 64-BIT. PERC 3/DC can be installed in either slot 1 or 2.

**Figure K-2. Final Illustration for Figure 3-2**

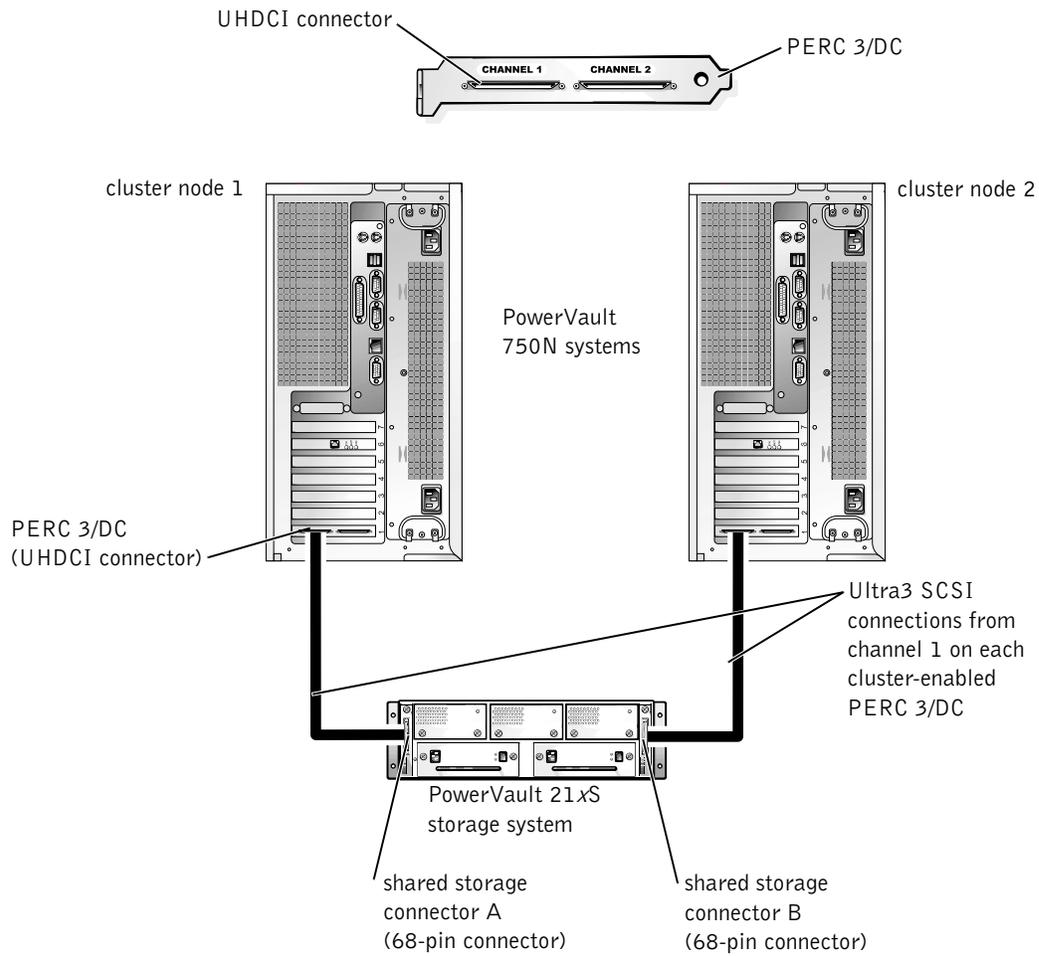


Figure K-1. Illustration Markup for Figure 3-9

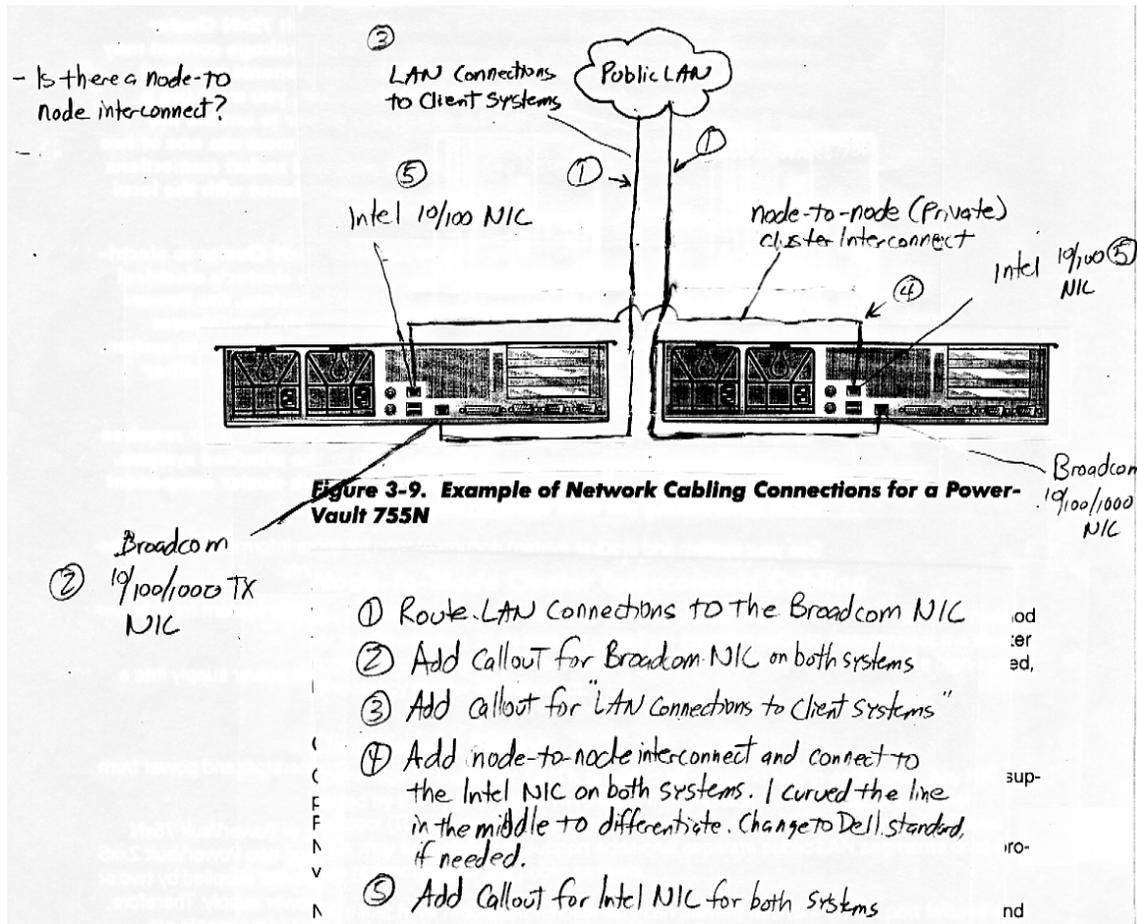
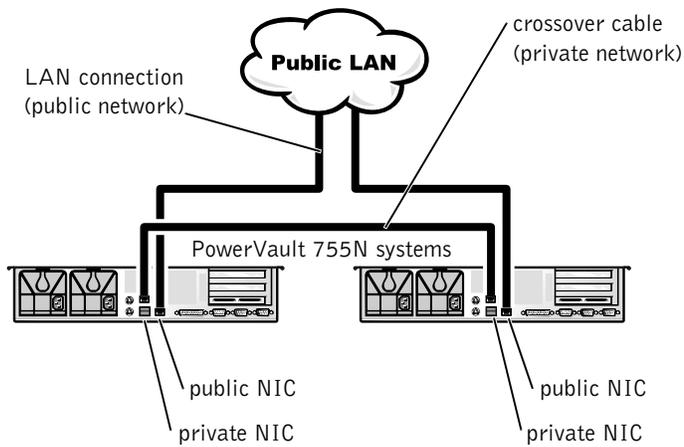


Figure 11-1. Final Illustration for Figure 3-9



## Bibliography

Anderson, Paul V. "What Technical and Scientific Communicators Do: A Comprehensive Model for Developing Academic Programs." In Flammia, Madelyn, ed., Perspectives on the Profession of Technical Communication. Arlington, VA: Society for Technical Communication, 1995.

Blizinski, Dan. Selecting the Right NAS Appliance for your Workgroup LAN. Dell Power Solutions. Available: [http://www.dell.com/us/en/esg/topics/power\\_ps4q00-blizin.htm](http://www.dell.com/us/en/esg/topics/power_ps4q00-blizin.htm).

Jones, Dan. Technical Writing Style. Needham Heights, MA: Allyn & Bacon, 1998.

Killingsworth, M. Jimmie. Information in Action: A Guide to Technical Communication. Needham Heights, Massachusetts: Simon and Schuster, 1999.

Mulvany, Nancy C. Indexing Books. Chicago: The University of Chicago Press, 1993.

Ottom, Erik. (2001). Availability. Fibre Channel Focus, Issue 5, 67-69.

Raskin, Jeff. (2000, April) Jef Raskin on Technical Writing. Available: <http://library.stanford.edu/mac/primary/interviews/raskin/index.htm>

Sheehy, Gail. New Passages: Mapping Your Life Across Time. New York, NY: Random House, 1995.

Sagert, Kelly Boyer. The Interviewing Conundrum. Available: <http://www.poewar.com/articles/interviewing.htm>

Shriver, Karen A. Dynamics in Document Design: Creating Text for Readers. New York: (John) Wiley Computer Publishing, 1999.