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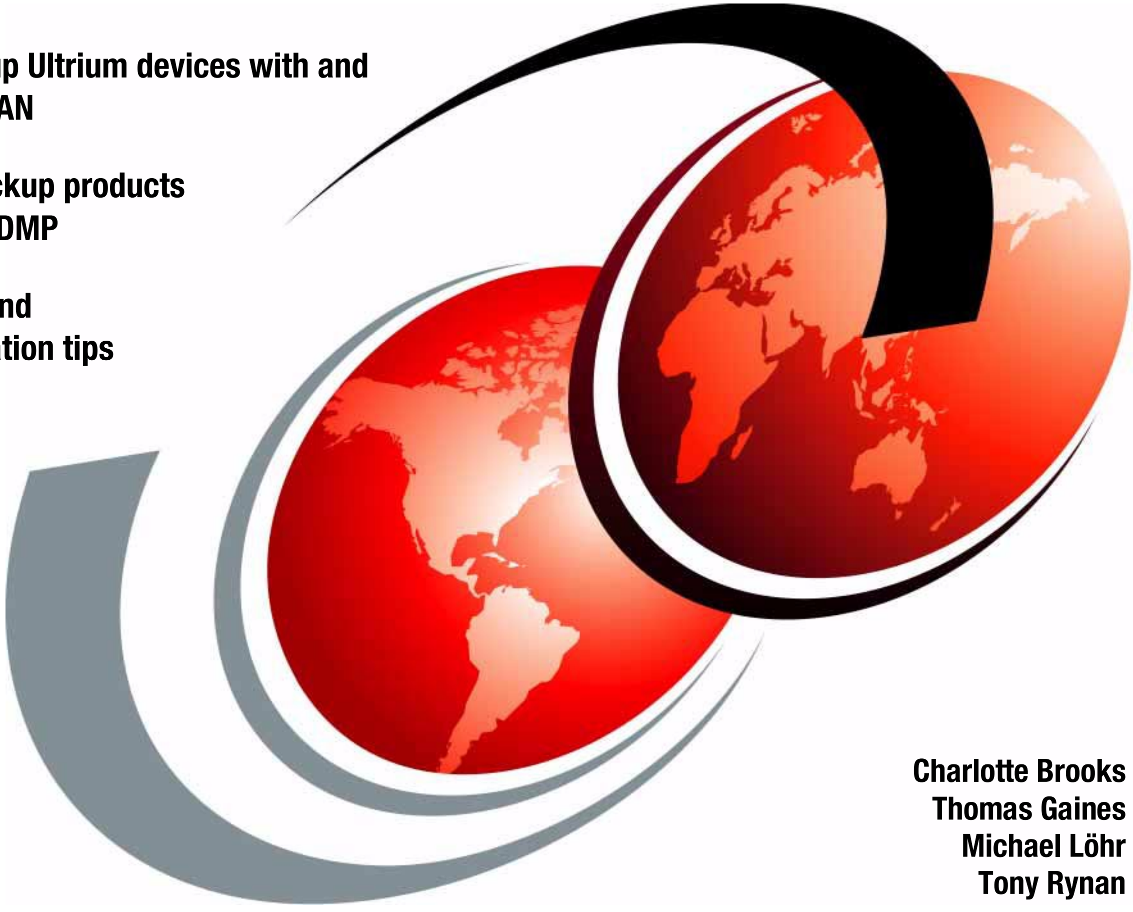
SG24-6268-00

Implementing IBM LTO in Linux and Windows

How to setup Ultrium devices with and without a SAN

Popular backup products including NDMP

Operation and implementation tips



Charlotte Brooks
Thomas Gaines
Michael Löhr
Tony Rynan

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International Technical Support Organization

Implementing IBM LTO in Linux and Windows

April 2002

SG24-6268-00

Take Note! Before using this information and the product it supports, be sure to read the general information in "Special notices" on page 449.

First Edition (April 2002)

This edition applies to the IBM Ultrium LTO tape drives and libraries and associated SAN products and adapters.

This document created or updated on March 20, 2002.

Comments may be addressed to:
IBM Corporation, International Technical Support Organization
Dept. QXXE Building 80-E2
650 Harry Road
San Jose, California 95120-6099

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Contents

Figures

Tables

Preface

This Redbook covers the implementation details of attaching IBM LTO tape subsystems (Ultrium products) to servers running Linux and Windows 2000. It describes how the attachment support is provided in the different operating system environments, as well as how to set up the devices using direct SCSI and SAN connections. Many practical examples are given for full step by step instructions. We also discuss how to configure the LTO products with many popular backup products, including Tivoli Storage Manager, VERITAS Backup Exec, BakBone NetVault , CA BrightStor ARCServe, Arkeia and Legato NetWorker are covered.

This redbook will help IBM, Business Partners and customer personnel to better understand and implement the IBM Ultrium LTO product line in Intel-based environments.

We assume that the reader is familiar with tape drives and libraries and knows basic SAN concepts and technologies.

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

Charlotte Brooks is a project leader for open tape and storage management solutions at the International Technical Support Organization, San Jose Center. she has 11 years of experience with IBM in the fields of RISC System/6000 and storage management. She has written seven redbooks and taught IBM classes worldwide on all areas of storage management. Before joining the ITSO two years ago, she was the Technical Support Manager for Tivoli Storage Management in the Asia Pacific region.

Thomas Gaines has been employed as a Technical Specialist with IBM Global Services Australia for 12 months. His primary focus is implementing and administering Tivoli Storage Manager solutions. He currently works onsite for Westpac Institutional Bank, Australia and has been doing so for a total of two years. His other responsibilities include server support and capacity planning in the Distributed Computing environment.

Michael Löhr is a member of IBM Advanced Technical Support in EMEA, responsible for UNIX and Linux SAN backup solutions. He joined IBM in 1997 and worked for the TSM client development before joining ATS. He has a M.S. degree in computer science (Dipl.-Inform.) from the Technical University of Darmstadt (TUD), Germany. From 1990 to 1992 he contributed to an industry project on DBMS and functional language support for software engineering. From 1992 to 1997 he worked at the German National Research Center for Computer Science (GMD) in a multimedia database project.

Tony Rynan is a Senior Software Specialist in IBM Australia. He currently performs architectural and implementation services for Tivoli Storage Manager products throughout Australasia. His areas of expertise include Tivoli Storage Manager, RISC System/6000, RISC System/6000 SP and SAN.

Figure 0-1 The team, left to right: Tony, Tom, Michael, Charlotte

Thanks to the following people for their contributions to this project:

Emma Jacobs
International Technical Support Organization, San Jose Center

Yvonne Lyon
International Technical Support Organization, San Jose Center

The authors of *Using IBM LTO Ultrium with Open Systems*, SG24-6502:
Tony Abete, Marco Ceresoli and Josef Weingand

Rich Cushman
Open Systems Tape Marketing, IBM Tucson

Kala Dutta
Tivoli Storage Manager development, IBM San Jose

Minh Le
Tivoli Storage Manager development, IBM San Jose

Dave Cannon
Tivoli Storage Manager development, IBM Tucson

Mary Ann Vandermark
Tivoli Storage Manager development, IBM Tucson

James Knibloe
SAN development, IBM Tucson

Jamie Shikiya
BakBone Software

Chris Verner
BakBone Software

Kristel Vecchiarelli
Arkeia

Notice

This publication is intended to help customers, IBM and Business Partner personnel who are responsible for tape storage solutions to implement the IBM LTO Ultrium product range in Intel-based Windows 2000 and Linux environments. The information in this publication is not intended as the specification of any programming interfaces that are provided by the IBM LTO Ultrium products. See the PUBLICATIONS section of the IBM Programming Announcement for the IBM LTO Ultrium products for more information about what publications are considered to be product documentation.

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Part 1

Setting up LTO Ultrium

In this part we introduce the LTO Ultrium products and describe how to set them up in various Windows 2000 and Linux environments. Both native SCSI and SAN (Fibre Channel) attachments are presented. We also show how to use the administration tools for the LTO, such as the StorWatch Specialist.

1

Introduction to LTO on Linux and Windows

This chapter provides the following:

- The development of LTO
- An overview of the four IBM LTO models available
- Server and OS platforms explained
- Storage management software
- Connectivity Examples
  - Direct SCSI attach
  - SAN Data Gateway attach
  - Integrated SDG attach
  - SCSI bus performance
- HBAs and drivers discussion
- LVD vs. HVD discussion
- HD68 vs. VHDCI discussion

1.1 LTO Overview

This section will cover the following:

- LTO development
- Enhancements since announcement
- LTO model overview
- LTO detail on individual models

1.2 LTO Development

The Linear Tape Open (LTO) program is a joint initiative of Hewlett-Packard, IBM and Seagate Technology. In 1997, the three companies set out to enable the development of best-of-breed tape storage products by consolidating state-of-the-art technologies from numerous sources. The three companies also took steps to protect customer investment by providing a four generation roadmap and establishing an infrastructure to enable compatibility between competitive products.

The LTO technology objective was to establish new open-format specifications for high capacity, high performance tape storage products for use in the midrange and network server computing environments, and to enable superior tape product options

LTO program cooperation goes beyond the initial three companies. LTO format specifications have been made available to all who wish to participate through standard licensing provisions. LTO program technology has already attracted a number of other industry leaders, so that LTO specified products (tape drives and tape storage cartridges) will reach the market from multiple manufacturers, not just the Technology Provider Companies. This is critical to meeting an open market objective, and is accomplished through open licensing of the technology.

Cooperation is also evident in the LTO program requirement that all products produced by licensees be technically certified annually. The primary objective of this certification is to ensure "LTO compliant media from any vendor can be read and written in LTO compliant drives from any vendor ".

All three consortium members (IBM, HP and Seagate) are now shipping LTO products. This redbook will discuss only the IBM LTO Ultrium product line.

The Linear Tape-Open organization homepage is at

`http://www.lto.org/`

1.2.1 LTO enhancements since introduction

Since their introduction in 2000, there have been several enhancements to the IBM LTO family in the areas of feature, function and connectivity.

August 23, 2000 - Initial announcements for all products

On August 23, 2000, the LTO family was announced. It comprised the following products:

- 3580 Ultrium Tape Drive
- 3581 Ultrium Tape Autoloader
- 3583 Ultrium Scalable Tape Library
- 3584 Ultrium UltraScalable Tape Library

Also included with this announcement were previews of future function planned for the LTO product line. The IBM definition of preview is:

```
Previews provide insight into IBM plans and direction. Specific availability
dates, ordering information and terms and conditions will be provided when the
product is announced.
```

Preview for 3580, 3581 & 3583

- Fibre Channel attachment through SAN Data Gateway
- Linux operating system support

Preview for 3584

- Fibre Channel — Arbitrated Loop (FC-AL) attachment
- Expanded Input/Output Station
- Support for Digital Linear Tape (DLT) technology
- Remote management and support features
- Certification in SAN solutions including LAN-free backup
- Linux operating system support for open systems servers

February 20, 2001

3584 announcement information

- Native FC-AL attach
- SAN LAN free backup capability

3584 preview

- Linux server attachment

- HP-UX Fibre Channel attachment
- Fibre Channel attach via Emulex family of adapters

June 12, 2001

3580 announcement

- Rack mount
- Linux support

3581 announcement

- Linux support

3583 announcement

- Native Fibre Channel via SAN Data Gateway Integrated Module
- Remote Management Unit (RMU)
- StorWatch Specialist

3583 preview

- SCSI extended copy command (data mover function)
- Attachment to McDATA and INRANGE switches
- Attachment to Linux servers
- HP-UX Fibre Channel attachment
- 2 Gigabit Fibre Channel attachment via Emulex and QLogic adapters

3584 announcement

- StorWatch Specialist
- DLT support via D42 frame
- Optional 20 LTO or 18 DLT cartridge I/O Station
- Hot swappable drives (LVD, HVD and FC-AL)
- Redundant Drive power supplies

June 26, 2001

3584 announcement

- Non hot swappable, sled mounted drives (LVD, HVD and FC-AL)

For more information consult *The IBM LTO Ultrium Tape Libraries Guide*, SG24-5946.

The IBM LTO homepage is located at:

http://www.ibm.com/storage/lto

A roadmap (shown in Figure 1-1) has been published by the consortium members, which gives an indication of the future of this technology. This is subject to change.

LTO Ultrium Road Map

	Generation 1	Generation 2	Generation 3	Generation 4
Capacity (Native)	100GB	200GB	400GB	800GB
Transfer Rate (Native)	10-20MB/s	20-40MB/s	40-80MB/s	80-160MB/s
Media	Metal Particle	Metal Particle	Metal Particle	Thin Film

Figure 1-1 LTO Ultrium Roadmap

Important: Hewlett-Packard, IBM, and Seagate reserve the right to change the information in this migration path without notice.

1.2.2 LTO Ultrium models

There are four IBM LTO Ultrium models available, shown in Figure 1-2. They are the 3580 Ultrium Tape Drive, The 3581 Ultrium Tape Autoloader, The 3583 Ultrium Scalable Tape library, and the 3584 UltraScalable tape library

Ultrium tape capacity is 100 GB per cartridge in native format, and using (2:1) compression is 200 GB. The Ultrium drives have sustained data rates of 15 MB/sec native and 30 MB/sec at 2:1 compression.

Note that some suppliers may offer alternative cartridge capacities either as standard or on demand. Check with your supplier for details.

Figure 1-2 The LTO Ultrium product family

1.2.3 IBM 3580 Ultrium Tape Drive

The IBM 3580 Ultrium Tape Drive (abbreviated to 3580), is an external, stand-alone, SCSI-attached tape drive that attaches to iSeries, pSeries, xSeries, Intel, AS/400, RS/6000, Netfinity, RS/6000 SP, and other UNIX and PC servers supporting OS/400, IBM AIX, Sun Solaris, HP-UX, and Microsoft Windows NT/2000 open systems using a suitable SCSI adapter.

The IBM 3580 Ultrium tape drive can also connect to Fibre Channel server host bus adapters through the IBM SAN Data Gateway Routers models 2108-R03 or 2108-G07.

The IBM 3580 is available as two separate model types, depending on which type of SCSI interface is required: - LVD or HVD.

The two models are:

- IBM 3580 -L11 has a Low-Voltage Differential (LVD) Ultra2 SCSI attachment that connects to LVD fast/wide adapters.
- IBM 3580 -H11 has a High-Voltage Differential (HVD) Ultra SCSI attachment that connects to HVD fast/wide adapters.

Figure 1-3 is a picture of the 3580 Ultrium Tape Drive.

Figure 1-3 3580 Ultrium Tape Autoloader

1.2.4 IBM 3581 Ultrium Tape Autoloader

The 3581 Ultrium Tape Autoloader (abbreviated to 3581) is an external, stand-alone or rack-mounted autoloader that incorporates an IBM Ultrium Tape Drive. It attaches to iSeries, pSeries, xSeries, Intel, AS/400, RS/6000, Netfinity, RS/6000 SP, and other UNIX and PC servers supporting OS/400, IBM AIX, Sun Solaris, HP-UX, and Microsoft Windows 2000/NT open systems using a suitable SCSI adapter.

The 3581 Ultrium Tape Autoloader capacity is seven tape cartridges, providing a media capacity of up to 700 GB (1.4 TB with 2:1 compression) data storage per library and a sustained data rate of up to 15 MB per second (uncompressed).

The two model types are:

- IBM 3581-L17 has a Low-Voltage Differential (LVD) Ultra2 SCSI attachment that connects to LVD fast/wide adapters.

- IBM 3581-H17 has a High-Voltage Differential (HVD) Ultra SCSI attachment that connects to HVD fast/wide adapters.

Figure 1-4 is a picture of the 3581 Ultrium Tape Autoloader.

Figure 1-4 3581 Ultrium Tape Autoloader

1.2.5 IBM 3583 Ultrium Scalable Tape Library

The IBM 3583 Ultrium Scalable Tape Library (abbreviated to 3583) is a high-performance, reliable, scalable tape subsystem. Designed for tape automation, the IBM 3583 Scalable Tape Library can be attached to iSeries, pSeries, xSeries, Intel, AS/400, RS/6000, Netfinity, RS/6000 SP, and other UNIX and PC servers supporting OS/400, IBM AIX, Sun Solaris, HP-UX, and Microsoft Windows 2000/NT open systems using SCSI attachment or Fibre Channel attachment.

The libraries use the IBM Ultrium Tape Drives for faster data transfer and reliability in automated library service. Each aspect of the library subsystem has been designed for repeated, reliable unattended tape handling.

Tape capacity is 100 GB per cartridge in native format, and using (2:1) compression is 200 GB. The Ultrium drives have maximum sustained data rates of 15 MB/sec native and 30 MB/sec at 2:1 compression. Of course, the real achieved performance depends on many other system variables.

The tape library is designed for easy expansion. It can accommodate from one to six tape drives and from 18 to 72 cartridges. There are three Library Models: L18, L36, and L72. The cartridge capacity of the Model L18 is 18 cartridges, the Model L36 is 36 cartridges, and the Model 72 is 72 cartridges. Models 18 and 36 can be field upgraded to hold 72 cartridges. Cartridge expansion is in increments of 18 cartridges.

One IBM Ultrium drive is required and five additional drives are available for factory or field installation. Upgrade features are modular units that are easy to install. If you are NOT using the integrated SAN Data Gateway, then direct attached SCSI drives may be any mixture of LVD or HVD up to a total of six. If the SAN Data Gateway is used, then only LVD drives can be configured.

The tape library input/output (I/O) station enables cartridges to be inserted and removed without disrupting library operation. There are two I/O station options: a single slot option and a 12 slot option. The 12 slot I/O station is required to achieve the 72 cartridge maximum library configuration. With the 12 slot I/O station feature the library can be configured as 72 storage slots, or 60 storage slots and 12 I/O slots.

The **Remote Management Unit** (RMU) comes standard in every library shipped after July 27, 2001. The unit can be added to pre-existing libraries by ordering the chargeable upgrade Feature Code 1660. The RMU provides an Ethernet port so that the library can be configured as a TCP/IP device on the network. Library status can be sent to the network as Simple Network Management Protocol (SNMP) traps.

The StorWatch Specialist enables network access (via web browser) to the RMU for library status and control. All library front panel operator functions can be accessed using the StorWatch Specialist. We provide detailed information on the StorWatch Tape Library Specialist for the 3583 in 2.4.1, “IBM 3583 StorWatch Specialist” on page 100.

The **SAN Data Gateway Integrated Module** is an additional chargeable feature. The gateway provides the ability for SCSI devices in the library to connect into a SAN infrastructure. This feature is integrated into the existing physical library structure so that externally, the library appears to be fibre-channel attached.

The SAN Data Gateway Integrated Module supports both 1 and 2 Gigabit port speeds depending upon SAN connection using SC-style shortwave multimode Gigabit Interface Converter (GBIC) modules. The Integrated Gateway has two Fibre Channel interfaces (ports) and four SCSI interfaces.The two Fibre Channel interfaces allow multiple paths to the SCSI devices. This will allow path redundancy in some operating systems.

The Fibre Channel interfaces are capable of communicating reliably at distances of up to 300m over 50µm multimode-optical fiber cables. The four SCSI ports are Ultra2, low voltage differential (LVD), with VHDCI-style connectors (Very High Density Cable Interconnect), so be sure to order the LVD version of the LTO drive only. We discuss implications of LVD and HVD in 1.8.1, “What is LVD and HVD?” on page 23.

You can specify the **SAN Data Gateway Integrated Module** feature when ordering a new 3583 or order it as a later upgrade to an existing model. An existing **SAN Data Gateway (2108)** cannot be physically installed into a 3583 library but will perform the same function.

> **Note:** Only shortwave (SW) GBICs and LVD drives are supported when using the Integrated SAN Data Gateway module

Figure 1-5 is a picture of the 3583 Ultrium Scalable Tape Library.

Figure 1-5 3583 Scalable Tape Library

1.2.6 IBM 3584 UltraScalable Tape Library

The IBM 3584 UltraScalable Tape Library (abbreviated to 3584) (shown in Figure 1-6) is designed for the large, unattended storage requirements from today's mid-range systems up to high-end open systems. Each aspect of the subsystem is designed to optimize access to data and reliability. The 3584 UltraScalable Tape Library is designed to connect to host systems using any combination of Fibre Channel, Ultra2/Wide Low Voltage Differential (LVD) SCSI, or Ultra/Wide High Voltage Differential (HVD) SCSI interfaces.

Figure 1-6 3584 Ultrium UltraScalable Tape Library

All 3584 libraries shipped after August 31, 2001 come equipped as standard with the no charge Feature Code 9660 which provides the ability to connect the library to a 10/100 Ethernet LAN. The unit can be added to pre-existing libraries by ordering the chargeable upgrade Feature Code 1660. The StorWatch Specialist software, included with the Ethernet connection, enables network access (via web browser) to the library for status and control. All library front panel operator functions can be accessed using the StorWatch Specialist. We provide detailed information on the StorWatch Tape Library Specialist for the 3584 in 2.4.2, “IBM 3584 StorWatch Specialist” on page 105.

Base Unit 3584-L32

The IBM 3584 base library, the Model L32, has 141 to 281 cartridge slots and support for up to twelve IBM LTO Ultrium tape drives with an incremental reduction of storage slots for more than 4 drives. Data capacity for the Model L32 is 14 to 28 TB native and 28 to 56 TB using LTO-DC (LTO Data Compression) (2:1) compression. Customers can expand library capacity and number of drives to meet their changing needs.

Up to twelve logical libraries and/or up to twelve control paths can be configured for each L32 frame.

Each 3584-L32 library has a standard 10 slot and 30 slot cartridge input/output stations for importing or exporting cartridges from the library with need for re-inventory. For bulk-loading of IBM LTO Ultrium tape cartridges the library door can be opened and cartridges loaded. Each time the library door is then closed, the bar code reader mounted on the autochanger re-inventories the cartridges in the library frame. This usually takes less than 60 seconds. A door lock is included to restrict physical access to cartridges in the library.

The base 3584-L32 can be expanded by adding up to five additional frames - D32, D42 or a combination of the two. Figure 1-7 is a diagram of a fully expanded, 6-frame, 3584.

LTO expansion frame 3584-D32

Up to five expansion frames, Model 3584-D32, may be added to the base frame (Model 3584-L32) in order to add storage and/or drive capacity. Each 3584-D32 frame supports up to 440 storage slots and up to twelve drives, with incremental reduction of storage slots for each set of four of drives installed.

A fully configured 3584 with one Model L32 frame and five Model D32 frames will support up to seventy-two drives with an aggregate data rate of 7.8 TB per hour (2:1 compression) or up to 2481 storage slots with a total capacity of 248.1 TB native or 496.2 TB with 2:1 compression.

Each frame can have up to 12 logical libraries and 12 control paths due to the multipath capability of the 3584.

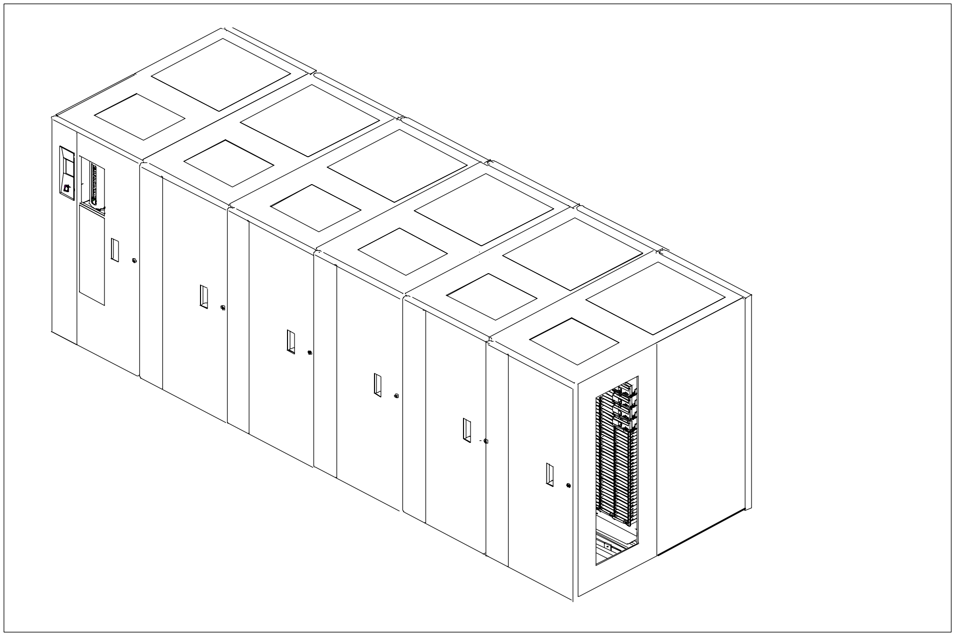

Figure 1-7 Example of a 6-frame 3584

DLT expansion frame 3584-D42

The 3584 Model D42 expansion frame allows both LTO and DLT libraries to co-exist in the same physical structure. Each 3584 Model D42 expansion frame contains from 1 to 12 DLT 8000 tape drives, each having a native data transfer rate of 6 MB/sec and a cartridge capacity of 40 GB. Using data compression, the DLT 8000 drives have an effective data rate of up to 12 MB/sec and a cartridge capacity of up to 80 GB (with 2:1 compression) on DLTtape IV media.

Each 3584-D42 frame supports up to 360 storage slots and up to twelve drives, with incremental reduction of storage slots for each set of four of drives installed. A 3584 UltraScalable Tape Library with five D42 frames has a capacity of up to 1784 DLTtape slots and 229 LTO Ultrium slots, resulting in a maximum native data capacity of 22.9 TB on LTO Ultrium media and 71.4 TB on DLT tape.

Each frame can have up to six logical libraries and six control paths due to the multipath capability of the 3584.

Figure 1-8 shows the different slot and drive capacities contained in each type of 3584 frame.

Drives in Model L32 Frame	Slots in Model L32 Frame (without Capacity Expansion Feature			Slots in Model L32 Frame (with Capacity Expansion Feature and 30 I/O Slots)			Slots in Model L32 Frame (with Capacity Expansion Feature and 10 I/O Slots)		
	Quantity	Native Capacity (in TB)	Comp. Capacity (in TB)	Quantity	Native Capacity (in TB)	Comp. Capacity (in TB)	Quantity	Native Capacity (in TB)	Comp. Capacity (in TB)
0-4	141	14.1	28.2	229	22.9	45.8	281	28.1	56.2
5-8	113	11.3	22.6	201	20.1	40.2	253	25.3	50.6
9-12	87	8.7	17.4	175	17.5	35.0	227	22.7	45.4
Drives in Model D32 Frame	Slots in Model D32 Frame								
	Quantity			Native Capacity (in TB)			Compressed Capacity (in TB)		
0	440			44.0			88.0		
1-4	423			42.3			84.6		
5-8	409			40.9			81.8		
9-12	396			39.6			79.2		
Drives in Model D42 Frame	Slots in Model D42 Frame								
	Quantity			Native Capacity (in TB)			Compressed Capacity (in TB)		
0	360			36.0			72.0		
1-4	346			34.6			69.2		
5-8	333			33.3			66.6		
9-12	324			32.4			64.8		

Figure 1-8 3584 frame capacity

Note: The library capacity depends on whether the Capacity Expansion Feature is installed, whether the upper and lower I/O stations are used, and the number of drives installed in a frame.

1.3 Hardware and operating system platforms

This section will document the hardware platforms, and the operating systems platforms that support the LTO family.

1.3.1 Hardware server platforms

The LTO products are supported on the following hardware server platforms:

- IBM iSeries, AS/400
- IBM pSeries, RS/6000, RS/6000 SP
- IBM xSeries and other Intel Architectures (Windows NT, Windows 2000)
- Sun SPARC
- Hewlett-Packard
- Linux
- other open systems using SCSI attachment or Fibre Channel attachment.

For specifics of which Ultrium models support which attachment, see the following websites.

http://www.storage.ibm.com/hardsoft/tape/3580/3580opn.html
http://www.storage.ibm.com/hardsoft/tape/3581/3581opn.html
http://www.storage.ibm.com/hardsoft/tape/3583/3583opn.html
http://www.storage.ibm.com/hardsoft/tape/3584/3584opn.html

Attention: Always check the website for the most current information

1.3.2 ISV storage management software

Although operating systems provide utilities such as **dd**, **tar** and **cpio** to perform basic read/write operations for tape drives, in most cases a particular storage management software package is used. These packages provided specific functions and much more sophisticated capabilities than the native operating system utilities. They are available from companies known as ISVs or Independent Software Vendors. We discuss some of the popular backup applications for Linux and Windows in Part 2, “LTO Ultrium with applications” on page 195.

IBM publishes information about ISV storage management applications which are certified with LTO Ultrium devices on which operating system platforms. These URLs are:

http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3580.html
http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3581.html
http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3583.html
http://www.storage.ibm.com/hardsoft/tape/conntrix/isv3584.html

You should also check with the appropriate ISV of your application for the most current and accurate support information, as this changes frequently.

1.4 Windows 2000 connectivity

In this section we will cover methods of connecting LTO models to Windows 2000, using the 3583 as an example.

1.4.1 Windows 2000 SCSI direct attach

Table 1-1 is an example of the IBM website that details server, operating system levels, Host Bus Adapters and fabric support for the 3583 in the Windows 2000 environment. We gave the URLs for each LTO model in 1.3.1, “Hardware server platforms” on page 16.

Table 1-1 LTO Windows2000 attachment summary

Windows 2000 Adapter Support		
Servers	**Operating System**	**Host Adapters**
	Windows 2000 Build 2195 or later	Adaptec 29160 LVD Adaptec 39160 LVD Adaptec 2940 UB2 LVD Adaptec 2944 UW HVD LSI Logic Sym 22910 LVD Adaptec 29160LP LVD
Notes Adaptec 29160LP corresponds to Netfinity adapter #19K4646 Adaptec 2940 corresponds to Netfinity adapter #33L5000 Adaptec 2944 corresponds to Netfinity adapter #59H3900		

From the table, the following is true:

In order to attach a 3583 to a Windows 2000 Server, you need to be running build 2195 or higher of the operating system.

The matrix shows that there is a choice of six SCSI HBAs. Five of the cards use the LVD interface and the other card uses the HVD interface. The correct SCSI interface needs to be determined based upon the tape drives being purchased.

1.4.2 Windows 2000 SAN Data Gateway attach

Suppose you want to attach the 3583 with 6 LVD drives at a distance of 21 meters from the server. As the maximum multidrop length for LVD is 12 meters, a SAN solution would be a functional alternative. Since the 2108 G07 doesn’t support LVD, we will use the 2108 R03. But what adapter will you need? For that, let’s look at Table 1-2 which is a subset of the table you will see at the following website.

http://www.storage.ibm.com/hardsoft/products/tape/ro3superserver.htm

Table 1-2 SAN attachment for LTO devices

IBM 385X LTO Ultrium Tape			
Storage Systems	**Descriptions**	**Operating System and adapters**	**Additional Detail**
Tape storage systems	3580 Ultrium Drive 3581 Ultrium Autoloader 3583 Scalable Library 3584 UltraScalable Library	Windows NT service pack 6 Windows 2000 build 2195 QLogic QLA2200F FC adapter Emulex LP8000 FC adapter	IBM 2108 R03 LVD IBM2108 G07 HVD

Table 1-2 indicates that with either the QLogic or Emulex adapters, you can attach the LVD version of the 3583 through the 2108-R03. Alternatively,you can add a switch or director therefore extending the distance out to 11km. Do you need the latest microcode for this adapter? For this information, you need to go the QLogic or Emulex support pages.

http://www.qlogic.com/
http://www.emulex.com/

We give more information on using SCSI and SAN HBAs to attach the LTO drives and libraries with Windows 2000 in Chapter 2, “Basic LTO setup for Windows 2000” on page 27.

The SAN Data Gateway Module (feature code 8005) is an optional feature available for the 3583 Ultrium Scalable Tape Library. If you have this feature installed, then the drives are internally converted from SCSI to FC, enabling them to be connected into a SAN without an external gateway. Currently supported configurations are shown in Table 1-3.

Table 1-3 SAN Data Gateway Module support

SAN Data Gateway Module Feature 8005			
Servers	Operating System	Host Adapter	Fabric Support
Servers that support the listed host adapters	Windows 2000 Build 2195 or later	QLogic QLA2200F Emulex LP8000	IBM 2103 H07 IBM 2109
Notes			
Qlogic QLA 2200F corresponds to adapters Netfinity #00N6881 and FAStT adapter			

Information about the SAN Data Gateway Module Feature 8005 can be found at:

http://www.storage.ibm.com/hardsoft/tape/3583/3583opn.html

1.5 Linux connectivity

In this section we will cover a direct SCSI attachment to Red Hat Linux using the 3583 LTO. There is currently no connectivity information about 358x SAN attachments using Red Hat Linux.

1.5.1 Red Hat Linux SCSI direct attach

Table 1-4 is an example of the IBM website that details server, operating system levels, SCSI Host Bus Adapters for the 3583 in the Red Hat Linux environment. The URLs for each LTO model can be found in 1.3.1, “Hardware server platforms” on page 16.

Table 1-4 Linux Attachment

component	level
drive	3580 3581 3583 3584
SCSI Adapter	Adaptec 29160 LVD Adaptec 39160 LVD Adaptec 2940 UB2 LVD Adaptec 2944 UW HVD
Linux OS	Red Hat 7.1 Kernel 2.4.2-2up Red Hat Linux 7.1 Kernel 2.4.2-2smp
Device Driver	Adaptec SCSI device driver 6.1.7 aic7xxx_mod IBMtape device driver 1.0.7 IBMtapeutil 1.0.5 IBMatl 5.0.7.0-0

From the table, the following is true.

In order to attach a 3583 to a Linux server, you need to ensure that you are running the correct Linux OS and kernel levels.

The matrix reflects that there is a choice of four SCSI HBAs. Three of the cards use the LVD interface and one card the HVD interface. The correct SCSI interface needs to be determined based upon the tape drives being purchased.

1.6 Determining the number of drives on a SCSI bus

How do you determine how many SCSI drives to place on a host adapter? There are several factors to take into consideration, including:

- tape drive speed capability
- disk drive speed capability
- application
  - application needs
  - application characteristics - read/write mix, amount of data transferred, streaming or stop/start, data block size
- adapter slot availability and capability
- cost of more adapters

To ensure best performance, if possible, avoid daisy-chaining (connecting more than one drive to an adapter). If cost or slot availability considerations make daisy-chaining unavoidable, then connect no more than 2 drives per HVD and 2-4 drives per LVD adapter.

Another situation where daisy-chaining may be required is when connecting a multi-drive library through a SAN Data Gateway. The SDG has a total of four ports and one is recommended for for the SCSI medium changer. Therefore, if more than three drives are installed in the library, daisy-chaining will be required.

The type of application is also very significant. If you are mainly doing smaller volume reads or writes, then more drives can be attached without saturating the adapter. A more typical use of tape is in high-volume backup, usually writing large blocks of data (for example backing up large database files). In this scenario, a single drive per adapter will give the best performance.

1.7 Host Bus Adapters and Device Drivers

This section will cover the following:

- What are HBAs
- Why are they needed, and which one do you need?
- Are drivers needed for HBAs?

Restriction: At this time, sharing a HBA with Disk and Tape is NOT supported for 358x models. You should check on the website http://www.storage.ibm.com/ or with your local support organization for details of specific recommended/supported combinations.

What are HBAs?

HBA stands for Host Bus Adapter. An HBA is an I/O adapter (or card) that sits between the host computer's bus and the SCSI or Fibre Channel loop and manages the transfer of information between the two channels. In order to minimize the impact on host processor performance, the HBA performs many low-level interface functions automatically or with minimal processor involvement.

What are Device Drivers?

A device driver is a program that controls a device. Every device, whether it be a printer, disk drive, or keyboard, must have a driver program. Many drivers, such as the keyboard driver, come with the operating system. For other devices, you may need to load a new driver either from the operating system CD or provided by the manufacturer when you first install the device on your computer.

A driver acts like a translator between the device and programs that use the device. Each device has its own set of specialized commands that only its driver knows. In contrast, most programs access devices by using generic commands, i.e. Read, Write, Put, Get. The driver, therefore, accepts generic commands from a program and then translates them into specialized commands for the device.

Figure 1-9 is an example of the data flow between an application program and a LTO tape device. Note the different pieces of code or microcode involved.

Note that the HBA device driver is not always a separate piece of installable software; sometimes it is included as part of the standard operating system. This is true for many common SCSI adapters with Linux - you should check the documentation provided with the card to see if this applies. For Fibre Channel HBA's, driver software will almost always need to be installed.

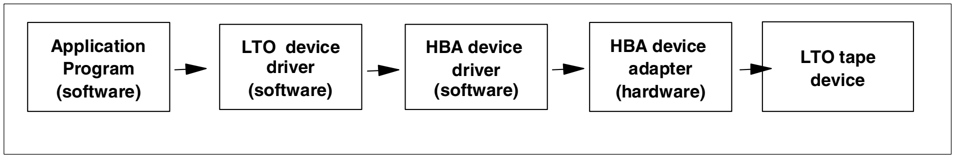

Figure 1-9 Device data flow

Data flow

The simplified list below reflects the components involved in the data path for moving data at a file level between disk storage devices and tape.

Problem or performance analysis must be approached by determining which component of the data path impacts performance.

- Disk Device
- SCSI Device Adapter
- Adapter Device Driver
- Disk Device Driver
- Logical Volume Manager
- File System
- Application Program
- Atape Device Driver - tape driver
- HBA Adapter Device Driver
- HBA (SCSI or FC-AL) Device Adapter
- Tape Device

IBM device driver overview

The IBM Ultrium tape and medium changer device drivers are designed specifically to take advantage of the features provided by the IBM Ultrium tape drives and medium changer devices. The goal is to give applications access to the functions required for basic tape functions (such as backup and restore) and medium changer operations (such as cartridge mount and dismount), as well as to the advanced functions needed by full tape management systems. Whenever possible, the Ultrium driver will optimize use of the device features transparently to the application.

1.8 LVD or HVD

What is it? Why choose one over the other? Why should you care?

1.8.1 What is LVD and HVD?

LTO tape drives have two types of SCSI attachment interfaces, LVD (Low Voltage Differential), and HVD (High Voltage Differential). LVD and HVD, as the names imply, use different voltage levels while sending the signal down the SCSI bus. LVD uses 3.3 Volts DC and HVD uses 5 volts DC. LTO tape drives are either LVD or HVD and cannot be upgraded or converted from one to the other. In order to change from LVD to HVD, a LVD drive would need to be replaced with a HVD drive. Therefore, when configuring an LTO product, consider carefully whether you should choose HVD or LVD drives.

1.8.2 Why is this important?

Why choose one over the other and why should you care? The most over-riding reason is connectivity. If you to try to attach an HVD LTO drive to an LVD adapter, it will not work. Placing an LVD device on an HVD bus will cause the LVD device to shut down. Placing an HVD device on an LVD bus will cause the entire LVD bus to shut down. Therefore, check to see what type of adapter you have available in the hosts which will be attaching and choose the correct model of drive accordingly.

There are also differences in the speed characteristics of HVD vs. LVD. LVD is available either as Ultra2 SCSI which has a 80MBs/sec speed or the new Ultra160 SCSI at 160MB/sec, while HVD is Ultra SCSI which has a maximum speed of 40MBs/sec. Does this mean that the LTO drive will run faster with LVD versus HVD? Not necessarily.The speed seen here is the SCSI bandwidth or bus speed. All Ultrium drives (whether LVD, HVD or native Fibre Channel) have a nominal speed of 15MB/second. If the speed of the bus were the only limiting factor in your configuration, then yes, switching to a faster bus should improve your performance. Usually, the speed capability of the bus will determine the number of LTO drives that could be attached on the same bus. But again, this isn't the only factor in the equation.

In addition to the speed differences, there are connection restrictions associated with each. Both HVD and LVD can span 25 meters in a point to point configuration. In a multidrop (daisy chain) configuration HVD can span 25 Meters, while LVD is limited to 12 Meters.

So which should you choose?

If you have a situation where the 12 meter multidrop limitation of LVD isn't a issue, then you would purchase LVD, right? You would think so, but the correct answer is, “it depends”. It depends on the HBA that you have installed in your server. If you have an existing adapter and you don't want to change it, then whether the adapter is HVD or LVD will dictate which LTO drive you order and the configuration capabilities.

What if you don't already have an adapter. Order LVD, right? Again, not necessarily. At this time, not all supported SCSI HBAs are available in both interface types. For example, AS/400 and SUN support only HVD drives when directly SCSI attached. See the following URL for current information:

http://ssddom01.storage.ibm.com/techsup/swtechsup.nsf/support/ultriumcompinfo

Table 1-5 HVD and LVD characteristics

	HVD	LVD
Point to Point	25 meters	25 meters
Multidrop	25 meters	12 meters
Speed	40 MB/sec	80 or 160 MB/sec

1.9 SCSI HD68 and VHDCI cable connectors

There are three types of SCSI cables, HD68-HD68, HD68-VHDCI and VHDCI-VHDCI. The HD68 connector is the normal 68 pin SCSI connector. The VHDCI (Very High Density Connector) is a mini SCSI connector, about half the width of the HD68 connector. The server SCSI adapter can be either HD68 or VHDCI. For RS/6000, AS/400, and HP servers, LVD SCSI adapters are always VHDCI, and HVD adapters are always HD68. But Sun and Netfinity/Intel servers have some adapters that are reversed.The connector type for a given adapter can be found in either of two ways. You can look at the adapter and the plug will be either about 3cm wide (VHDCI) or 6 cm wide (HD68). The other method is to look up the adapter characteristics to determine the plug type. One source of this information is the 3584 planning and operators guide available online at

`http://www.storage.ibm.com/hardsoft/tape/pubs/pubs3584.html`

Before the June 12, 2001 announcement, all the LTO tape drives used HD68 connectors. The new 3584 hot swappable canister LTO drive uses the VHDCI connectors. Check to make sure you order the correct cable with the right end plug to attach to your HBA.

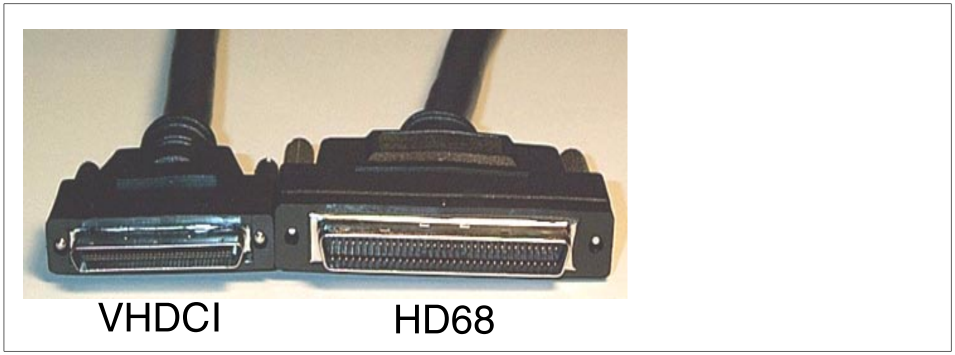

Figure 1-10 SCSI connectors

2

Basic LTO setup for Windows 2000

In this chapter we give you detailed information on the basic setup of the LTO drives and libraries for Windows 2000, including:

- Host Bus Adapter drivers installation and update
- Device and library drivers installation and update
- Removable Storage Manager configuration and Windows 2000 backup with LTO
- IBM StorWatch Specialist for the Ultrium Tape Libraries
  - 3583 StorWatch Specialist
  - 3584 StorWatch Specialist
- Device, library and RMU firmware upgrade

At the end of this chapter you should be able to understand and implement the tasks required to:

- Install and configure the required Host Bus Adapter drivers
- Install the required device drivers
- Understand the use of the StorWatch Specialist product
- Upgrade the library and drive microcode
- Test basic library operation

2.1 Overview

The basic setup for the LTO involves:

- planning
- installing the adapter card and driver
- attaching the library
- installing the IBM device drivers
- configuration and testing

The IBM Ultrium tape and medium changer device drivers are designed specifically to take advantage of the features provided by the IBM Ultrium tape drives and medium changer devices.

The objective is to give applications access to the functions required for basic tape operations (such as backup and restore) and medium changer operations (such as cartridge mount and dismount), as well as to the advanced functions needed by full tape management systems.

Note: Some application software uses operating system native device drivers, or their own drivers, to access the library and drives. Follow the specific implementation instructions for the software that you are installing to determine if the IBM-supplied device drivers are suitable for your installation, or if other drivers are required.

Later in this book, in Part 2, "LTO Ultrium with applications" on page 195, we describe specific LTO implementation for some of the most common application software for Windows 2000.

For further information and specific installation instructions for Windows 2000, refer to *IBM Ultrium Device Drivers: Installation and User's Guide,* GA32-0430.

The device drivers allow the operating system and the application software to manage tape devices and medium changer to automate the use of the tape media.

2.2 LTO installation for Windows 2000 with SCSI

The LTO installation for a direct SCSI attachment is performed by following the steps listed below. Note that the installation for SAN attached LTO via Fibre Channel Host Bus Adapter (HBA) follows the same steps, with the exception of the HBA installation and configuration. Additional HBA installation and configuration information is detailed in 2.3, “Windows 2000 Fibre channel HBA driver installation” on page 63. To install the Ultrium Library, we did the following:

- Determine the Installation requirements
- Install the SCSI adapter
- Install the SCSI device driver
- Attach the LTO tape library
- Install the LTO Tape device and Medium Changer drivers
- Verify installation through Device Manager
- Test the library and drive with NTUTIL
- Configure Library though Device Manager and Removable Storage Manager

2.2.1 Determine Requirements

To check if your environment has the correct operating system level, combined with the appropriate server and the supported host bus adapter and Storage Area Network fabric components, check the section of the following link:

http://ssddom01.storage.ibm.com/techsup/swtechsup.nsf/support/ultriumcompinfo

LTO tape libraries and devices are generally supported on build 2195 (Service Pack 2) or later. Even though device driver media was shipped with your LTO hardware, we recommend you always check and download the latest version from either of these two websites:

ftp://service.boulder.ibm.com/storage/devdrvr/Win2000
http://www.storage.ibm.com/storagesmart/lto/support/lto_ftp.htm

The file we downloaded is called IBMUltrium.Win2k.exebin. It should be renamed to IBMUltrium.Win2k.exe before installing.

The Windows 2000 Ultrium device driver install process will extract files into the following directory:

- C:\Program Files\IBM Corporation\IBM Ultrium Device Drivers\

Typically, an install package will contain multiple driver versions for compatibility reasons. Be sure to check the **README** file for the latest installation notes and pre-requisites, and determine which version to use.

The LTO device driver installation for Windows 2000 is the same for both direct SCSI attached and SAN attached LTO libraries.

In our first setup, we are installing the Ultrium tape driver for a direct SCSI attached configuration, shown in :

- Intel server with Windows 2000 Server SP2
- Adaptec 29160 LVD SCSI adapter
- 3583 Ultrium Scalable Tape Library with LVD drives

Figure 2-1 Windows SCSI attach configuration

The setup uses the Windows Install shield to install the driver. If the Ultrium device driver is already installed in your system and you just want to update it, follow the instructions in "Removing Ultrium driver from the system (uninstallation)" on page 63.

2.2.2 Installing the SCSI adapter

SCSI Host adapter compatibility for Windows 2000 is listed in 1.4.1, "Windows 2000 SCSI direct attach" on page 18. Additional information regarding SCSI interfaces and connector types may be found in 1.8, "LVD or HVD" on page 23 and 1.9, "SCSI HD68 and VHDCI cable connectors" on page 25. For Adaptec adapters we suggest you obtain the latest driver levels and firmware updates for SCSI adapters from the Adaptec website

```
http://www.adaptec.com/worldwide/support/suppbyproduct.html?cat=/Technol
ogy/SCSI+Host+Adapters&fromPage=driverindex
```

Note that there have been performance issues observed (at the time of this writing) when using Ultrium Drives with drivers for either the Adaptec 29160 or Adpatec 39160 that have been obtained from the Adaptec FTP site. It is recommended for production environments, to use the drivers from the Windows 2000 distribution CD or from the following site:

`ftp://ftp.software.ibm.com/storage/devdrvr/Win2000/Neptune5.zip`

The adapter we installed for our direct-attached configuration was an Adaptec 29160 (LVD). When installed in a Windows 2000 machine, it will detect the card and load its own drivers automatically. You may, however, update the adapter to a later driver level.

You will need to shutdown the system to install the card. When Windows starts up you will be prompted to reboot as in Figure 2-2, since it has already loaded its own drivers.

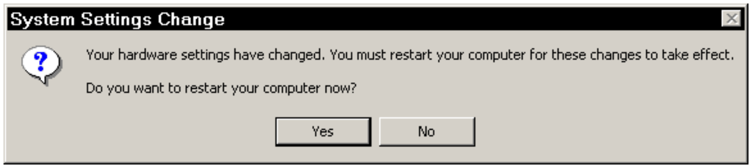

Figure 2-2 System settings change

Select yes to reboot for a clean install. When Windows comes back up, you may update to a later version of the device driver through Device Manager. Right-click on My Computer, go to **Device Manager -> SCSI and RAID controllers**, right-click on the SCSI card to be updated (Adaptec SCSI Card in our example) and select **Properties** as shown in Figure 2-3.

Figure 2-3 Accessing SCSI controller properties

On the Properties window (Figure 2-4), click on the Drivers tab and select **Update Driver**.

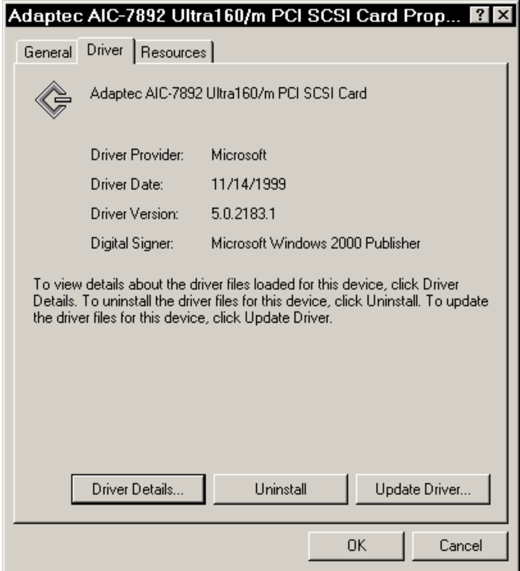

Figure 2-4 Adaptec properties Driver tab

You will be presented with the Upgrade Device Driver Wizard as in Figure 2-5. Click **Next** to begin.

Figure 2-5 Upgrade device driver wizard

The Wizard will prompt to either search for a device driver or display a known list of drivers (Figure 2-6). Select the Search option and click **Next**

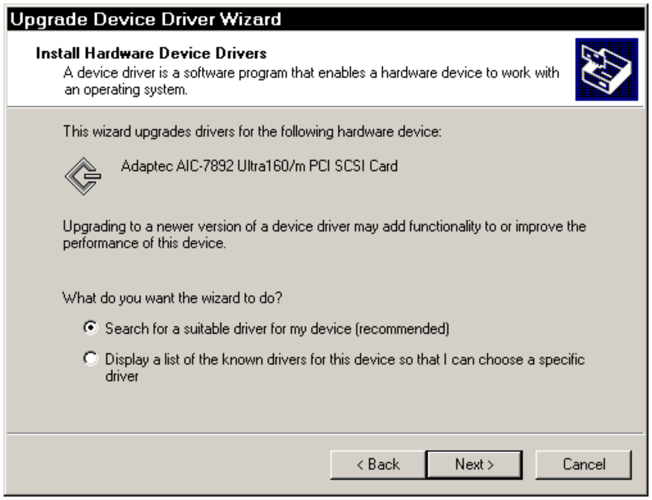

Figure 2-6 Device driver search options

In the Locate Driver Files window (Figure 2-7), check **Specify a location**.

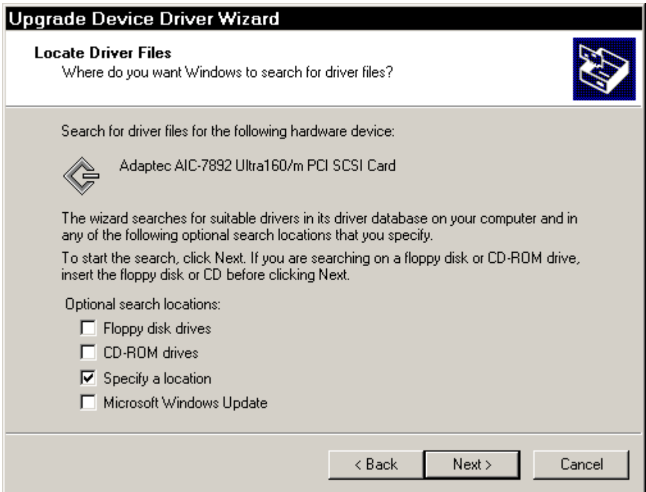

Figure 2-7 Device driver search location

Specify the location of the driver file you wish to use for the upgrade (Figure 2-8). This should be either the CD-ROM (if installing from CD) or the directory where the device driver was downloaded to.

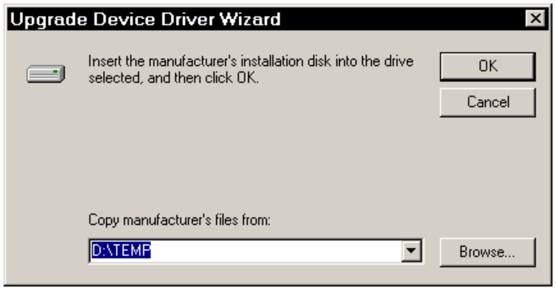

Figure 2-8 Device driver copy location

The Search results window appears (Figure 2-9). Click **Next**.

Figure 2-9 Device driver search results

The Wizard indicates that it has now located a newer version of driver than that which is currently installed (Figure 2-10). Click **Next.**

Figure 2-10 Driver file search results

It is possible that the driver is not digitally certified by Microsoft yet, in which case you will see the warning screen shown in Figure 2-11. This does not neccessarily mean the driver will not function with the LTO library. If you are unsure of any limitation in the driver, refer back to the Readme that comes with the driver files.

Figure 2-11 Digital Signature warning

The driver will be installed. You will be notified of successful installation of the device driver. You may also be prompted to restart the computer. It is suggested that you reboot for a clean install.

2.2.3 Installing the LTO Medium Changer and tape device drivers

This section will describe the setup for a Windows 2000 attached LTO tape library.

The installation for the LTO library is performed as follows:

- Shutdown the machine you are connecting the library to
- Attach the library via the SCSI connection
- Reboot the machine
- Install the device drivers

If the LTO Tape Library is physically attached, then Windows 2000 will attempt to automatically install the drivers upon boot. The Driver Installation wizard will appear and request details regarding the location of the drivers and information files. The LTO Library can, technically, be hot-plugged into the SCSI adapter. In this case you may perform a hardware scan from Device Manager as shown in Figure 2-12 to detect the added devices and initiate the Device Driver install wizard.

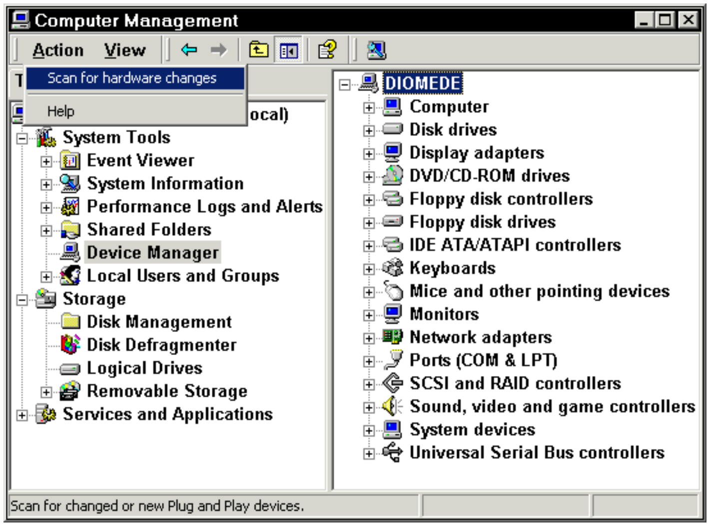

Figure 2-12 Performing a hardware scan

However, we will show the following method of installing the devices:

1. Download and extract the latest IBM Ultrium device drivers for Windows 2000
2. Shutdown the system
3. Attach the library using the SCSI cable connection
4. Restart the system

5. Install the device drivers

Downloading the drivers

Obtain the latest drivers for IBM LTO tape libraries as described in 2.2.1, "Determine Requirements" on page 29

Extracting the drivers

Run the executable (.exe file) from the downloaded location. Figure 2-13 shows the initial screen.

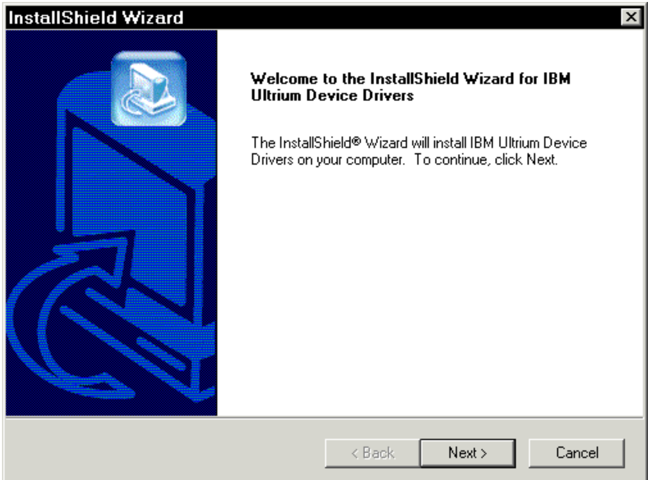

Figure 2-13 InstallShield wizard

Select the type of installation that you want from the choices shown in Figure 2-14. A custom installation will allow you to select all levels of drivers to be extracted using the *Device Driver Depot* option. The Device Driver Depot installs multiple device driver versions into a user-specified directory so they can be extracted and applied for later use. A compact installation will install only the most up to date version of the drivers in the system directory (%systemroot%\SYSTEM32\DRIVERS). A typical installation will install the latest level of drivers in the system directory as well as providing the Device Driver Depot. For our installation we chose the Custom option which allows to select the specific components to be installed.

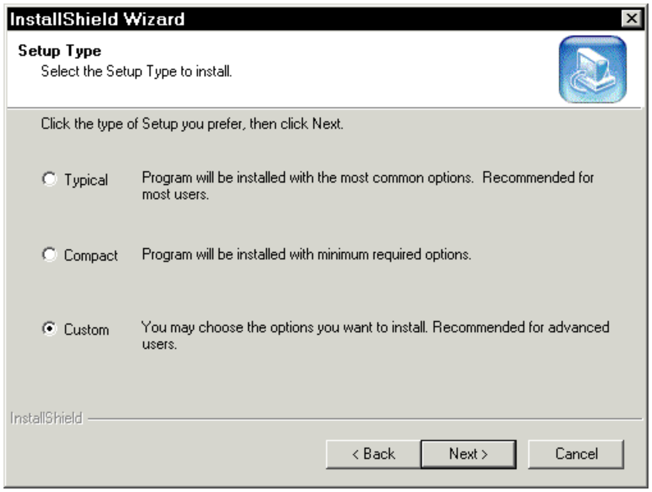

Figure 2-14 Installshield Wizard setup type

Select the options you wish to install (Figure 2-15). The Device Driver Depot allows multiple versions to be loaded.

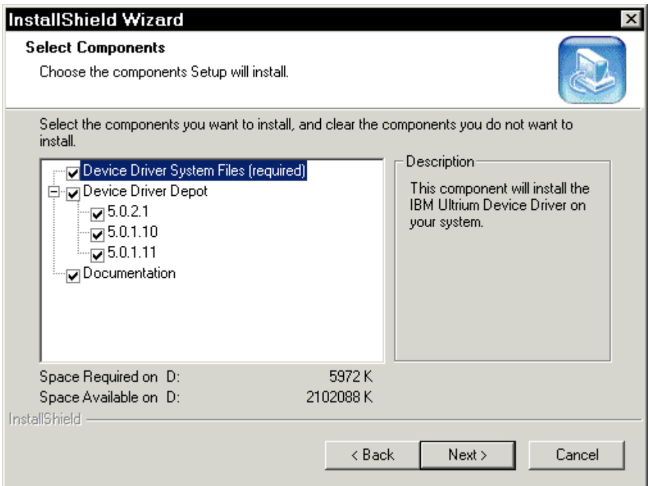

Figure 2-15 Installshied wizard custom setup options

Click **Next** and then specify the directory you wish the Device Driver Depot files to be installed in (Figure 2-16).

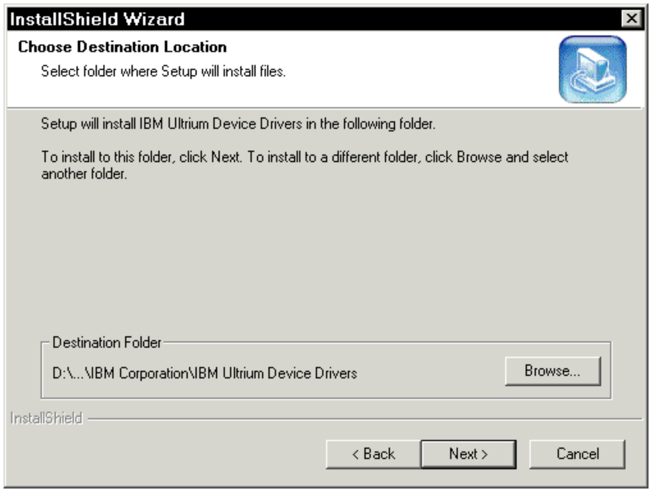

Figure 2-16 Program folder destination

Click **Next** twice and the InstallShield Wizard will begin to copy the files. The device driver depot files will form the directory structure as shown in Figure 2-17

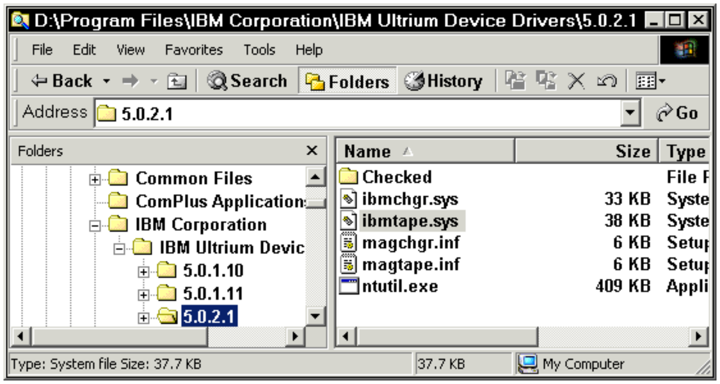

Figure 2-17 The extracted directory and files from the InstallShield Wizard.

You now reboot the system and cable the Ultrium device to the host system. When you reboot the machine the installation of the Ultrium device drivers begins automatically by prompting for the location of the installation files. At this point you may browse for the directory where the extracted InstallShield files are located.

Alternatively, you can cancel these prompts, and use the update device driver procedure to ensure you have the device driver level you require. We will show the installation of the device drivers using this method so you are aware of how to install the drivers from scratch.

installing the medium changer device driver

This step is not required if you have installed a 3580, as it does not have a medium changer.

The devices which have just been attached should appear as unknown devices. If they do not, then carefully check the preceding steps (is the right cable being used, LVD/HVD issues, correct SCSI adapter card and so on). Open **Device Manager**, select **Medium Changer**. You should see an **Unknown Medium Changer Device** entry. Right-click on it and select **Properties**. (Figure 2-18)

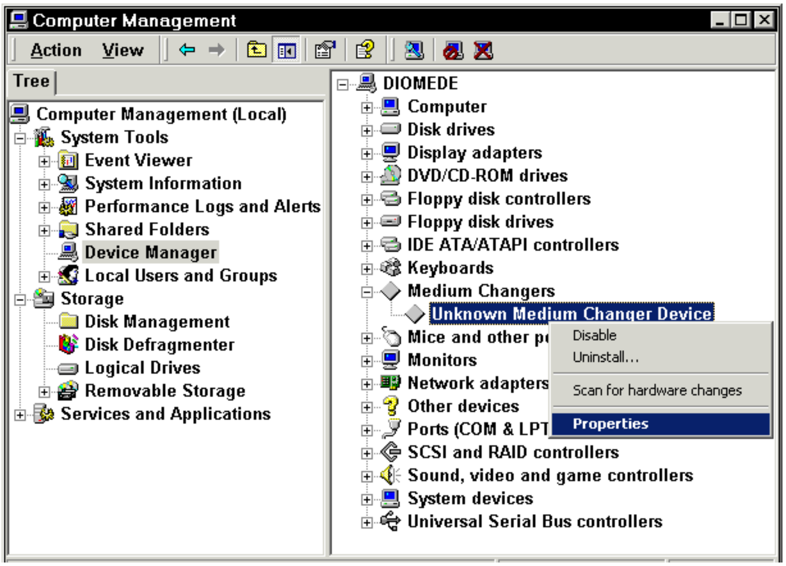

Figure 2-18 Device Manager window with an unknown Medium Changer detected.

Click on the driver tab, and then **Update Driver (**Figure 2-19).

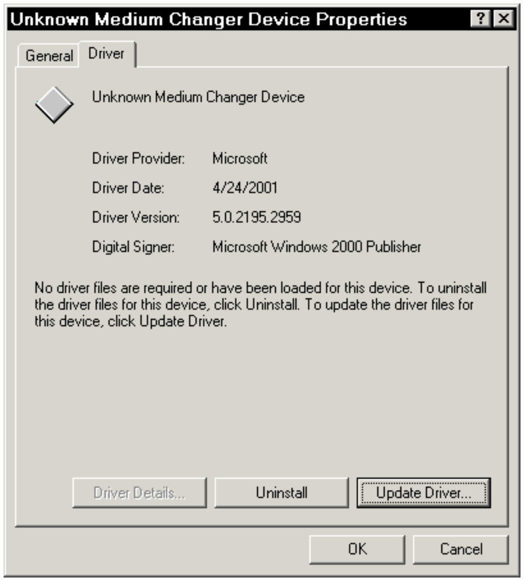

Figure 2-19 The driver tab of the Medium Changer's properties box

You will see the Upgrade Device Driver window (Figure 2-20), prompting to search for a driver or display a known list of drivers for installation. Click on the **Search** option then click **Next**.

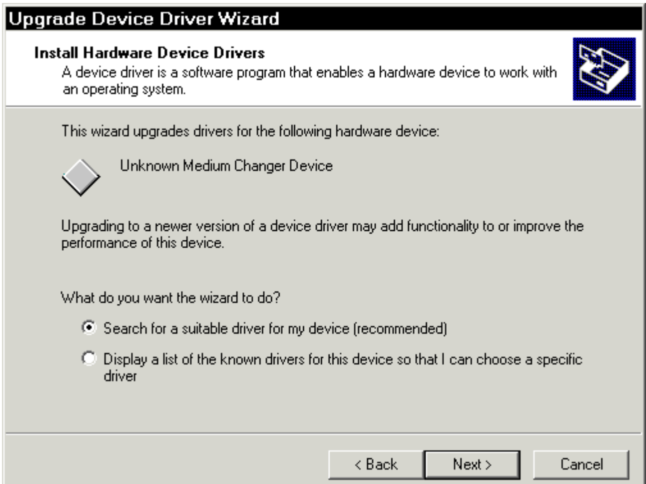

Figure 2-20 Device driver wizard install options

Check the box **Specify a location** and click **Next** as in Figure 2-21.

Figure 2-21 Device driver location search options

The wizard will locate a device driver from the Device Driver Depot, shown in Figure 2-22. If this is the driver version you wish to install click **Next**, otherwise check the box labelled **Install one of the other drivers** and click **Next**. Typically the latest driver version is installed unless there is a specific reason not to, for example, ISV application support issues.

Figure 2-22 Search results

The path to the location of the drivers will be presented as in Figure 2-23. If this is incorrect, click the **Browse** button to locate the driver

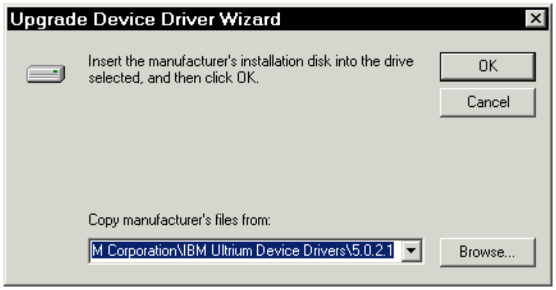

Figure 2-23 Specify a location

From the list of files (Figure 2-24), select magchgr.inf and click **Open**.

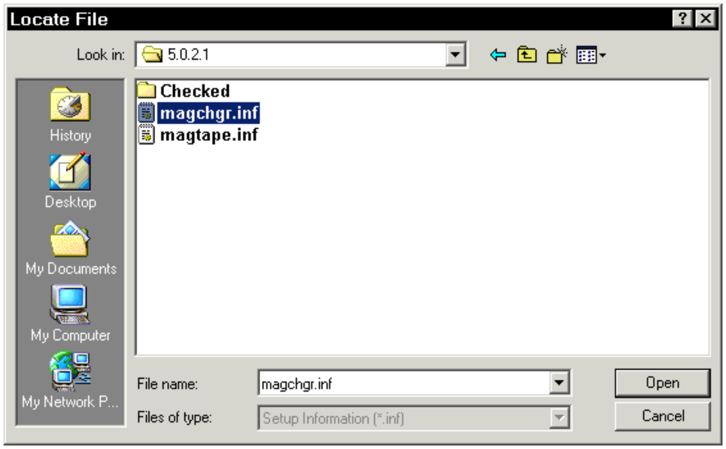

Figure 2-24 Specify a location by browsing.

Now click **Next**. The Device Driver Wizard will proceed to install the device driver and inform you when the installation is complete as shown in Figure 2-25.

Figure 2-25 Device Driver Wizard completion.

installing the tape drive device driver

The tape device driver installation follows the same steps. You will need to install the drivers for each individual tape device if using a multi-tape library like the 3583 or 3584. From **Device Manager**, expand **Other Devices** to show the tape drives. They should appear with a question mark as shown in Figure 2-26.

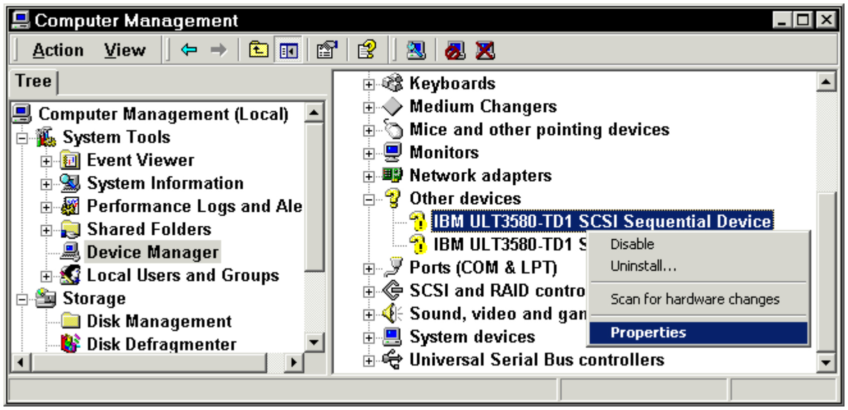

Figure 2-26 Unknown Ultrium tape devices in Device Manager

Select **Properties** for the first drive and install the driver, using the same process as for the Medium Changer. When you get to the Locate File step shown in Figure 2-24 choose magtape.inf. Repeat this process for each drive.

Rebooting the system here is recommended to ensure a clean installation of the drivers.

Now your Medium Changer and Tape Drives should display their correct product names in Device Manager as shown in Figure 2-27 and Figure 2-28.

2.2.4 Verifying the Ultrium device installation

The Ultrium device driver installation for the Medium Changer and Tape devices may be initially verified through Device Manager. To view any installed Tape Devices and Medium Changers, right-click **My Computer** on the desktop, then select **Manage-> Device Manager**.

To determine whether there are LTO devices present, look under Medium Changers (Figure 2-27) and Tape Devices (Figure 2-28). Since the device driver is correctly installed, the drives and libraries display as 3580 and 3583 devices respectively. Note that if you have installed a 3580 stand-alone device, there will be no Medium Changer listed. All the other 358x models will generate a Medium Changer entry.

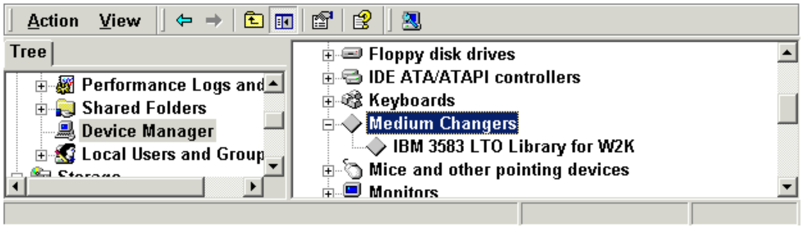

Figure 2-27 Viewing Medium Changers in Device Manager

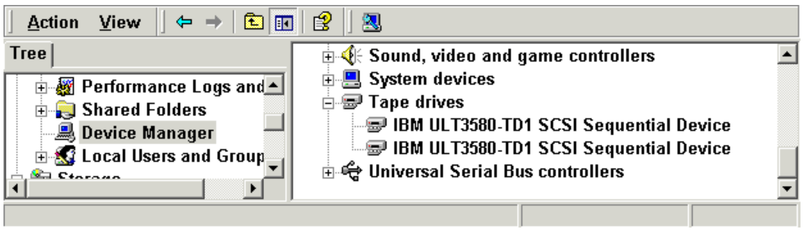

Figure 2-28 Viewing Tape Drives in Device Manager

This view of the devices confirms that the drivers are installed correctly.

The device driver levels and associated files may be viewed by right-clicking each device and selecting **Properties** (Figure 2-29). This window also displays the Bus Number, target ID's and LUN (Logical Unit Number).

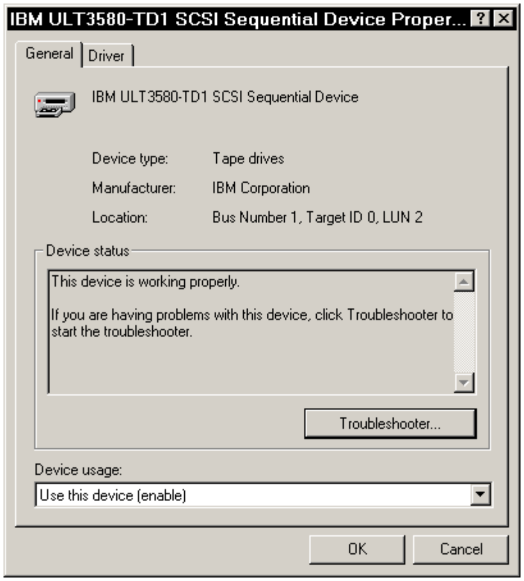

Figure 2-29 Driver details

The driver level for the device is shown in the **Driver** tab in Figure 2-30. Note that the driver is not digitally certified by Microsoft at this time, but is still supported by IBM.

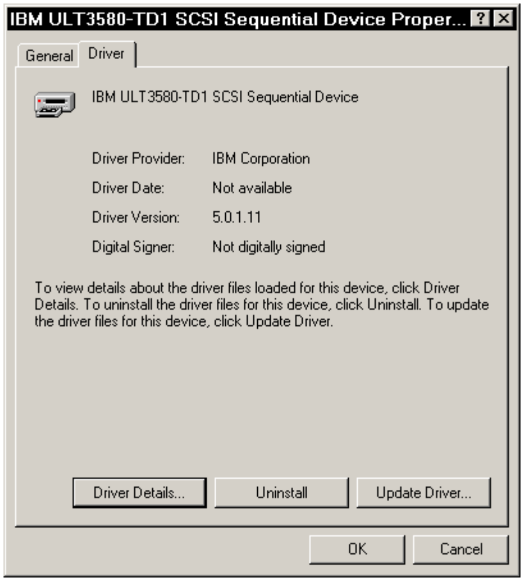

Figure 2-30 Driver tab

The driver file details can be viewed by clicking on the Driver Details tab (Figure 2-31).

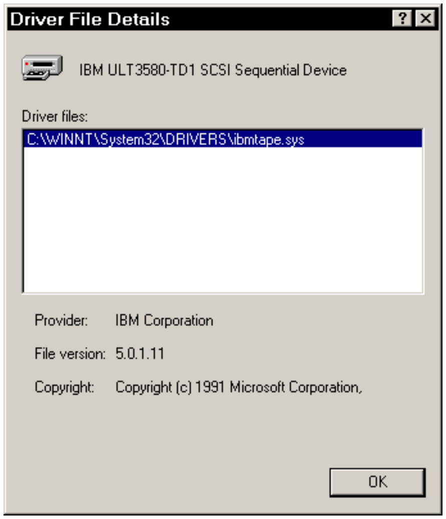

Figure 2-31 Driver file details

Note: There is also a debug version of the Ultrium drivers available with the installed package located in the \checked directory immediately below the original location of the device drivers. In our configuration, the debug version was located in C:\Program Files\IBM Corporation\IBM Ultrium Device Drivers\checked.

This version may be coupled with a debugging tool to identify and resolve any issues encountered when installing the device driver. For more information regarding the use of the debug driver version, refer to the *IBM Ultrium Device Drivers: Installation and User's Guide,* GA32-0430

You can now use the NTUTIL utility to test the library. This utility will allow you to open the device, issue inquiry commands, read and write, and move media within the library to ensure the devices are functioning and operating correctly with the installed driver.

Testing the Library with NTUTIL

NTUTIL is a utility that comes packaged with the Ultrium changer and device drivers. It may be used to perform several functions including

- Read and write operations
- Media mounts and dismounts
- Microcode updates
- Forcing driver dumps
- Sending and obtaining status of SCSI commands and retrieving sense data from commands that encounter errors.

For our purposes, we used NTUTIL to test basic operations as a way of verifying correct installation of the LTO tape library and drives.

Note that you must stop the Removable Storage Manager (RSM) service in Windows before you can use NTUTIL. NTUTIL will not have visibility of the devices until RSM releases them. Alternatively, you may simply disable the LTO library in RSM. For more information about RSM, see Chapter 5, “Configuring RSM” on page 197.

NTUTIL can run in either interactive or batch mode. Interactive mode will present you with a menu of commands that you can use to drive the library and drives. Batch mode will pass on a series of commands from a user generated file to the utility.

NTUTIL will install into your %systemroot%\system32\ directory when you load the Ultrium device drivers and since it is in the PATH environmental variable, can be invoked from the run command box as shown in Figure 2-32. This will start NTUTIL in interactive mode.

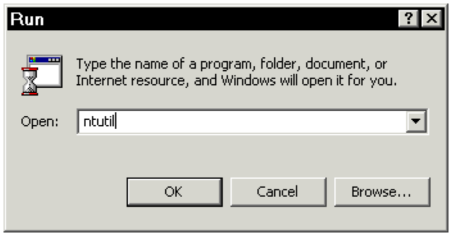

Figure 2-32 Invoking NTUTIL from the run command box

Example 2-1 shows the main menu which presents the option to run the utility in interactive (manual) or batch mode.

Example 2-1 NTUTIL main menu

```
NTutil - Copyright (c) 1997-2000 IBM Corporation

Main Menu:
Microsoft Windows 2000 version
==========

  1: Manual test
  2: Batch  test
  9: Exit ntutil

Enter selection:
```

Selecting manual test provides the following menu for interactive commands.

Example 2-2 NTUTIL Manual test menu

```
manual test menu:
=======================================================================
  1: set device special file          2: display symbols
  3: set block size R/W (now !0 fixed)
  5: set return error when fail       6: set/reset trace
  7: set exit on unexpected result    8: Library Mode
=======================================================================
 20: open                            21: close
 22: read                            23: write
 24: read and display block          25: flush (buffer->media)
 26: read block id                   27: erase
 28: locate block id                 29: display block data
=======================================================================
```

```
 30: write filemark(s)                31: rewind
 32: forward space filemark(s)        33: unload
 34: reverse space filemark(s)        35: load
 36: forward space record(s)          37: return error
 38: reverse space record(s)          39: test unit ready
 43: set media parms (block size)     44: set dev parms(compression)
 46: get device information           47: restore data
 48: get medium information           49: inquiry
 50: poll registered devices
 53: space EOD                        54: display message
======================================================================
 70: system command

======================================================================
 80: Force Dump                       81: Read Dump
 82: Update MicroCode                 83: Log Sense
 84: Get Last Sense                   85: Get Version
 86: Associative/Persistent WProtect  87: Read/Write Test
 88: List registered devices          89: Get MTDevice Info
======================================================================
 99: return to main menu

======================================================================
enter selection:
```

There are two modes that the utility can be run in: Base mode and Library Mode. Option 8 toggles between them. Both modes support Open/Close/Read/Write operations however you may only use medium changer commands such as move media while in Library mode.

Open the device first, (option 20) before entering any SCSI commands.

To enter Library mode select option 8. Note that the text for this option has now changed to Base Mode - indicating that 8 will change the mode back to base.

Example 2-3 NTUTIL in library mode

```
manual test menu:
======================================================================
  1: set device special file           2: display symbols
  3: set block size R/W (now !0 fixed)
  5: set return error when fail        6: set/reset trace
  7: set exit on unexpected result     8: Base Mode
======================================================================
 10: ioctl return library inventory   11: ioctl move medium
 12: ioctl initialize element status  13: ioctl get changer parameter
======================================================================
 20: open                             21: close
 22: read                             23: write
```

```
 24: read and display block          25: flush (buffer->media)
 26: read block id                   27: erase
 28: locate block id                 29: display block data
=======================================================================
 30: write filemark(s)               31: rewind
 32: forward space filemark(s)       33: unload
 34: reverse space filemark(s)       35: load
 36: forward space record(s)         37: return error
 38: reverse space record(s)         39: test unit ready
 43: set media parms (block size)    44: set dev parms(compression)
 46: get device information          47: restore data
 48: get medium information          49: inquiry
 50: poll registered devices
 53: space EOD                       54: display message
=======================================================================
 70: system command

=======================================================================
 80: Force Dump                      81: Read Dump
 82: Update MicroCode                83: Log Sense
 84: Get Last Sense                  85: Get Version
 86: Associative/Persistent WProtect 87: Read/Write Test
 88: List registered devices         89: Get MTDevice Info
=======================================================================
 99: return to main menu

=======================================================================
enter selection:
```

To view the installed Library and drive select 88 *List registered devices*. Medium changer devices are given a device special name of *Changerx*, and tape drives are known as *Tapex*. The bus, target ID and LUN id for each device is also shown here.

Example 2-4 List registered devices

```
enter selection: 88
Device found: Changer0 @"Scsi Port 3\Scsi Bus 1\Target Id 0\Logical Unit Id 1"
Device found: Tape0 @"Scsi Port 3\Scsi Bus 1\Target Id 0\Logical Unit Id 2"
Device found: Tape1 @"Scsi Port 3\Scsi Bus 1\Target Id 0\Logical Unit Id 4"
Total elapsed time in seconds =     0.00
Return to continue:
```

To test the medium changer we will load a tape to a drive, perform a read/write test on it, then unload the tape. While still in Library Mode, open the device. Select 20 *Open*.

Example 2-5 Open a device

```
enter selection: 20
Enter open mode (1) RW (2) RO: 1
special file (\\.\tape0) will be opened
special file (\\.\changer0) will be opened
analyze() called with  rc 8 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =    16.00
Return to continue:
```

To move the cartridge, you need to know the source and destination addresses for the media.

This can be obtained by selecting 10 *ioctl return library inventory* as shown in Example 2-6. The addresses are given in hexadecimal format and will need to entered as such when using the move medium command. Each entry in the inventory has an element type and a number in hexadecimal format. The element type indicates the classification of the element and is one of the following:

1. MTE - Medium Transport Element (picker)
2. SE - Storage Element (storage slot)
3. IEE - Import/Export Element (Medium Changer bulk I/O slots)
4. DTE - Data Transfer Element (the drives).

The command output shows that there is one MTE (cartridge picker), 12 I/O slots (IEE), 2 drives (DTE) and 42 storage slots (SE) in the 3583’s inventory. Each entry also shows if there is a cartridge present (by indicating Full or Empty).

Example 2-6 Return library inventory

```
enter selection: 10
Type: MTE, Addr: 0x00000000, Empty
Type: IEE, Addr: 0x00000000, Empty Access
Type: IEE, Addr: 0x00000001, Empty Access
Type: IEE, Addr: 0x00000002, Empty Access
Type: IEE, Addr: 0x00000003, Empty Access
Type: IEE, Addr: 0x00000004, Empty Access
Type: IEE, Addr: 0x00000005, Empty Access
Type: IEE, Addr: 0x00000006, Empty Access
Type: IEE, Addr: 0x00000007, Empty Access
Type: IEE, Addr: 0x00000008, Empty Access
Type: IEE, Addr: 0x00000009, Empty Access
Type: IEE, Addr: 0x0000000a, Empty Access
Type: IEE, Addr: 0x0000000b, Empty Access
Type: DTE, Addr: 0x00000000, Empty Access TgtId: 0x00
Type: DTE, Addr: 0x00000001, Empty Access TgtId: 0x01
Type: SE , Addr: 0x00000000, Empty Access
Type: SE , Addr: 0x00000001, Empty Access
```

```
Type: SE , Addr: 0x00000002, Empty Access
Type: SE , Addr: 0x00000003, Empty Access
Type: SE , Addr: 0x00000004, Empty Access
Type: SE , Addr: 0x00000005, Empty Access
Type: SE , Addr: 0x00000006, Full  Access
Type: SE , Addr: 0x00000007, Empty Access
Type: SE , Addr: 0x00000008, Empty Access
Type: SE , Addr: 0x00000009, Empty Access
Type: SE , Addr: 0x0000000a, Empty Access
Type: SE , Addr: 0x0000000b, Empty Access
Type: SE , Addr: 0x0000000c, Empty Access
Type: SE , Addr: 0x0000000d, Full  Access
Type: SE , Addr: 0x0000000e, Empty Access
Type: SE , Addr: 0x0000000f, Empty Access
Type: SE , Addr: 0x00000010, Empty Access
Type: SE , Addr: 0x00000011, Empty Access
Type: SE , Addr: 0x00000012, Empty Access
Type: SE , Addr: 0x00000013, Empty Access
Type: SE , Addr: 0x00000014, Empty Access
Type: SE , Addr: 0x00000015, Empty Access
Type: SE , Addr: 0x00000016, Empty Access
Type: SE , Addr: 0x00000017, Empty Access
Type: SE , Addr: 0x00000018, Empty Access
Type: SE , Addr: 0x00000019, Empty Access
Type: SE , Addr: 0x0000001a, Empty Access
Type: SE , Addr: 0x0000001b, Empty Access
Type: SE , Addr: 0x0000001c, Empty Access
Type: SE , Addr: 0x0000001d, Empty Access
Type: SE , Addr: 0x0000001e, Empty Access
Type: SE , Addr: 0x0000001f, Empty Access
Type: SE , Addr: 0x00000020, Empty Access
Type: SE , Addr: 0x00000021, Empty Access
Type: SE , Addr: 0x00000022, Empty Access
Type: SE , Addr: 0x00000023, Empty Access
Type: SE , Addr: 0x00000024, Empty Access
Type: SE , Addr: 0x00000025, Empty Access
Type: SE , Addr: 0x00000026, Empty Access
Type: SE , Addr: 0x00000027, Full  Access
Type: SE , Addr: 0x00000028, Full  Access
Type: SE , Addr: 0x00000029, Full  Access
analyze() called with  rc 1 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     3.00
Return to continue:
```

You can see that there is a slot (SE) 00000006 with a state of ‘Full Access’. This is the cartridge we wish to move in our example. We will be loading that cartridge into a tape drive, specifically, the DTE with an address of 00000000.

Example 2-7 shows how to move a tape cartridge from a slot in the library and mount it in a drive. We selected option 11 *ioctl move medium*.

At this stage we simply wish to mount a tape volume into the drive using the medium changer. We specify SE (Storage Element Slot) as the source type. NTUTIL then prompts for a valid source address which we enter in hexadecimal format (00000006). Then provide a destination type which is a tape drive (DTE), followed by a destination address (00000000).

Example 2-7 Move media

```
enter selection: 11
source type [moving from]: 2 = SE, 3 = IEE, 4 = DTE:2
source address moving from: 00000006
destination type [moving to]: 2 = SE, 3 = IEE, 4 = DTE:4
destination address moving to: 00000000
execute move_medium stype = 2, saddr = 6, dtype = 4,  daddr = 0
analyze() called with  rc 1 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =    29.00
Return to continue:
```

Once the tape is mounted (indicated by the ERROR_SUCCESS output), you may perform a read/write test (option 87) on the cartridge. Note this will overwrite any date on the tape (NTUTIL does not interact with any applications so is not aware of whether the tape has valid data on it or not) so be careful about which tape you choose for this operation.

Example 2-8 Read/write test

```
enter selection: 87
This will rewind and write on tape! Are you sure? Y or N
y
ntutil execute_command_read_write test
rewinding
Rewind OK, set blocksize to 32K
Set Block Size OK, writing 32K
Write 32K OK, rewinding
Rewind after Write OK, reading data
Read after Rewind OK, comparing data
analyze() called with rc 1 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =    27.00
Return to continue:
```

The tape has been successfully written to as shown above. We may now unload the cartridge by selecting Option 33 *Unload*. The source and destination elements will be reversed from the Load operation, so that the cartridge is moved from the drive back to its original slot.

To display information about the library or drive use 49 *inquiry* command. In Library Mode you must specify which device (changer or tape drive) you wish to gather information from. In Base mode NTUTIL will return information only about the opened drive.

Example 2-9 Inquiry

```
enter selection: 49
Drive = 0, Library = 1: 0
  Device Path SCSI data:
  PortNumber 3, PathId 0
  TargetId   6, Lun    0
INQUIRY data:
  devtype(0):           01, rmb(1):           80
  ASO/ECMA/ANSI(2):     03, resp_data_fmt(3): 02
  additional_length(4): 21, reserved(5):      00
  SCSI_3(6):            01, flags(7):         30
  vendor_id (8-15): IBM
  product_id (16-31): ULT3580-TD1
  Microcode Revision Level (32-35): 16E0
  vendor specific (bytes 36-55):
     00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
analyze() called with  rc 1 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     4.00
Return to continue:
```

NTUTIL can also be run in batch mode. For more information about NTUTIL refer to the *IBM Ultrium Device Drivers: Installation and User's Guide,* GA32-0430. This guide is installed with the packaged device drivers. There is also the I*BM Ultrium Device Drivers: Programming Reference* WB1304 which details information relating to issuing commands to tape device drivers and manipulating tape APIs.

Native Windows backup utility (NTBACKUP)

The Windows 2000 native backup utility, NTBACKUP can use the LTO library and drives to perform basic backup, restore and system state backup functions. In order to make use of the Windows backup utility, you must have the RSM service started, and the media contained within the libraries must be 'prepared' before it can be made available to the application. For more information on RSM operation and features refer to Chapter 5, "Configuring RSM" on page 197**.** NTBACKUP will give an error if it is started without the RSM service running.

NTBACKUP may be initiated from the Start Menu, (**Accessories -> System Tools**), command line or run prompt. If you start NTBACKUP without any allocated media you will receive the following message:

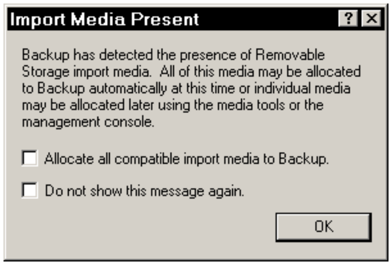

Figure 2-33 Import media present message

If you wish to allocate all free media at this time you may do so, bearing in mind that this operation will cause NTBACKUP to take ownership of all media. If there are other backup applications that use this media do not allocate all media. Again, you may prepare (format) the tape volumes as needed through RSM, and NTBACKUP will allocate free (prepared) volumes when required.

The Windows 2000 backup and restore functions as used with LTO are illustrated below, and are much the same as for any other natively attached tape libraries and drives. If new media is requested to be written to, then the tape mount preparations will take place with RSM driving the medium changer in the background. Similarly, mount requests for restore operations are transparent to the application. From the Backup tab (Figure 2-34) you may select the files and directories to be backed up, the Backup destination device and the media to mount for the operation.

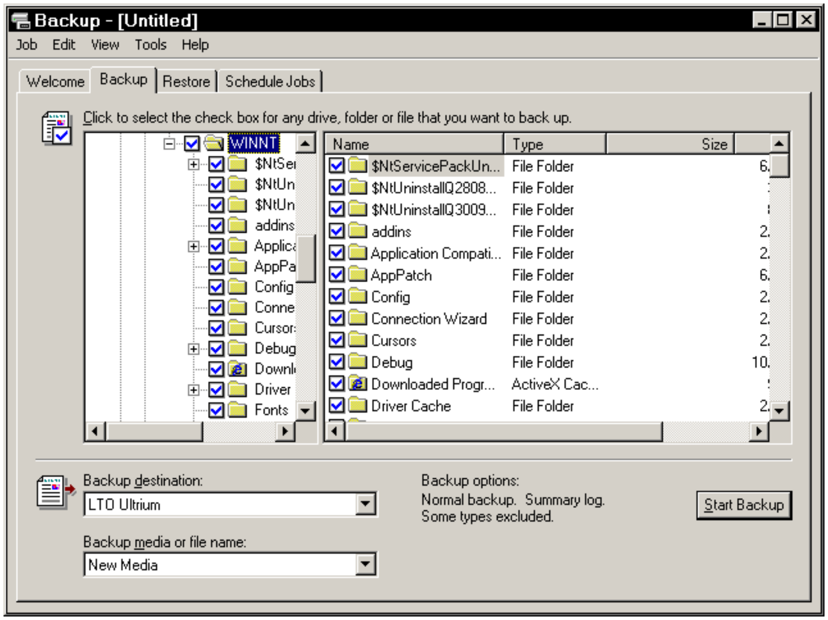

Figure 2-34 The NTBACKUP backup tab.

In our example, we have selected a full directory for backup. The backup destination is listed as LTO Ultrium (this has been configured through RSM) and the backup media as ‘New Media’ which means that NTBACKUP will automatically query the RSM database for a Free scratch volume and ask for it to be mounted.

Figure 2-35 shows the NTBACKUP restore window. Here you may select the media contained within the LTO library that you wish to restore from. The available restore media are listed as defined in the RSM database. The LTO Ultrium tapepool shows the tape volumes that are candidates for restore operations. They are automatically stamped with the time of the backup operation. If we click on the media we will be able to see the backed up files and directories which it contains.

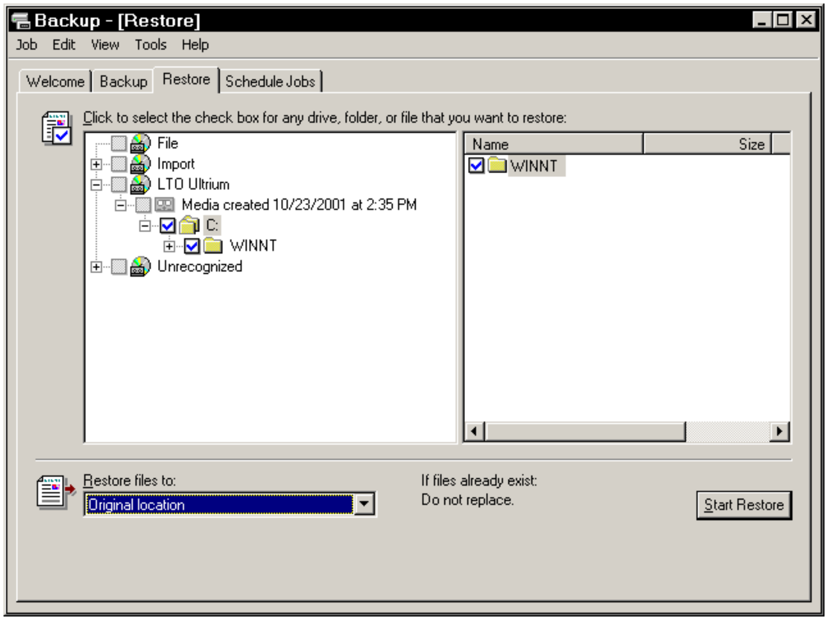

Figure 2-35 The NTBACKUP restore tab.

NTBACKUP with a SAN

It is not possible (by default) to use RSM and hence NTBACKUP to drive the LTO medium changer in a SAN attached configuration. RSM can only auto-configure a robotic library when the following conditions are true:

- The robotic library hardware unit supports drive element address reporting with the Read ElementStatus SCSI command. (Consult the manufacturer to find out if your library hardware unit supports this feature).
- All drives inside the robotic library are on the same SCSI bus as the library itself.
- The TAPE library is NOT attached to a Fibre Channel Switch. (This may change in future versions of RSM.)

RSM will attempt to auto-configure the libraries attached to the SAN Data Gateway (SDG) but is unable to do so, since the SDG remaps SCSI device ids and LUNs. Consequently, RSM is unable to resolve the SDG addresses with those contained in the Read Element Status data for the drives. For Fibre-Channel attached drives in a 3584, typically a switch would be involved. RSM devices, however, may be configured using the RSMConfg.exe tool in the

Windows 2000 resource kit utility or manually by editing the registry. To manually configure the registry, use the process shown in 5.3, “RSM with a SAN” on page 207. Once this operation has been performed, you may be able to use NTBACKUP.

2.2.5 Configuring tape and medium changer devices

Some default operating parameters for the LTO Medium changer and tape devices may be altered using NTUTIL. NTUTIL has a series of **`Set`** commands which can change these parameters:

- Drive Compression - default: (0=off)
- Block size - default: (0=variable)
- Block ID

To activate or deactivate drive compression (on/off), open NTUTIL, select 20 *open* then select 44 *set dev parms(compression).* A value of ‘0’ indicates compression is off and any other value indicates on.

Example 2-10 Activating compression

```
enter selection: 44
Compression off = 0, on = 1: 1
execute set_device_parameters compression = ON
analyze() called with  rc 0 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     4.00
Return to continue:
```

The drive block size may also be altered similarly with option 43 *set media parms (block size)*. This is 0 (variable) by default. This value may be overwritten by some backup applications.

You can view the current device parameters such as Target Id and LUN by selection option 88 *List registered devices.*

Example 2-11 List registered devices

```
enter selection: 88
Device found: Changer0 @"Scsi Port 3\Scsi Bus 1\Target Id 0\Logical Unit Id 1"
Device found: Tape0 @"Scsi Port 3\Scsi Bus 1\Target Id 0\Logical Unit Id 2"
Device found: Tape1 @"Scsi Port 3\Scsi Bus 1\Target Id 0\Logical Unit Id 4"
Total elapsed time in seconds =     0.00
Return to continue:
```

When devices are attached via an IBM SAN Data Gateway, SCSI target IDs and LUNs on the gateway's SCSI channels are remapped to other values which are then presented to the host operating system.

When the server boots, the devices attached to the first gateway encountered by the boot I/O scan process, are assigned SCSI target ID 0 (with LUNs between 0-127), devices attached to the second gateway have SCSI target ID 1 and so on.

Important: For every SDG attached to the server, LUN 0 is used by the gateway itself, and LUNs 2-126 are used for tape devices attached to the gateway.Tape drives are always assigned an even number LUN and start at 2. The medium changer will have an ODD number.

Then for the tape devices the gateway assigns LUNs in increasing sequence, as the devices are discovered on its attached SCSI channels.

This means that adding and removing devices, cabling changes, and readdressing of devices may cause gaps in the sequence of assigned LUNs, because the LUN number assignment is made every time the server reboots. This problem may be overcome by enabling persistent binding on the Fibre Channel HBA. For more details regarding persistent binding, refer to 4.3, “Persistent binding” on page 181.

Updating microcode using NTUTIL

NTUTIL also allows you to update the drive microcode. Refer to 2.5, “Updating library, drive and RMU firmware” on page 110 for instructions.

2.2.6 Deleting LTO devices

In some cases, it could be necessary to remove the tape device or the medium changer from the Windows device configuration. This is a required step for some application software that must have a specific device driver for medium changer or the tape drive. It may also be intended to simply disable a driver, perhaps for troubleshooting purposes. In this section we will describe how to disable an LTO device driver in Windows 2000 and then how to remove a device driver altogether.

Disabling an LTO Medium Changer or Tape Device

To disable an LTO device in Windows 2000, open Device Manager, locate the device (in this case under Medium Changers or Tape Drives), right-click on the device and select **Disable**. Alternatively, you can do this from the Properties box for the device under the General tab. This is illustrated in Figure 2-36.

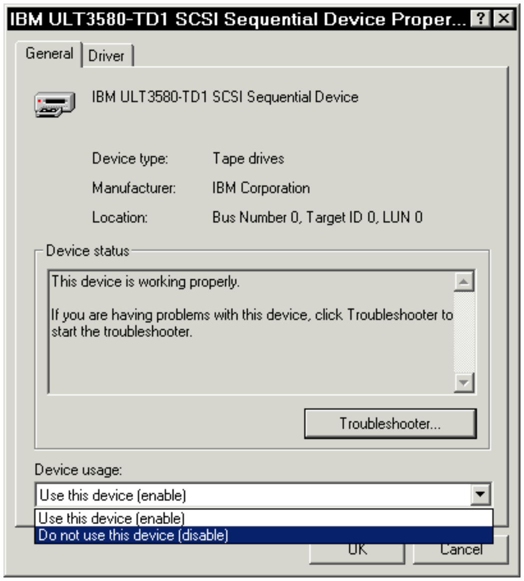

Figure 2-36 Disabling an LTO device

Disabling RSM

It is recommended that you first disable RSM from the services window in Computer Management before removing Ultrium devices. Ensure that all device activity has been halted before performing this step. Access the services window (Figure 2-37) by going to **Start -> Programs -> Administrative Tools -> Services.**

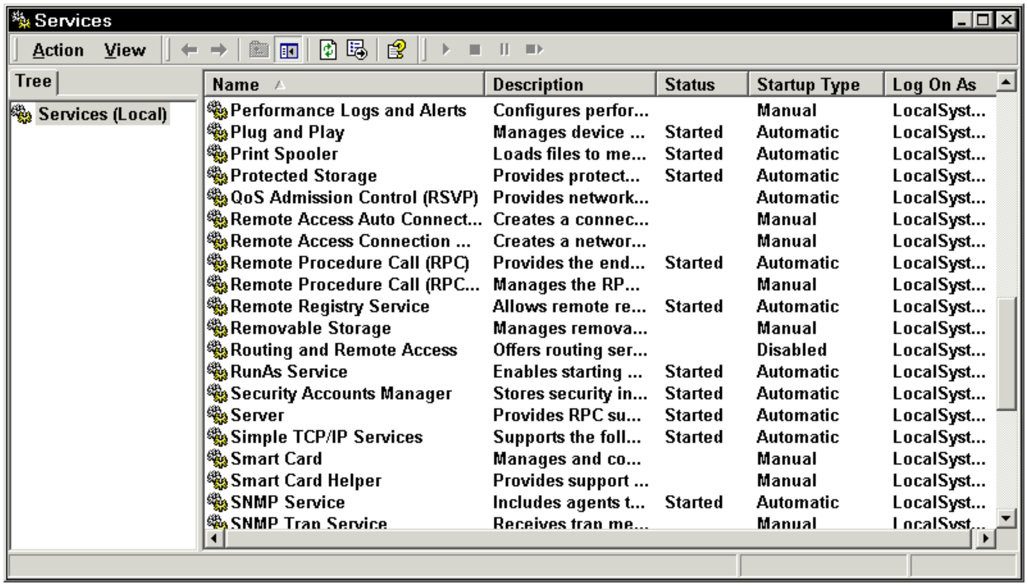

Figure 2-37 The Services window

Double-click on Removable Storage and select the General tab (Figure 2-38). From here you may stop and then disable RSM.

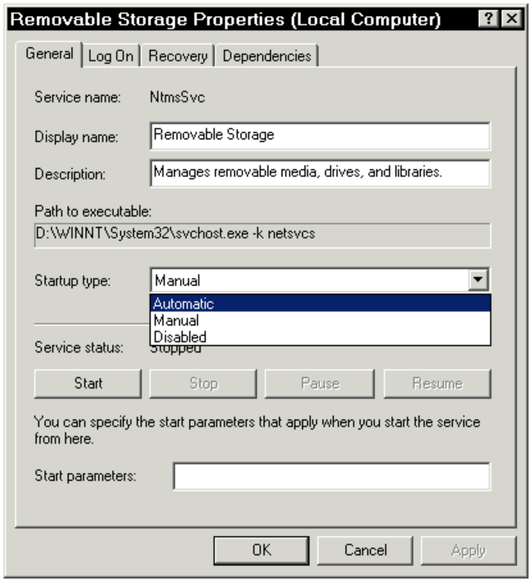

Figure 2-38 Disabling RSM

Removing Ultrium driver from the system (uninstallation)

To remove the Ultrium changer and tape device drivers, perform the following steps:

Open Device Manager and right click on the device (Figure 2-39).

Figure 2-39 Accessing the Device uninstall option

Click **Uninstall**. You will be presented with a popup warning window to confirm you really want to deinstall the device. Click **OK** to continue. Windows will proceed to remove the device drivers. Repeat these steps for all tape devices and the Medium Changer. Shutdown the operating system and physically detach the library if required.

2.3 Windows 2000 Fibre channel HBA driver installation

Up to now, we have assumed direct SCSI attachment. Alternatively, you can connect LTO Ultrium tape libraries and drives through a Storage Area Network, using either direct Fibre Channel attach (using native FC drives where available or with the 3583 Ultrium Scalable Tape Library with internal SAN Data Gateway module) or by using an external SAN Data Gateway with supported Ultrium models.

For our setup we tested both Emulex LP8000 and Qlogic QLA2200F adapters. We used an IBM 3583 Ultrium Scalable Tape Library that was SAN attached via an external SAN Data Gateway SDG (2108 R03). The SDG and HBA’s were connected to a SAN Fibre Channel Switch (2109-S08). The SAN lab setup is shown in Figure 2-40.

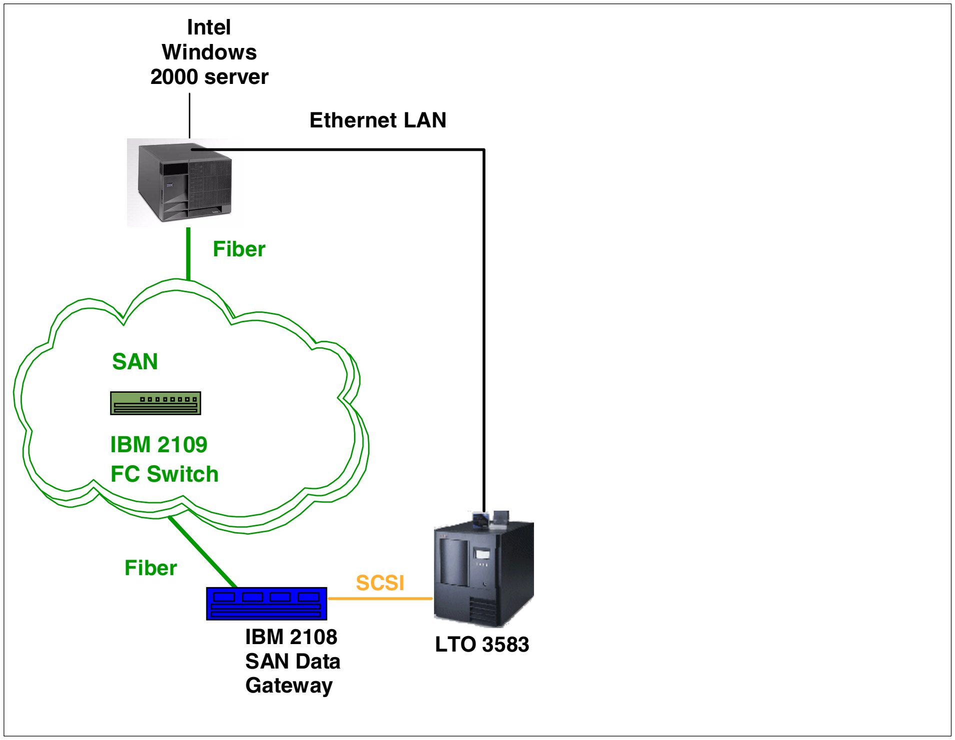

Figure 2-40 SAN lab setup

The tape device driver installation process is the same for both SCSI attached and Fibre Channel drives (see 2.2, “LTO installation for Windows 2000 with SCSI” on page 29). From the server side, you must have a Fibre Channel Host Bus Adapter (HBA) to connect the server to a Storage Area Network. This is also true if you have a direct point-to-point fibre channel connection between a server and an IBM LTO fibre channel library.

The Fibre Channel Host Bus Adapter must be supported and certified by IBM for the LTO model that you are connecting to the server. To locate supported HBA adapters for Windows 2000 refer to the supported adapters matrix in 1.4, “Windows 2000 connectivity” on page 17 or check the following web sites to verify that your HBA is supported, selecting the appropriate LTO model and the corresponding server:

```
http://www.storage.ibm.com/hardsoft/tape/3583/3583opn.html
http://www.storage.ibm.com/hardsoft/tape/3584/3584opn.html
```

For LTO models 3580 and 3581, since they are only available through SAN Data Gateway, check the following web site:

http://www.storage.ibm.com/hardsoft/products/tape/ro3superserver.htm#358x%20LTO

The above link points to the support matrix for the IBM SAN Data Gateway Router 2108-R03. The following link:

http://www.storage.ibm.com/hardsoft/products/tape/tapesupport.htm

gives supported devices and configurations for the IBM SAN Data Gateway 2108-G07 model. This device supports HBA drives only. Look in the sections related to Ultrium devices.

Once you have carefully verified that your HBA is supported, you have to check the driver level and, if necessary, download an updated driver.

The HBAs for our Windows 2000 setup are manufactured by QLogic and Emulex. The following sections detail the driver installation for these host bus adapters.

2.3.1 QLogic QLA2200F HBA driver installation

The currently supported QLogic adapter for LTO library and tape drives is the QLA2200F. To download the driver or firmware or to check if there is a later update available, go to this URL:

http://www.qlogic.com/support/product_resources.asp?id=112

Locate the Windows 2000 device driver link and download the Windows 2000 certified device driver which is in zip format. Unzip the files to a temporary directory - the unzipped files will include two with extension SYS and INF.

This process works for either a new device driver installation or an overwrite to upgrade a lower level of the driver.

To install the driver, perform the following steps

1. Shutdown the machine
2. Install the HBA
3. Startup the machine
4. Install the driver using the Found New Hardware wizard as shown below.
5. It is suggested you reboot or shutdown the machine before attaching the Fibre Channel connection.

When the machine reboots, you will be prompted by the Found New Hardware Wizard as in Figure 2-41. Click **Next**.

Figure 2-41 Found New Hardware Wizard

The wizard will detect the HBA adapter as in Figure 2-42 and prompt you to either search for a driver or display a list of known drivers. Select the **`Search`** option then click **Next**.

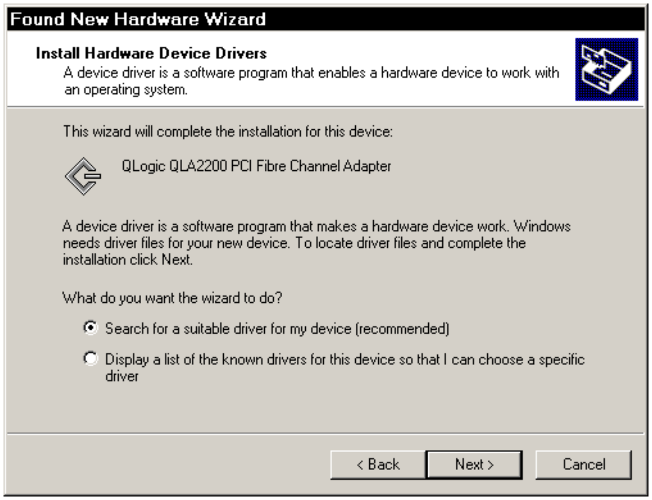

Figure 2-42 Wizard detects added hardware

Now you must specify a search location as shown in Figure 2-43.

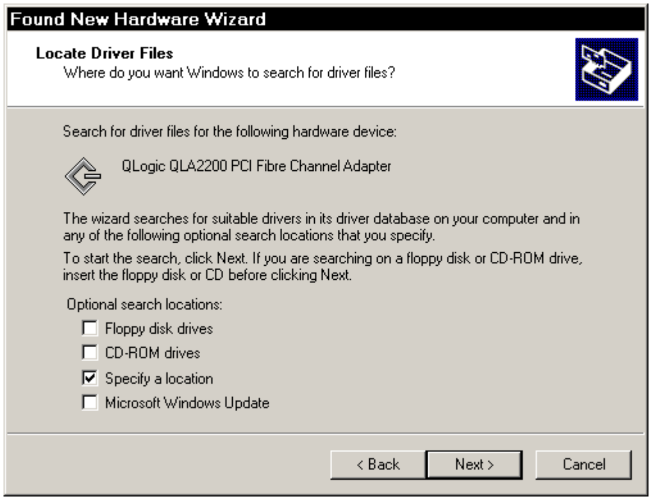

Figure 2-43 Wizard prompts for a location to install from

Enter in the location where you unzipped the downloaded driver file (Figure 2-44). If you are unsure click **Browse**.

Figure 2-44 Specify driver location

When the search results window appears (Figure 2-45), click **Next**.

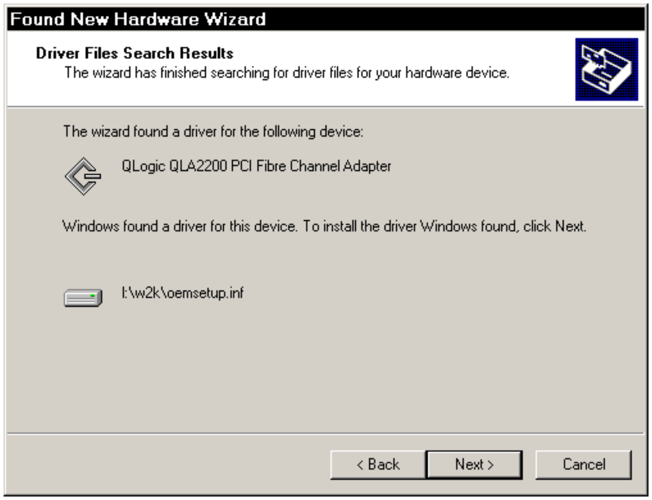

Figure 2-45 Wizard search results

The wizard will proceed to install the specified drivers as shown in Figure 2-46.

Figure 2-46 Install drivers completion

When the install is complete, click **Finish**. The e HBA device driver has now been successfully installed.

2.3.2 QLogic QLA2200F HBA driver configuration

Much of the Qlogic QLA2200F HBA driver configuration may be performed using the QLconfig utility which is part of the HBA Management Package from QLogic. However, some configuration settings can only be viewed and displayed at the BIOS level. We will show how to use both these methods to configure the HBA. For recommended settings it is suggested to refer to the Readme.txt file with the device driver and any vendor documentation available at the QLogic website. HBA settings should be changed with care, as an improper value may cause you to lose access to the SAN-attached devices. Any changes should be carefully tested in your environment. We have, however, provided a list of our own suggested settings in Table 2-2 on page 76.

You may obtain the QLconfig utility from:

`http://www.qlogic.com/support/product_resources.asp?id=112`

Go to the Management Software section and download the HBA Management Package for Windows 2000.

Notes for installing QLconfig

QLconfig consists of two separate components:

1. QLconfig Security Agent: This utility is required for the QLConfig application. This component is used to establish a user account and password to access the QLogic settings either on the local computer or on a remote machine that also contains a QLogic QLA2200F adapter
2. QLconfig Application: This is the application that provides an interface through which some adapter settings may be viewed and (possibly) altered

Both components require the installation and execution of the Intel DMI 2.0 Service Provider. DMI standards for Desktop Management Interface, and is a computer management interface standard developed by the Desktop Management Taskforce. If the installation program does not detect an existing DMI Service Provider, it will launch the Intel DMI 2.0 Service Provider installer. At the **Installation Components Selection** screen, select **DMI 2.0 Service Provider** and **DMI 2.0 DCE Client**. If an existing DMI Service Provider is detected, the Installer will display a message stating "A previous version of DMI SP for Windows has been detected. Do you wish to overwrite?" Select **Yes** if you wish to use the DMI 2.0 Service Provider or No to use the existing Service Provider. The rest of the QLconfig installation is straightforward. A reboot is required to finish the installation.

QLConfig Security Agent

The QLConfig Security Agent is used to set the option to enable or disable the configuration of the system's devices and LUNs. This program also displays the current state of the QLconfig Security Agent (QLconfig NT Agent) service and the last error code, if any. The program allows administrator-level users to enter a password to control access to the system from the QLconfig Application.

1. Ensure the QLconfig NT Agent service is started from **Start -> Settings -> Control Panel -> Administrative Tools -> Services**. Verify that the service is started. If the service is not started, start it by highlighting the service, right-clicking and pressing on the **Start** button.

2. Select **Start -> Programs -> QLogic Management Suite -> QLconfig -> QLconfig Security**. There is only one screen, shown in Figure 2-47.

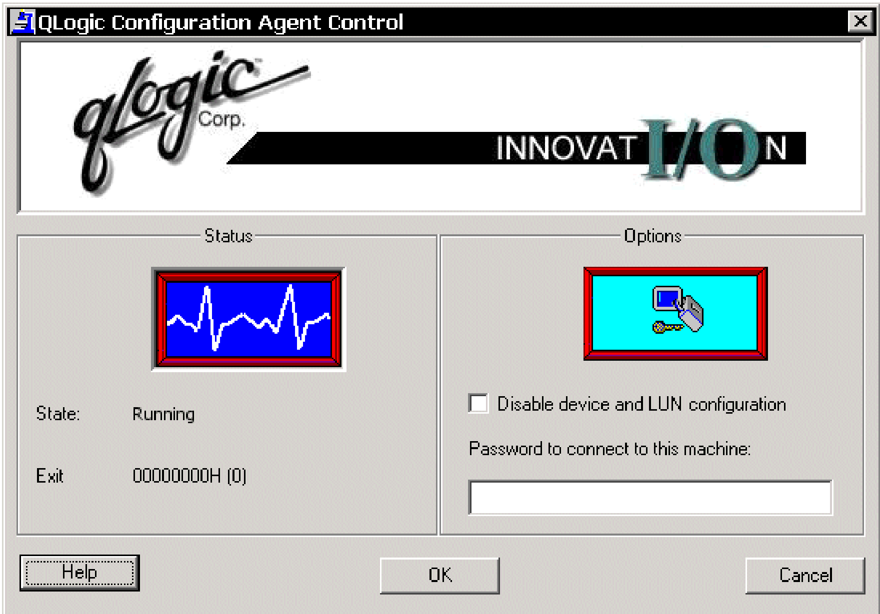

Figure 2-47 QLogic Configuration Agent Control

From here you can choose to enable/disable device and LUN configuration, and specify a password to be used when running QLconfig.

Using QLconfig

When QLconfig is installed it will place an icon on the desktop entitled QLconfig. When you execute it the screen shown in Figure 2-48 will appear with the Adapter name or type and MAC address. If we scroll down we will see the Pathlight router and associated LUN's. The Pathlight router entry is actually the IBM SAN Data Gateway, since it comes from this vendor.

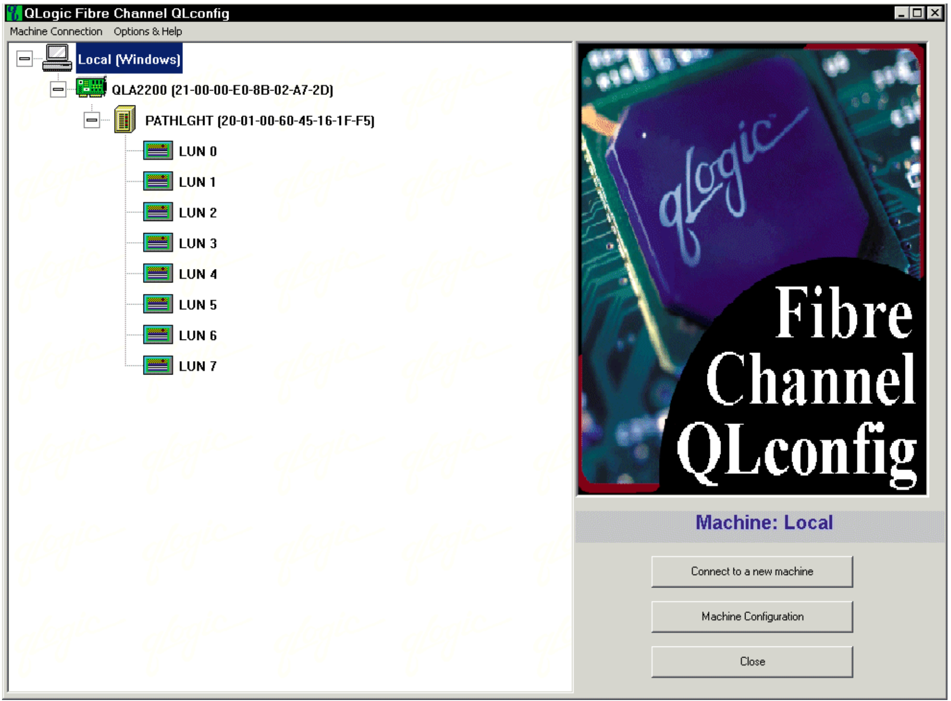

Figure 2-48 QLconfig main screen

Right-click on the entry for the Pathlight router and select **Device's LUN List**. The list of devices that the adapter has discovered will be displayed. Included in the list will be the status of the adapter, manufacturer and product name, revision and LUN. We can see the Gateway, Medium changer and two drives at LUN's 0, 1, 2 and 4 respectively.

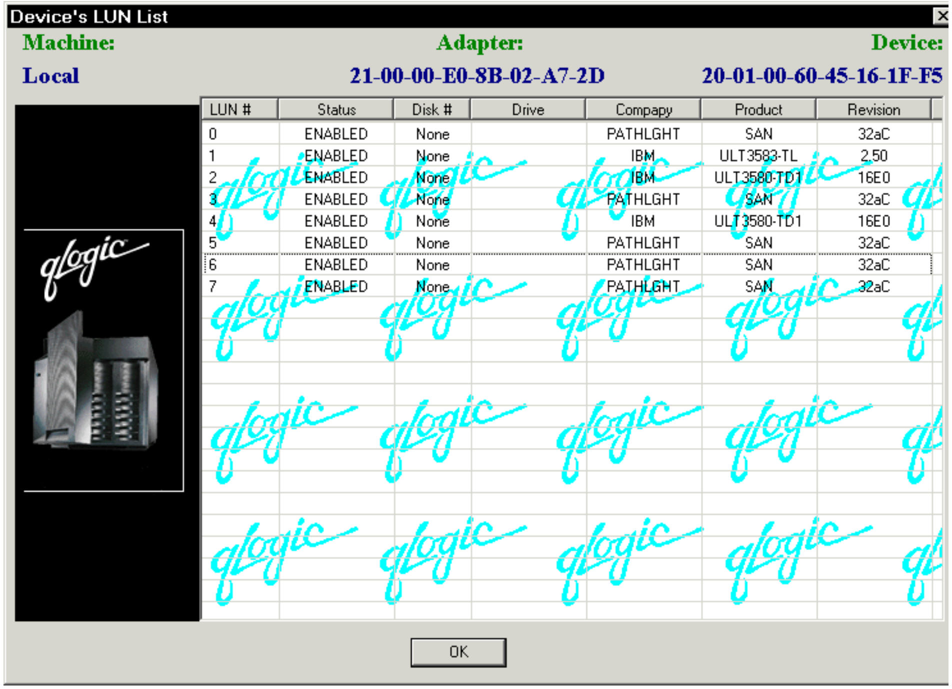

Figure 2-49 Device's LUN List

To view configuration options for QLConfig and LUN sharing options, from the main screen on Figure 2-48, go to **Options -> Help -> Options**. Figure 2-50 displays.

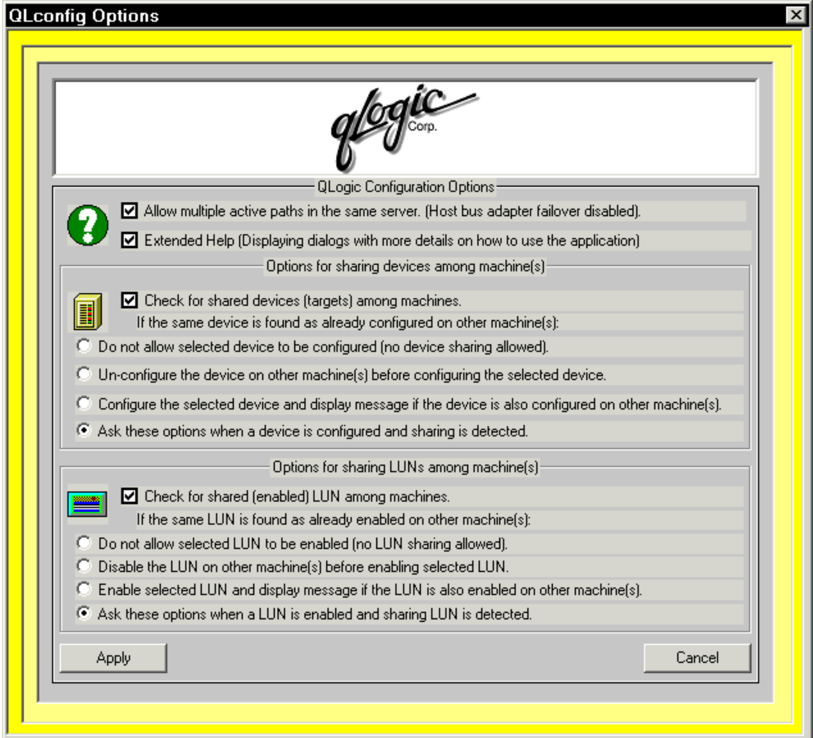

Figure 2-50 QLConfig options

QLConfig will allow you to perform LUN masking over multiple HBA's and target devices. For more information regarding LUN masking, refer to 4.4.1, "LUN masking using QLConfig" on page 187.

Fibre Channel Tape support

Currently, QLogic does not allow Fibre Channel (interfaced) tape support to be enabled via the configuration tool. There are two ways to enable FC tape support. The first method is to set/clear certain bits in the Firmware Options and Additional Firmware Options fields in the NVRAM (BIOS). To access the adapter BIOS, shutdown and reboot the server. During the boot process, when you see the QLConfig adapter messages, enter <ALT><Q>. This will start the Fast!UTIL program. A simple interface is provided to the adapter BIOS and changes can be made and saved.The system will reboot when you exit Fast!UTIL and it will activate the changes made.

To enable FC tape support, from the Fast!UTIL main menu, select **Configuration Settings -> Extended Firmware Settings**. Enable the Fibre Channel Tape Support and Fibre Channel Confirm options (they are disabled by default). The options to set are shown in Table 2-1.

Table 2-1 Firmware options bits

Field	Bit	Description	Value
Firmware Options	15	Extended Control Block	1
Firmware Options	14	Name Option	1
Additional Firmware Options	15	No Logo on Link Down	1
Additional Firmware Options	13	Enable FC Confirm	1
Additional Firmware Options	12	Enable FC Tape	1

The second way is to set the DriverParameter FCTape in the registry to 1. To do this, run **regedt32** and go to **HKEY_LOCAL_MACHINE -> SYSTEM -> Current_Control_Set -> Services -> ql2200**. This key is shown in Figure 2-51

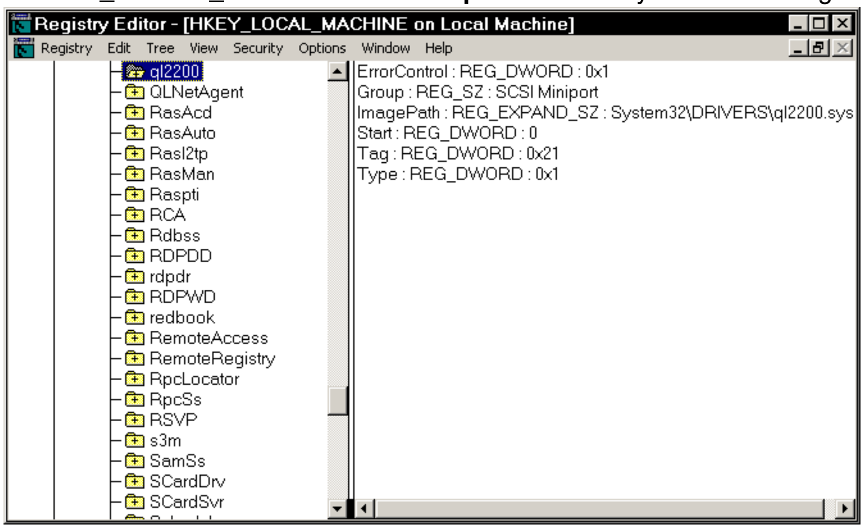

Figure 2-51 QL2200 registry key

Expand the ql2200 entry and scroll down to **Parameters -> Device** as in Figure 2-52.

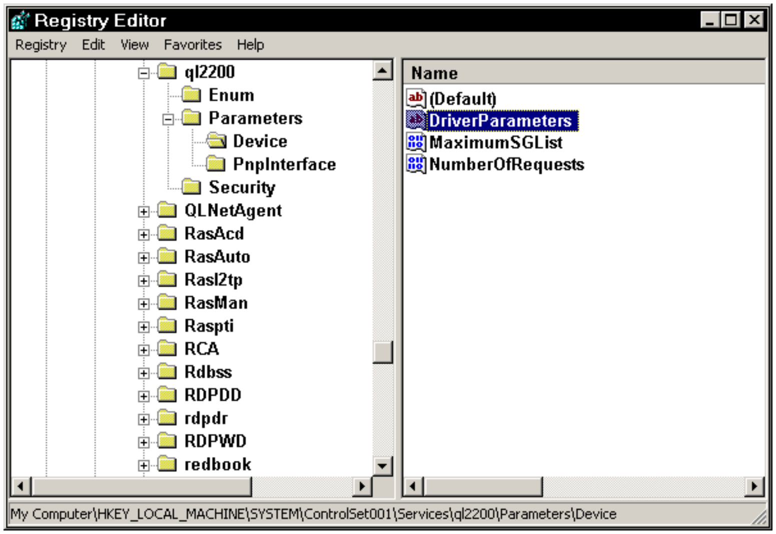

Figure 2-52 QL2200 device parameters

Double-click on **DriverParameters**. This will show the Edit String screen as in Figure 2-53.

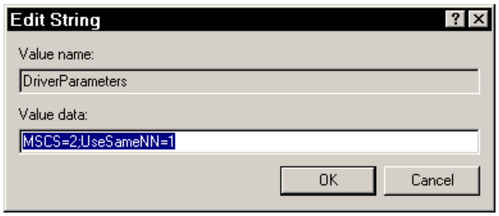

Figure 2-53 Edit String screen

In the Edit String box, type in a semi-colon followed by FCTape=1 (no spaces) and click **OK** (Figure 2-54)

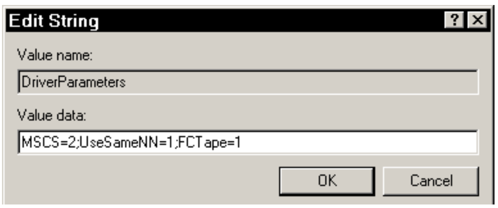

Figure 2-54 Enabling FC tape support

Table 2-2 lists some suggested settings for direct attached and SAN attached LTO libraries using the QLogic QLA2200F HBA. Please note that these are not a strict set of rules. For more information on recommended HBA settings, refer to the driver readme file and the Qlogic support web site

Recommended HBA settings

The table below lists some suggested settings for direct attached and SAN attached LTO libraries using the QLogic QLA2200F HBA. Please note that these are not a strict set of rules and any changes made here should be carefully tested in your environment. For more information on recommended HBA settings, refer to the QLogic support web site at

http://www.qlogic.com/support/home_support.asp

Table 2-2 Suggested QLogic QLA2200F HBA settings

Setting	LTO Fabric attached (switch) - with and without SDG	LTO Direct attached - with and without SDG
Host Adapter Settings		
Host Adapter BIOS:	Disabled	Disabled
Frame Size:	2048	2048
Loop Reset Delay:	5	5
Adapter Hard Loop ID:	Disabled	Disabled
Selectable Boot Settings		
Selectable Boot Device:	Disabled	Disabled
Current Boot Node Name:	0	0
Current Boot Lun Number:	0	0
Advanced Adapter Settings		
Execution Throttle:	255	255
Fast Command Posting:	Enabled	Enabled
>4GByte Addressing:	Disabled for systems with less the 4GB of memory	Disabled for systems with less the 4GB of memory
Luns per Target:	0	0
Enable LIP Reset:	No	No
Enable LIP Full Login:	Yes	Yes

Setting	LTO Fabric attached (switch) - with and without SDG	LTO Direct attached - with and without SDG
Enable Target Reset:	Yes	Yes
Login Retry Count:	30	30
Port Down Retry Count:	30	30
Drivers Load RISC Code:	Enabled	Enabled
Enable Database Updates:	No	No
Disable Database Load:	No	No
IOCB Allocation:	256	256
Extended Error Logging:	Disabled	Disabled
Extended Firmware Settings		
Extended Control Block	Enabled	Enabled
RIO operation Mode	0	0
Connection Options	1	2
Class 2 Service	Disabled	Disabled
ACK0	Disabled	Disabled
Fibre Channel Tape Support	Enabled	Enabled
Fibre Channel Confirm	Enabled	Enabled
Command Reference Number	Enabled	Enabled
Read Transfer Ready	Disabled	Disabled
Response Timer	0	0
Interrupt Delay Timer	0	0

2.3.3 QLogic QLA2200F HBA driver removal

To remove the QLA2200F HBA, perform the following:

1. Ensure there is no activity on the HBA
2. Disable the device (This is recommended but not mandatory)

3. Uninstall the device
4. Shutdown the machine
5. Remove the adapter and reboot.

You can disable the device from Device Manager as shown in Figure 2-55. Locate the device under SCSI and RAID Controllers, right-click and select **Disable**.

Figure 2-55 Accessing QLogic HBA properties

To uninstall the device, follow the same procedure to locate the device, right-click on it, and select **Uninstall**.

A pop-up warning box will appear asking for confirmation of the removal of the device. Click OK and the device will be removed. The device should no longer be visible in Device Manager.

You may now shut down the machine and physically remove the adapter.

2.3.4 Emulex LP8000 HBA driver installation

The currently supported Emulex adapter for LTO library and tape drives, is the LP8000 adapter. To download the driver or firmware, or to check if there is a later update available, go to this URL for the LP8000 adapter and download the file from the Drivers for Windows 2000 section.

`http://www.emulex.com/ts/fc/docs/frame8k.htm`

if an upgrade of the driver is required, or if you are installing the driver for the first time, download the installation file. We used the **miniport** driver which comes in ZIP format. This can be unzipped to a temporary directory - the unzipped files will include two with extension SYS and INF.

You find detailed installation instructions for the LP8000 adapter (PCI) at the same link, in the Documentation section. Click on the *Install driver* link and you will find the installation information. Be sure to read this information before continuing the driver installation.

To install the driver, do the following:

1. Shutdown the machine
2. Insert the HBA
3. Startup the machine
4. Use the Found New Hardware Wizard to install the driver as shown below.
5. It is recommended you reboot or shutdown the machine before attaching the Fibre Channel connection.

When the machine reboots, you will be prompted by the Found New Hardware Wizard (shown in Figure 2-41 on page 66). Click **Next**.

The wizard will detect the HBA adapter (Figure 2-56) and prompt you to either search for a driver or display a list of known drivers. Click on the **Search** option then click **Next**.

Figure 2-56 Upgrade device driver search options

Now you must specify a search location as shown in Figure 2-57.

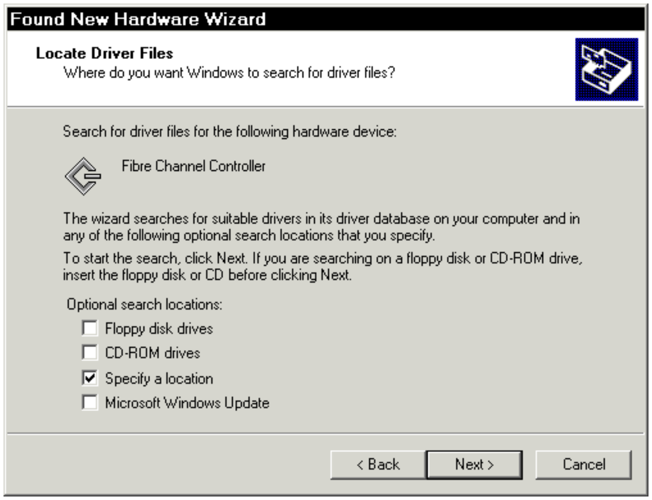

Figure 2-57 Locate driver file options

Enter in the directory where the device driver installation package was unzipped, as in Figure 2-58.

Figure 2-58 Copy from location

When the search results window appears (Figure 2-59), click **Next**.

Figure 2-59 Driver files search results

The wizard will proceed to install the specified drivers (Figure 2-60)

Figure 2-60 Upgrade device driver complete

When complete, click **Finish**. The HBA device driver has now been successfully installed. You may be prompted to reboot the server.

The installed HBA may be viewed through Device Manager as in Figure 2-61.

Figure 2-61 Emulex HBA device listing

Right-click on the device entry and select **Properties**. The **General** tab of the properties box appears as in Figure 2-62.

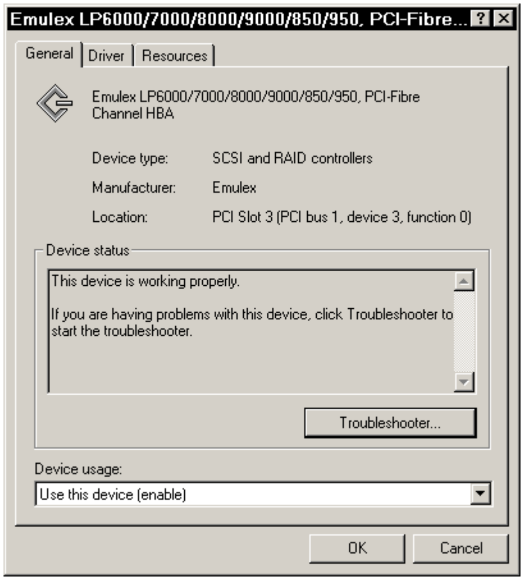

Figure 2-62 Emulex HBA general properties

Click on the **Driver** tab. From here (shown in Figure 2-63) you may update or uninstall the device driver, or simply view the driver file details.

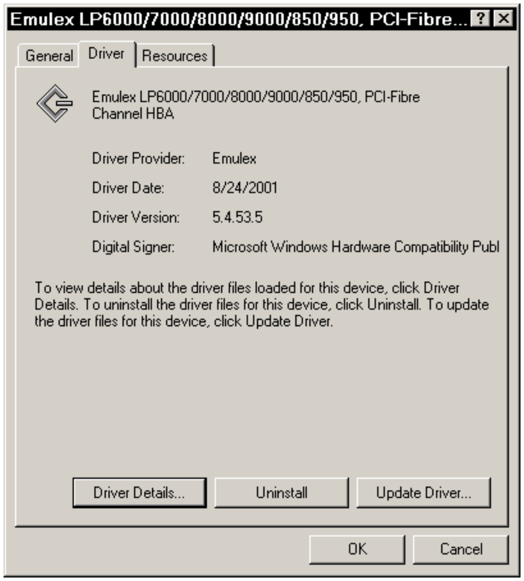

Figure 2-63 Emulex HBA properties driver tab

Figure 2-64 shows the Driver File Details window listing the location of the device driver files.

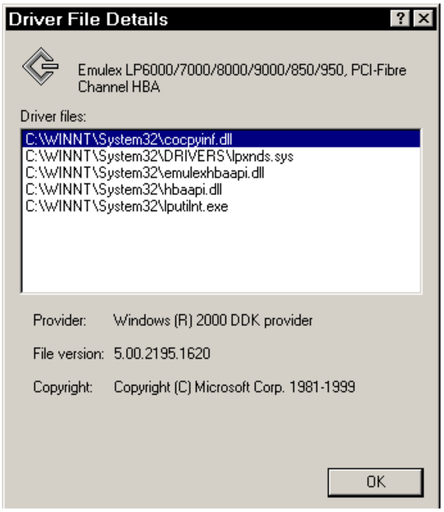

Figure 2-64 Emulex HBA driver file details

Now we can configure the driver.

2.3.5 Emulex LP8000 HBA driver configuration

For our setup we used an IBM 3583 Ultrium Scalable Tape Library that was SAN attached via an external SAN Data Gateway SDG (2108 R03). The SDG and HBA's were connected to a SAN Fibre Channel Switch (2109-S08). Our server was an Intel Pentium running Windows 2000 SP2. The setup is shown in Figure 2-40 on page 64.

Here we are using the SCSI Miniport Driver for Windows 2000 version 5-4.53a5. This driver provides support for the SCSI protocol over FC. There are other specialized drivers available such as the Emulex multiprotocol driver which will allow SCSI and/or IP functionality over Fibre Channel. The multiprotocol driver also allows persistent binding of SCSI device IDs. We will describe the multiport driver in 2.3.7, "Emulex Multiport driver" on page 90. For more details on persistent binding, refer to 4.3.2, "Persistent binding with a Emulex HBA" on page 181.

The miniport driver comes with a configuration utility, the LightPulse Utility (lputilnt.exe) which is installed into the c:\winnt\system32 directory when the device driver is installed. The utility can be started from the Run command box as shown in Figure 2-65.

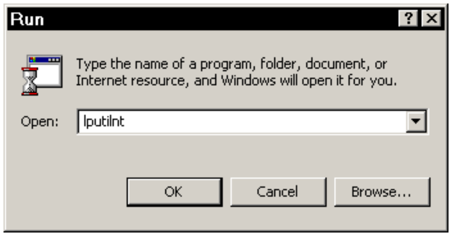

Figure 2-65 Initiate lputilnt

The LightPulse Utility main screen will appear with the installed HBAs on the left hand pane, as in Figure 2-66. On the right hand pane there is a drop down menu box that you can use to list various types of information including:

- Adapter revision levels
- Firmware maintenance
- Loop Map
- PCI Registers
- Configuration data
- Driver Parameters
- Link statistics

- Status and Counters

We are primarily concerned with the Driver Parameters that we may have to alter to optimize the function of our LTO libraries. This depends upon whether or not persistent device mapping is required (Refer to 4.3, “Persistent binding” on page 181), or if we need to enable Fibre Channel Tape support. For our setup, the default operating parameters were sufficient to allow us to use the LTO devices correctly

.

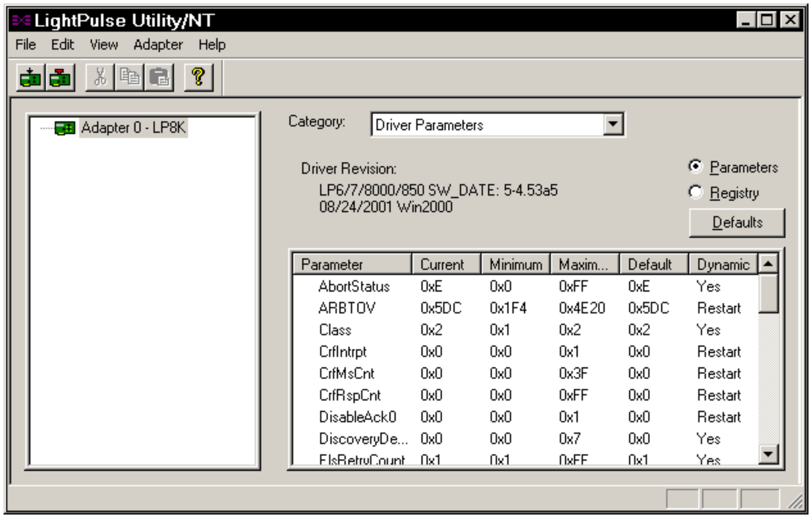

Figure 2-66 Emulex driver parameters

To alter the Driver Parameters, make sure **Driver Parameters** is displayed in the Category drop down menu and double-click on the device parameter that you wish to alter, (for example, AbortStatus). The Modify Driver Parameter box will appear (Figure 2-67). You may modify the current value for the parameters maintained in the Windows registry from here.

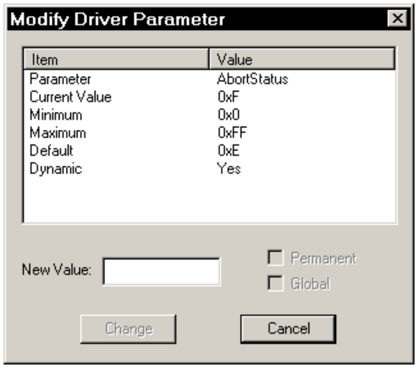

Figure 2-67 Modify driver parameters

You may also view the WorldWideName for this device though the Configuration Data category as shown in Figure 2-68.

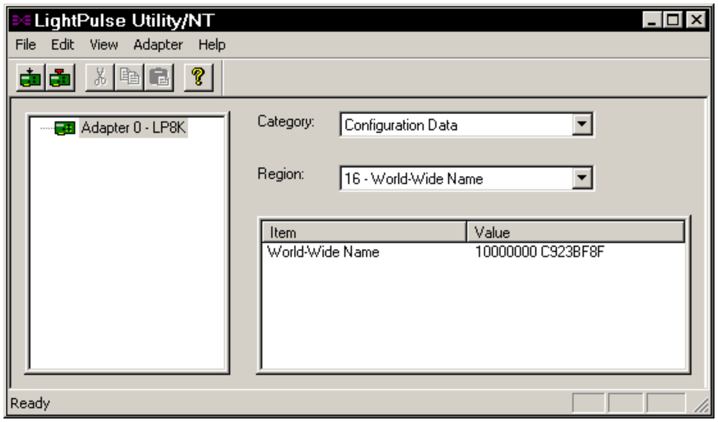

Figure 2-68 Emulex configuration data

Another category worth noting is Firmware Maintenance (Figure 2-69) from which you can view/update Firmware revision levels and Boot BIOS code.

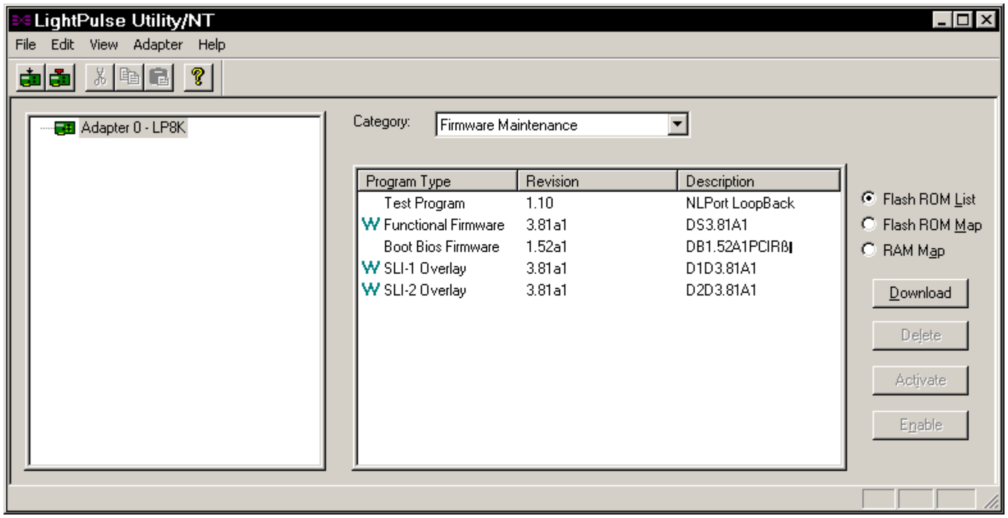

Figure 2-69 Emulex firmware maintenance

The Emulex multiport driver comes packaged with its own utility, **elxcfg** for configuring the adapter - the LightPulse utility is not used.

Table 2-3 lists some suggested settings for direct attached and SAN attached LTO libraries using the Emulex LP8000 HBA. Please note that these are not a strict set of rules. Be careful to thoroughly test any changes made to the HBA configuration to ensure they are suitable for your environment. For more information on recommended HBA settings, refer to the driver readme file and the Emulex support web site

http://www.emulex.com/ts/index.html

Table 2-3 Suggested Emulex LP8000 HBA settings

Setting	LTO Fabric attached (switch) - with and without SDG	LTO Direct attached - with and without SDG
Port Driver Installed	Fabric, Automap SCSI devices	Arbitrated loop, Auto map SCSI devices
Boot BIOS level	Boot BIOS	Boot BIOS
Adapter Controls		
Automatically Map SCSI Devices	Checked (enabled)	Checked (enabled)
Query name server for all N-Ports	Checked (enabled)	Checked (enabled)

Setting	LTO Fabric attached (switch) - with and without SDG	LTO Direct attached - with and without SDG
Allow Multiple paths to SCSI Targets	Checked (enabled)	Checked (enabled)
Point to Point	Not shown on screen	Not Checked (disabled)
Register For State Change	Checked (enabled)	Checked (enabled)
Use Report LUNs	Checked (enabled)	Checked (enabled)
Use Name Server after RSCN (Should be checked if using soft zoning on the switch)	Not Checked (disabled) (Should be checked if using soft zoning on the switch)	Not Checked (disabled)
Lun Mapping	Checked (enabled)	Checked (enabled)
Automatic Lun Mapping	Checked (enabled)	Checked (enabled)
Scan in Device ID Order	Not Checked (disabled)	Not Checked (disabled)
Enable Class 2 for SCSI Devices	Not Checked (disabled)	Not Checked (disabled)
Report Unknown SCSI Devices	Checked (enabled)	Checked (enabled)
Look for Disappearing Devices	Not Checked (disabled)	Not Checked (disabled)
Translate Queue Full to Busy	Not Checked (disabled)	Not Checked (disabled)
Use Bus Reset Status for Retries	Not Checked (disabled)	Not Checked (disabled)
Retry Unit Attention	Not Checked (disabled)	Not Checked (disabled)
Retry PLOGI Open Failures	Not Checked (disabled)	Not Checked (disabled)
Maximum Number of LUNs (value > or = to the number of Luns available to the HBA on any attached target).	(value > or = to the number of Luns available to the HBA on any attached target)	(value > or = to the number of Luns available to the HBA on any attached target)
Maximum Queue Depth	8	8

Setting	LTO Fabric attached (switch) - with and without SDG	LTO Direct attached - with and without SDG
Link Timer	30 sec	30 sec
Retries	64	64
E_D_TOV	2000 ms	2000 ms
AL_TOV	15 ms	15 ms
Wait Ready Timer	45 sec	45 sec
Retry Timer	2000 ms	2000 ms
R_A_TOV	2 sec	2 sec
ARB_TOV	1000 ms	1000 ms
Performance Parameters		
Max Interrupt Latency	0	0
Min I/O Completions per Interrupt	0	0
Max I/O Completions per Interruptions	128	128
Link Control Parameters		Tab not available
Topology	Point to Point	Not shown
Link Speed	Auto	Not shown

2.3.6 Emulex LP8000 HBA driver removal

To remove the Emulex LP8000 HBA, perform the following:

1. Ensure there is no activity on the HBA
2. Disable the device (recommended but not mandatory)
3. Uninstall the device
4. Shutdown the machine
5. Remove the adapter and reboot.

You can disable the device from Device Manager as shown in Figure 2-70. Locate the device under SCSI and RAID Controllers, right-click and select **Disable**.

Figure 2-70 Disabling the Emulex HBA

To uninstall, follow the same procedure to locate the device, right-click on it, and select **Uninstall**.

A pop-up warning box will appear asking for confirmation of the removal of the device. Click **OK** and the device will be removed. The device should no longer be visible in Device Manager.

You may now shut down the machine and physically remove the adapter.

2.3.7 Emulex Multiport driver

Emulex provide two drivers sets. The miniport driver provides support for the SCSI protocol only and is described in the previous section. The Multiport driver provides support for the SCSI and IP protocols, either separately or concurrently. The Multiport driver also has an additional tool called **elxcfg** that allows us to do LUN mapping - this tool is not in the miniport driver. You can get the Multiport driver from the Emulex website:

`http://www.emulex.com/ts/fc/docs/frame8k.htm`

Go to the **Drivers for Windows 2000 Section**, and click on the link **Specialized drivers.** Download the Port Driver and unzip it into a temporary directory. To install, in Device Manager double click on the HBA to be updated (Figure 2-71).

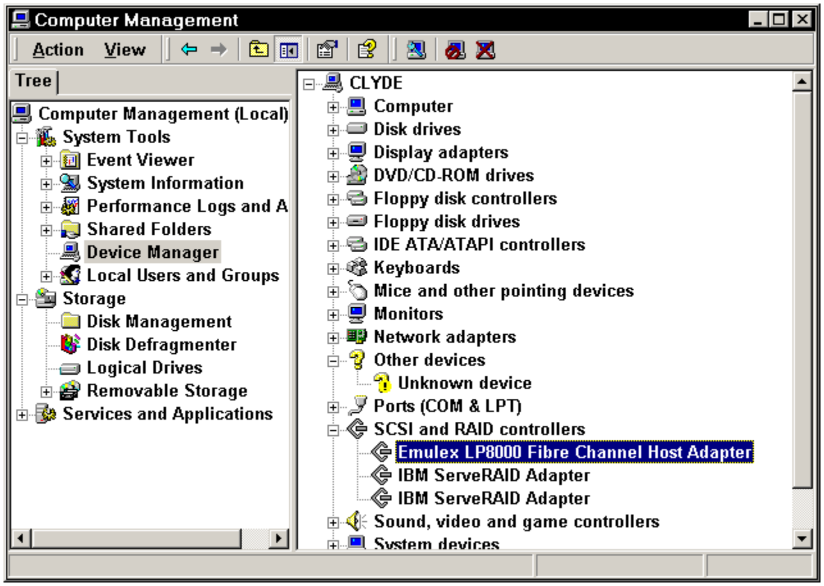

Figure 2-71 Listing the HBA

The General Properties screen displays (Figure 2-72).

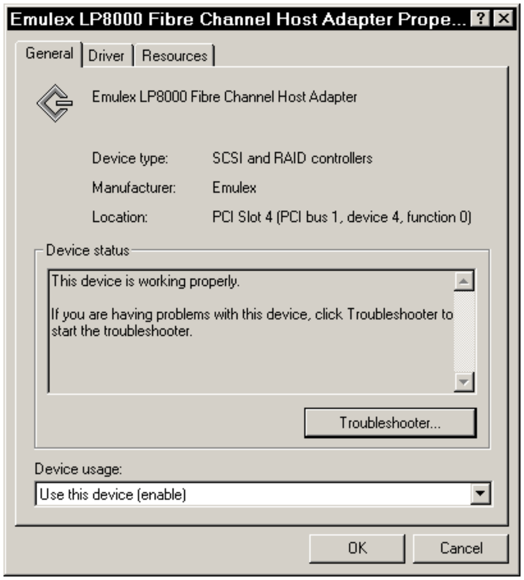

Figure 2-72 HBA properties

Select the **Driver** tab (Figure 2-73) and then **Update Driver**.

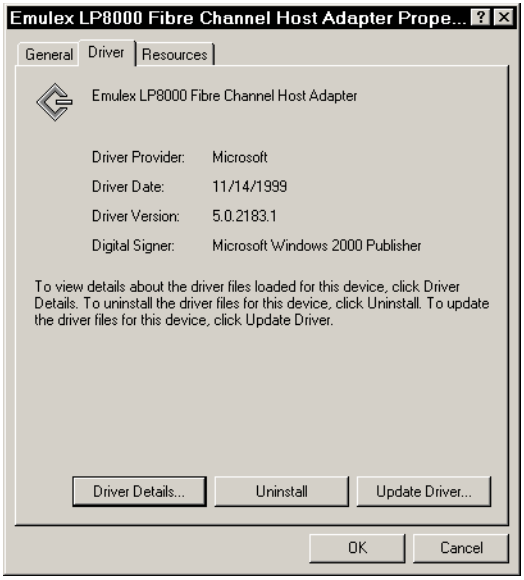

Figure 2-73 Driver properties

Click **Next** in the Device Driver Wizard (Figure 2-74).

Figure 2-74 Upgrade Device Driver Wizard

Do not search for a driver, take the second option in Figure 2-75, to explicitly select your own driver and click **Next**.

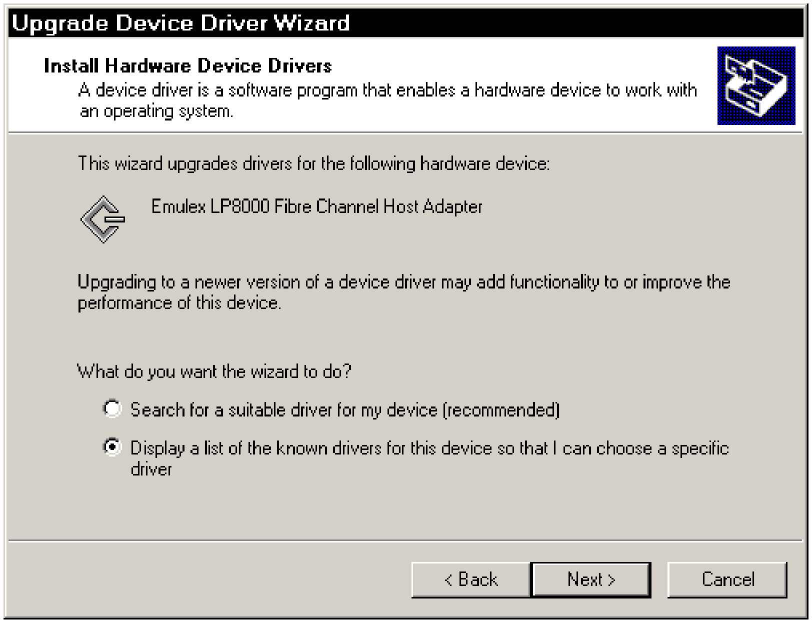

Figure 2-75 Selecting a driver

Click on the Have Disk button (Figure 2-76).

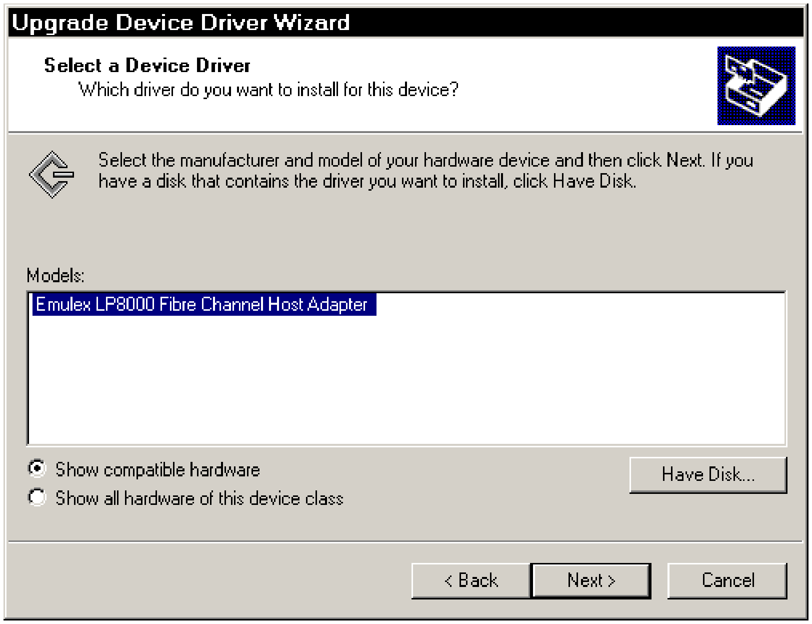

Figure 2-76 Have Disk

Select **Browse** and go the directory where the multiport driver was unzipped as shown in Figure 2-77.

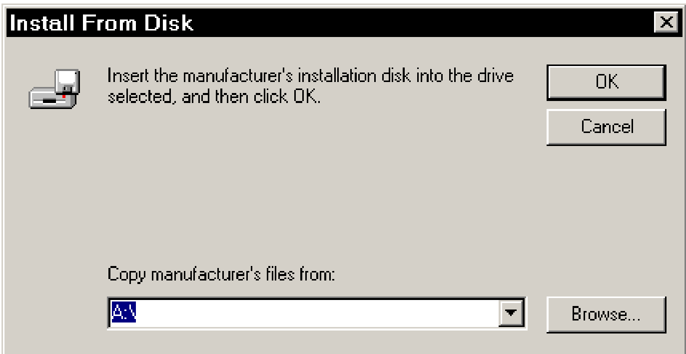

Figure 2-77 Browse for driver location

Select the driver file (elxscsi.inf) and **Open** (Figure 2-78).

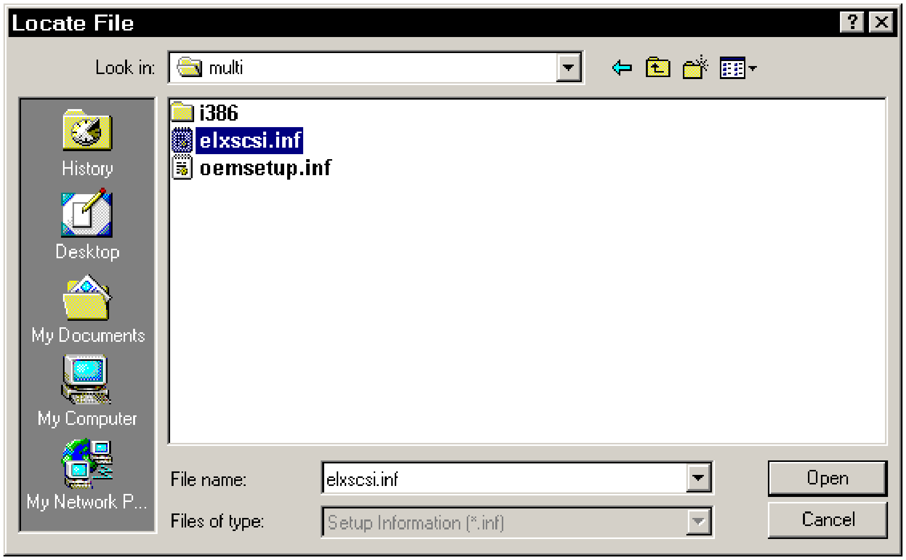

Figure 2-78 Locating driver file

A list of driver options is now displayed as in Figure 2-79. Based upon the SAN environment that you have, you will need to select a driver. We were using a SAN fabric environment, so we selected the **fabric, no automap of SCSI ids** and then **Next**.

Figure 2-79 Driver Type

We received a driver warning from the operating system, shown in Figure 2-80. We continued with the driver installation based upon the instructions from Emulex.

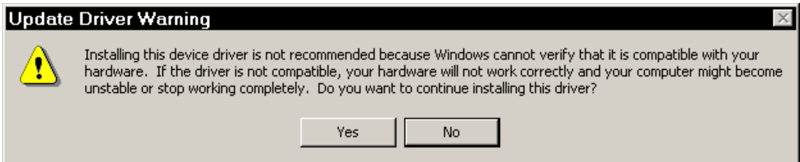

Figure 2-80 Driver Warning

The driver to be installed was listed (Figure 2-81) - click **Next** to complete the install.

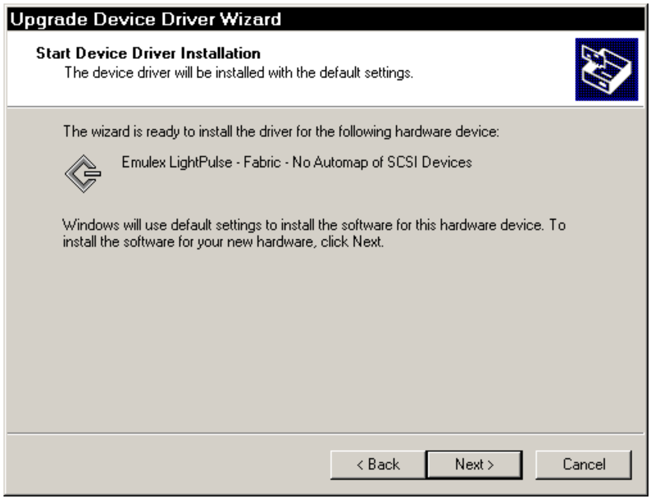

Figure 2-81 Driver confirmation

Select **Finish** to complete the installation (Figure 2-82) and reboot the server.

Figure 2-82 Upgrade completion

Fibre Channel tape support

Currently, Emulex does not allow Fibre Channel (interfaced) tape support to be enabled via their configuration tools, **lputilnt** and **elxcfg**. Fibre Channel tape support may be enabled manually in Windows 2000 for the *Emulex multiport driver*. This procedure requires registry editing. Run **regedt32** and go to **HKEY_LOCAL_MACHINE -> SYSTEM -> Current_Control_Set -> Services -> elxsli2** as shown in Figure 2-83.

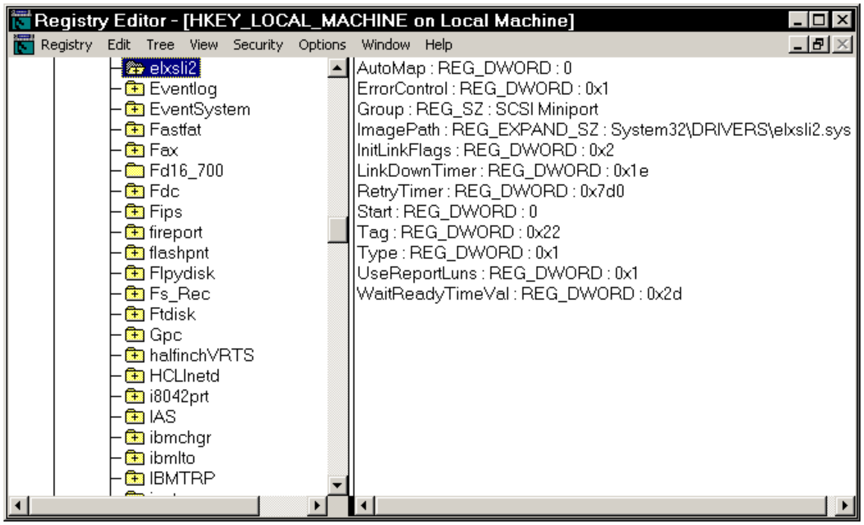

Figure 2-83 elxsli2 registry key

On the registry editor menu (Figure 2-84), select **Edit -> Add value**.

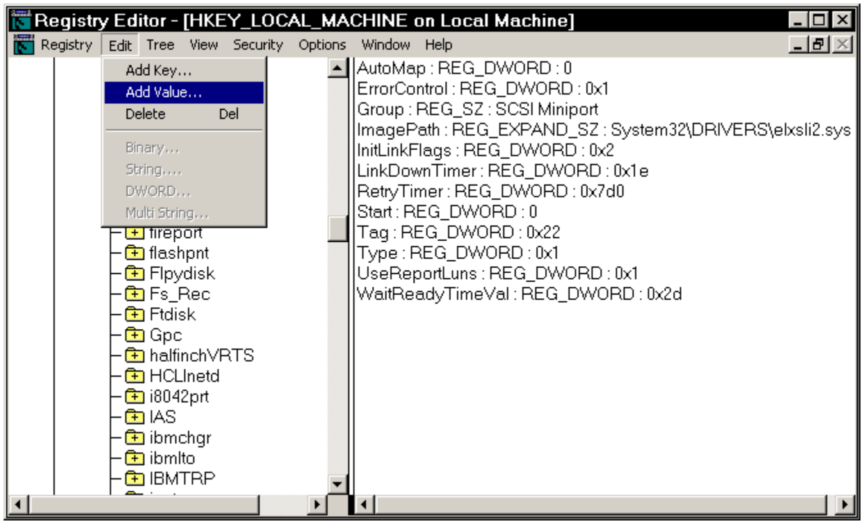

Figure 2-84 Add Value

Enter the following for the parameters in the screen shown in Figure 2-85:

- Value Name: FCTape
- Data Type: REG_DWORD

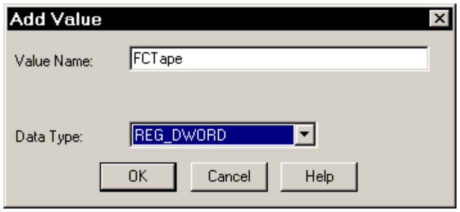

Figure 2-85 Data Type

When prompted for Data, enter 1 (it doesn't matter what the Radix is set to) - shown in Figure 2-86

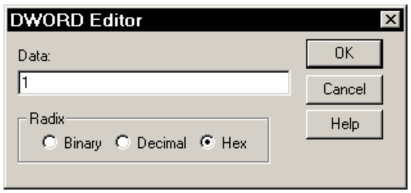

Figure 2-86 DWORD Editor

2.4 StorWatch Tape Library Specialist

The StorWatch Ultrium Tape Library Specialist is part of the IBM StorWatch products family. This is a set of software products which provide specific storage administrative functions for various IBM TotalStorage products from any location within an enterprise.

It is available at no charge for currently shipping models of the 3583 Ultrium Scalable Tape Library and the 3584 Ultrium UltraScalable Tape Library.

This product consists of a web interface accessible from any browser-equipped host on the network. You also require the RMU or Ethernet connection on the 3583 Ultrium Scalable Tape Library and the 3584 Ultrium UltraScalable Tape Library respectively. As described on 1.2.5, “IBM 3583 Ultrium Scalable Tape Library” on page 10 and 1.2.6, “IBM 3584 UltraScalable Tape Library” on page 13, these are available as priced upgrades for previously shipped libraries which do not have them.

In the next sections we describe in more detail the StorWatch Specialist applications for the 3583 and 3584.

2.4.1 IBM 3583 StorWatch Specialist

The StorWatch Ultrium Tape Library Specialist for the 3583 library is included with the RMU (Remote Management Unit). The RMU may have been shipped with your library - if not, then it is available as an upgrade - see 1.2.5, “IBM 3583 Ultrium Scalable Tape Library” on page 10 for more information.

The RMU provides remote access to the library over a network. You can attach the library to your network through a 10/100 Ethernet port on the RMU and access the StorWatch functions through the browser interface.

If you have already installed the RMU, then you need to connect the Ethernet port of the RMU unit to your network.

Using the 3583 operator panel, select **More -> Setup -> Library -> RMU.** The panel in Figure 2-87 is displayed.

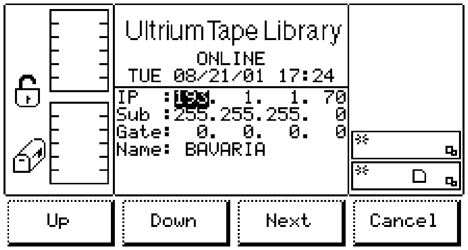

Figure 2-87 3583 operator panel: configuring RMU

Use the push buttons *Up* and *Down* to enter the IP address, subnet address, gateway (if present) and hostname. When finished press OK.

You should now be able to access the Specialist from your browser by entering in the IP address (for example `http://193.1.1.70`). Figure 2-88 shows the welcome screen of the 3583 Tape Library Specialist.

Figure 2-88 3583 Specialist: welcome panel

The first time you use the Specialist, login as *admin* with the password *secure*. Then you can access the **Configuration** menu and add the users that you want to grant access to the Specialist. Remember that every user authorized to access the Specialist panels, can potentially access every option available on the 3583 operator panel.

Use the menu bar at the top of the panel, right below the title bar, to navigate between the menus. You can choose between the following options:

Status	Library Status Drive Status RMU User Hostname IP address MAC address Library Serial # SNMP Alerts Library Firmware level RMU Firmware level
Configuration	Network Configuration SNMP Configuration User Configuration Date and Time
Firmware	Update Library Firmware Update RMU Firmware Update Drive Firmware
Diagnostic file	Library Command log Library Error log RMU Support log RMU Error log
Operator panel	access every option available on the 3583 operator panel (this is a graphical interface updated every few seconds)
Logs	view the current command log

In the black column at the left hand side of the Specialist screen, you find the help and documentation links that allow you to directly access the 3583 publications.

Next, we show some examples of the 3583 Ultrium Tape Library Specialist panels.

In the configuration panel shown in Figure 2-89, you can set the network configuration parameters, as well as Simple Network Management Protocol (SNMP) settings to send the alerts generated by the RMU to an SNMP server in your private network. The configuration panel also provides user management for the Specialist interface.

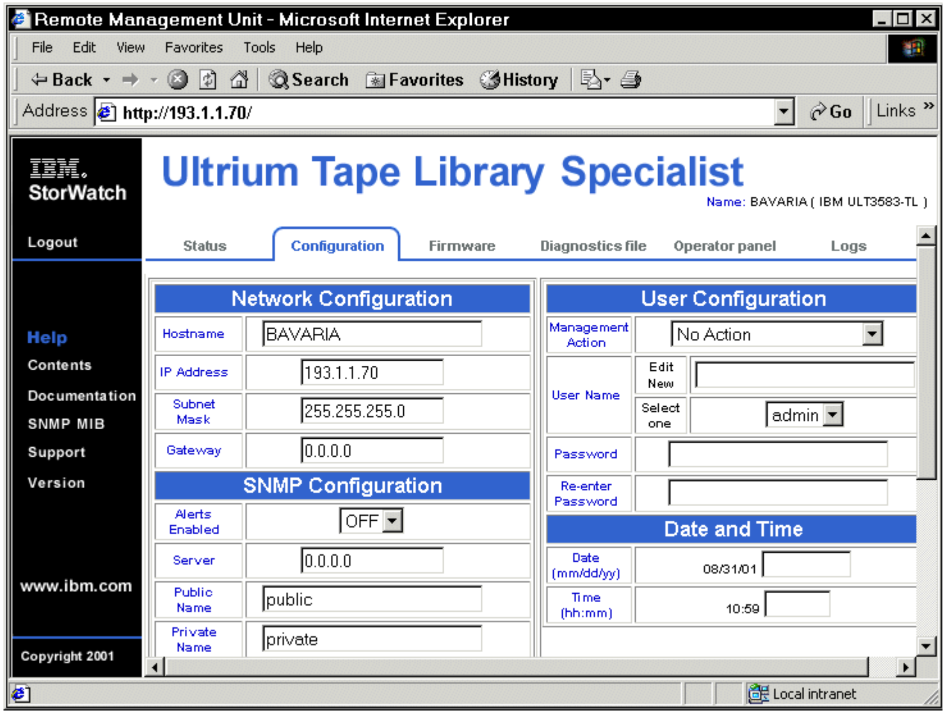

Figure 2-89 3583 Specialist: configuration panel

In the Diagnostics file panel shown in Figure 2-90 you can view and download the library and RMU logs, to possibly debug error situations and send the required documentation to the IBM support center.

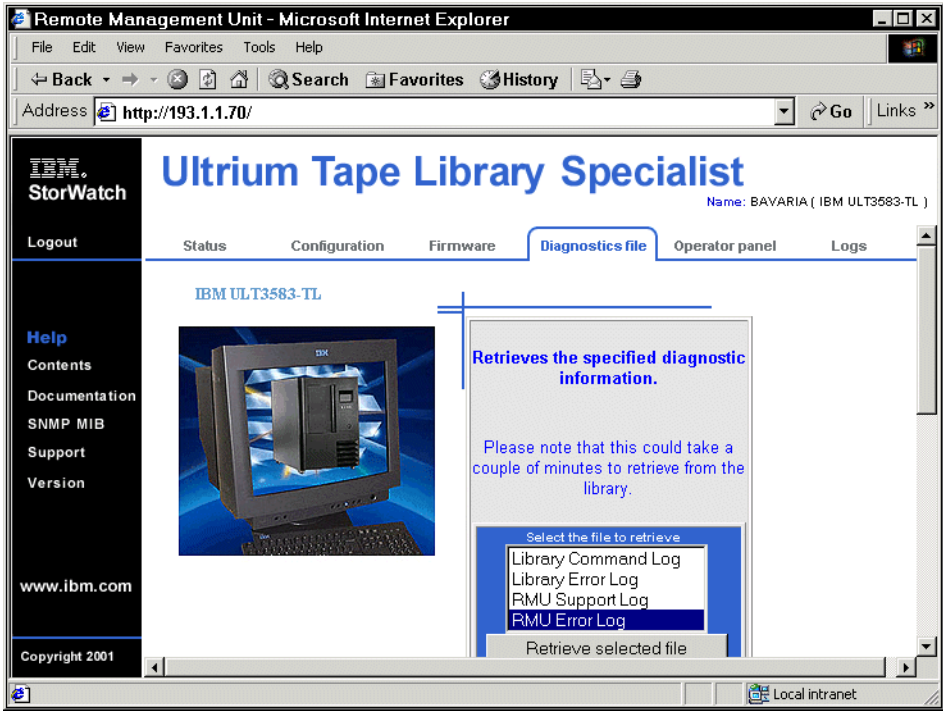

Figure 2-90 3583 Specialist: diagnostics file panel

In the Operator panel shown in Figure 2-91, you can operate the library exactly the same way as if you were at the real 3583 operator panel. The graphic display showing the image of the 3583 LCD panel has exactly the same functions as the physical library display. This feature allows you to view or update the configuration, reboot the library, vary drives offline and all other tasks from any browser with TCP/IP access to the library.

Figure 2-91 3583 Specialist: operator panel

2.4.2 IBM 3584 StorWatch Specialist

The StorWatch Ultrium Tape Library Specialist for the 3584 library is included with the Ethernet support. Ethernet support may have been included with your library - if not, then it is available as an upgrade - see 1.2.6, “IBM 3584 UltraScalable Tape Library” on page 13 for more information.

You will need to attach the Ethernet port to your network with a suitable cable and configure the TCP/IP addressing information. Choose **Settings -> Network Settings -> Ethernet.** You will see the current interface MAC address (which cannot be changed), and the assigned TCP/IP address, subnet mask and gateway. If the library has more than one frame, each frame requires a separate address. Use the UP and DOWN buttons to access the panels for the additional frames. The current configuration screen is shown in Figure 2-92.

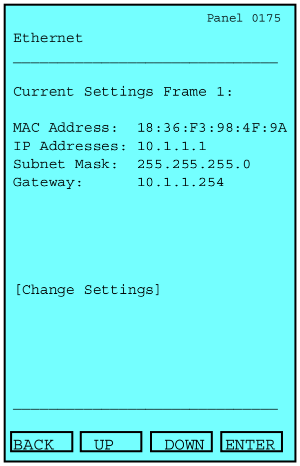

Figure 2-92 Change Ethernet parameters on 3584

Hit Enter to make changes. You can select to disable the Ethernet interface, use DHCP to automatically assign an address (if supported in your network) or manual configure the parameters.

Once you have configured the network connection, to use the 3584 StorWatch Specialist, enter the TCP/IP address of the library in your browser (for example, `http://10.1.1.1`).

The introductory screen of the 3584 Specialist web interface displays as shown in Figure 2-93. The screen lets you access library functions and provides information about using *Help*. It also offers a *Getting Started* link that gives an introduction to the interface and a *Reference Information* link that describes the library.

Figure 2-93 3854 Specialist: welcome screen

Use the left hand side of the panel to navigate between the menus. You can choose between the following options:

Physical Library	Cartridges I/O Station Drives Accessor Node cards Storage Slots Control Ports
Logical Libraries	Cartridges Drives Storage Slots
Manual Operations	Inventory Library Clean Drive Move Cartridge Insert Cleaning Cartridge Remove Cartridge

Settings	Security
	Library Configuration
	World Wide Names
	Control Paths
	Cleaning Mode
	Date and Time
	Drive SCSI/Loop IDs
	Control Port SCSI IDs
Service	Vital Product Data
	Download Logs
	Firmware Update

The StorWatch Ultrium Tape Library Specialist is a complete interface that allows you to easily monitor the library operations, with graphics and tables like those shown in Figure 2-94.

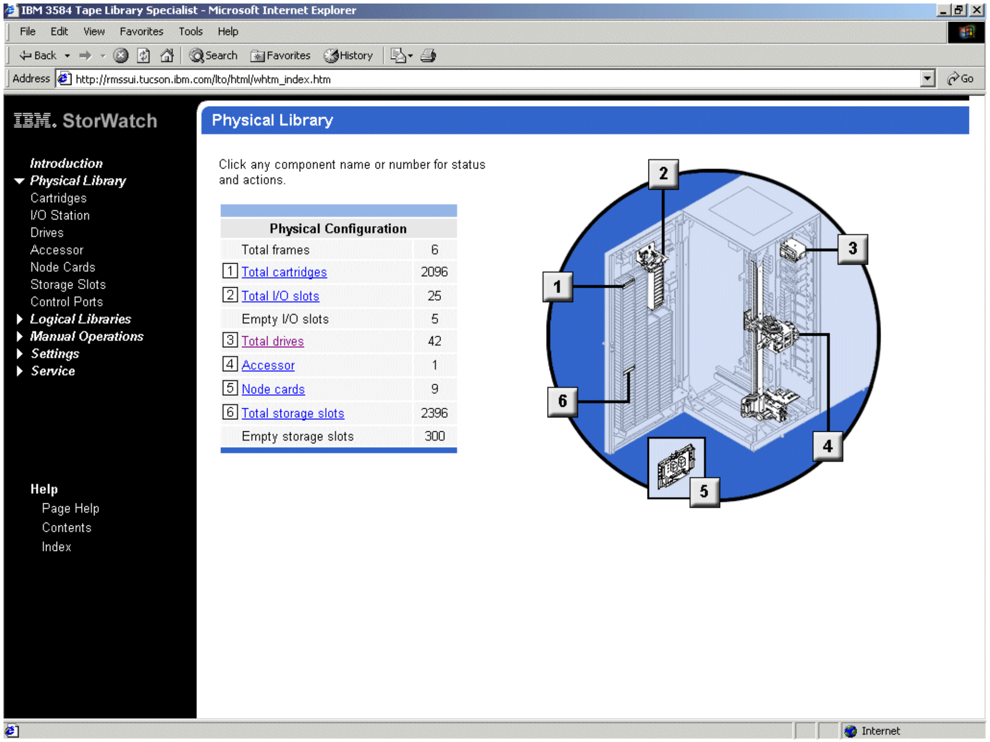

Figure 2-94 3584 Specialist: Physical Library entry pane

Other options are available to manage the library, as seen in Figure 2-95. Here, after select a tape drive you can clean it, change its SCSI id or view usage statistics.

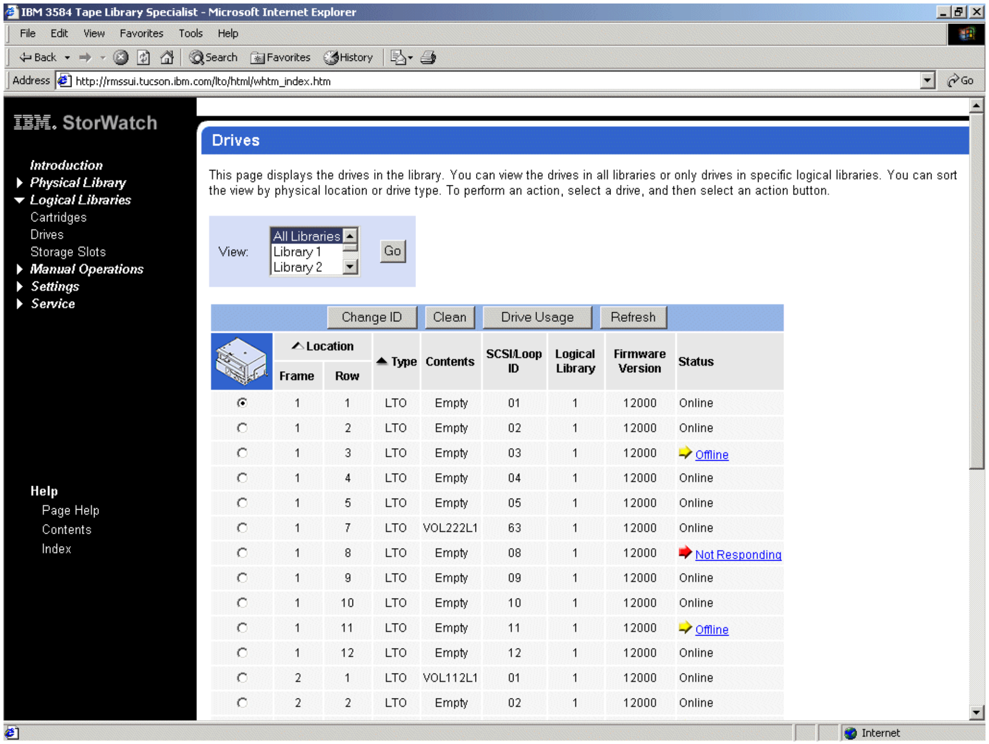

Figure 2-95 3854 Specialist: Logical Libraries drives panel

In addition, you can configure the library directly from the Specialist panels, specifying the SAN parameters, or the SCSI control paths, control ports as well as security options, as shown in Figure 2-96. Note that the TCP/IP and SNMP configuration functions are not available from the StorWatch Specialist.

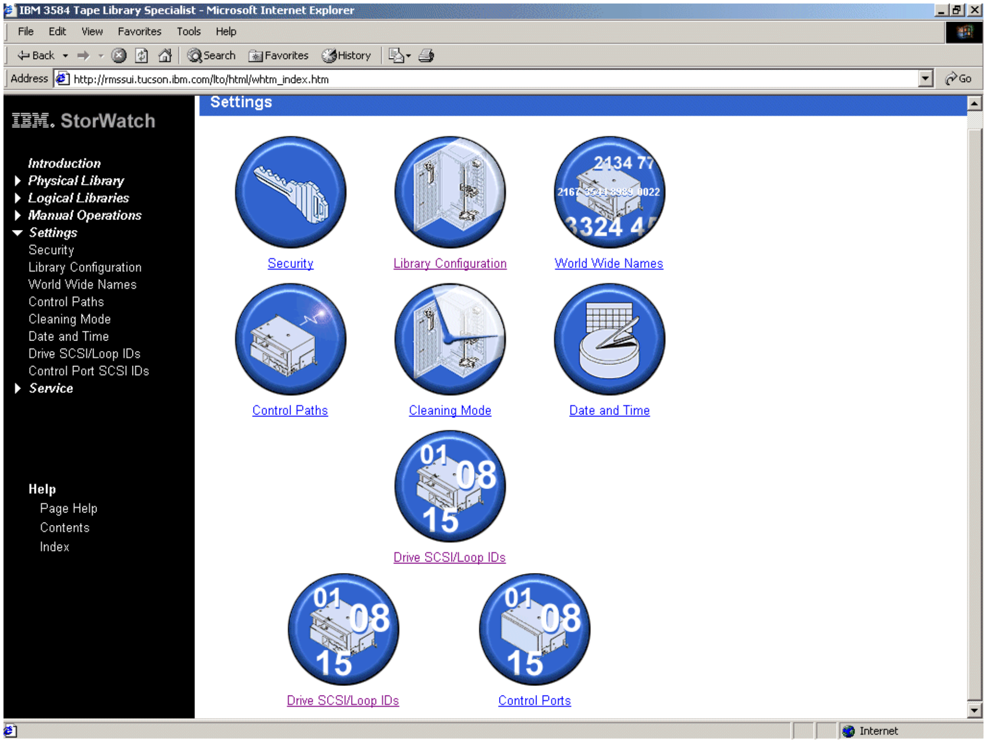

Figure 2-96 3584 Specialist: library settings panel

A password is required to access some functions of the Specialist, such as firmware update and the modification of the library configuration.

2.5 Updating library, drive and RMU firmware

Once you have completed the physical installation of the LTO library or drive, we recommend that you check for any higher level of firmware for the LTO drive, the LTO library and the optional Remote Management Unit (RMU), before beginning to use the devices.

It is not mandatory to upgrade the microcode, but it is a good habit to check from time to time for available updates at the IBM web site, to see if any new code has more support functions or has solved problems. To upgrade the installed microcode level of your library, refer to the appropriate Operator Guide for your library or drive. These are listed in Appendix , “Related publications” on page 445. In our example, we describe the procedures to check and update the library and drive microcode for a 3583 Ultrium Scalable Tape Library.

First, check the installed microcode level from the 3583 operator panel:

- for the library code, select **More -> About**. The *Version* field displays the microcode level
- for the drive code, select **Status -> Drives**. The *Version* field displays the microcode level

To check for microcode updates, use the following links:

3580

http://ssddom02.storage.ibm.com/tape/lto/tape_drive/firmware.html

3581

http://ssddom02.storage.ibm.com/tape/lto/autoloader/firmware.html

3583

http://ssddom02.storage.ibm.com/tape/lto/scalable_library/firmware.html

3584
http://ssddom02.storage.ibm.com/tape/lto/ultrascalable_library/firmware.html

or

ftp://ftp.software.ibm.com/storage/358x/

Here you can find the latest microcode releases for the LTO library, drives and RMU.

For the library microcode, use the compressed file *a*ppcode.exe for Windows systems or appcode.tar for Unix systems, it contains the Vn_n_n.lif file that is the microcode image file to upload in the library. For the drive code, download the latest *.fmr* file.

2.5.1 How to update the firmware

You can use the following methods to update the firmware:

- Using the Remote Management Unit (RMU) through the StorWatch Specialist
- Using the SCSI bus
- Using the Field Microcode Replacement (FMR) tape (drive firmware only)
- Using the library serial port (library firmware - only done by the IBM Customer Engineer)
- Using the 3583 Integrated SAN Data Gateway module (optional)

You can find detailed instructions on how to update the firmware at the following link:

`http://SSDDOM01.storage.ibm.com/techsup/swtechsup.nsf/support/ultriumfirmware`

or in the relevant library Setup and Operator Guide.

If the 3583 library has the optional SAN Data Gateway module installed you can update the firmware for this device using the gateway itself. For more information, see *IBM Storage Area Network Data Gateway Module Setup, Operator and Service Guide*, *GA32-0436*.

> **Note:** Before updating firmware on the drives, the library, or the RMU, vary the library OFFLINE to ALL attached hosts.

As an example, we describe next a practical procedure that shows the detailed e steps required to upgrade the library and drives microcode for the 3583 Ultrium Scalable Tape Library, through the SCSI bus interface using the NTUTIL utility for Windows 2000. Then we document the steps required to update the RMU code from the StorWatch Specialist panels.

2.5.2 Upgrading library firmware using NTUTIL

The following procedure describes how to update the library firmware in the 3583 Ultrium Scalable Tape Library, over the SCSI bus using the NTUTIL utility. In brackets [] you find the NTUTIL selection to use during the process.

To display the existing firmware version, on the library panel, press **More -> About**

In Figure 2-97 you can see an example of the 3583 Ultrium Scalable Tape Library display panel showing the library microcode version, 2.50.0025.

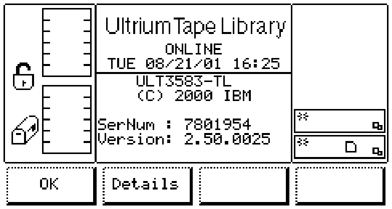

Figure 2-97 The 3583 tape library panel with the microcode level information

1. If you have an application device driver other than the IBM Ultrium native device driver, you will need to stop it and start the IBM Ultrium device driver. NTUTIL will only work with this device driver, so you will need to install it if you haven't already done so.
2. Open an NTUTIL session on a command line from the directory where the library firmware image was saved in (e.g c:\winnt\system32), by typing **NTUTIL** at a command prompt
3. Select 1 for a manual test

Example 2-12 NTUTIL main menu

```
NTutil - Copyright (c) 1997-2000 IBM Corporation

Main Menu:
Microsoft Windows 2000 version
==========

  1: Manual test
  2: Batch  test
  9: Exit ntutil

Enter selection: 1
```

4. The NTUTIL interactive menu will be displayed

Example 2-13 Manual test menu

```
manual test menu:
=======================================================================
  1: set device special file          2: display symbols
  3: set block size R/W (now !0 fixed)
  5: set return error when fail       6: set/reset trace
  7: set exit on unexpected result    8: Library Mode
=======================================================================
 20: open                            21: close
 22: read                            23: write
 24: read and display block          25: flush (buffer->media)
```

```
 26: read block id                      27: erase
 28: locate block id                    29: display block data
======================================================================
 30: write filemark(s)                  31: rewind
 32: forward space filemark(s)          33: unload
 34: reverse space filemark(s)          35: load
 36: forward space record(s)            37: return error
 38: reverse space record(s)            39: test unit ready
 43: set media parms (block size)       44: set dev parms(compression)
 46: get device information             47: restore data
 48: get medium information             49: inquiry
 50: poll registered devices
 53: space EOD                          54: display message
======================================================================
 70: system command

======================================================================
 80: Force Dump                         81: Read Dump
 82: Update MicroCode                   83: Log Sense
 84: Get Last Sense                     85: Get Version
 86: Associative/Persistent WProtect    87: Read/Write Test
 88: List registered devices            89: Get MTDevice Info
======================================================================
 99: return to main menu

======================================================================
enter selection:
```

5. Change to Library mode [8]

Example 2-14 Changing modes

```
======================================================================
enter selection: 8
Closing any open device before changing mode
Total elapsed time in seconds =     0.00
Return to continue:
```

6. Obtain the device names which will be used to set the device special file in the next step [88]

Example 2-15 List registered devices

```
enter selection: 88
Device found: Tape0 @"Scsi Port 3\Scsi Bus 0\Target Id 0\Logical Unit Id 0"
Device found: Tape1 @"Scsi Port 3\Scsi Bus 0\Target Id 1\Logical Unit Id 0"
Device found: Changer0 @"Scsi Port 3\Scsi Bus 0\Target Id 6\Logical Unit Id 0"
Total elapsed time in seconds =     0.00
```

```
Return to continue:
```

7. Select [1] set device special file. Enter the name of the tape and library path displayed in the previous step. In this example, we use Tape0 and Changer0.

Example 2-16 Set special file

```
enter selection: 1
Enter device special file (tape path) name or return for no change: tape0
Enter device special file (changer path) name, or "def" for
default lun1 changer or return for no change: changer0
Total elapsed time in seconds =    10.00
Return to continue:
```

8. Select [20] to open the tape device and medium changer. Enter (1) for Read/Write (RW) operations when prompted.

Example 2-17 Open the library and tape devices

```
enter selection: 20
Enter open mode (1) RW (2) RO: 1
special file (\\.\tape0) will be opened
special file (\\.\changer0) will be opened
analyze() called with  rc 8 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     1.00
Return to continue:
```

9. Verify the connection [49].

Example 2-18 Inquiry

```
enter selection: 49
Drive = 0, Library = 1: 1

Changer Path SCSI data:
  PortNumber 3, PathId 0
  TargetId   6, Lun    0

INQUIRY data:
  devtype(0):           08, rmb(1):           80
  ASO/ECMA/ANSI(2):     02, resp_data_fmt(3): 02
  additional_length(4): 33, reserved(5):      00
  SCSI_3(6):            20, flags(7):         00
  vendor_id (8-15): IBM
  product_id (16-31): ULT3583-TL
  Microcode Revision Level (32-35): 2.50
  vendor specific (bytes 36-55):
     32 2e 35 30 2e 30 30 32 35 20 20 20 20 20 20 20 20 20 20 01
analyze() called with  rc 1 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     2.00
```

```
Return to continue:
```

10. Now setup the library to accept the Firmware update. On the operator panel on the Library press **More -> Service -> Library -> Firmware Update**. This step is only required for the 3583. Select OK and the Library will reboot. When the library has rebooted, we can continue.
11. On NTUTIL, select [82] from the menu to update the microcode
12. Enter the name of the .fmr file. Be sure to enter the name of the file **without the .fmr extension**
13. Press enter. Do not touch the drive until the firmware load has completed. The update will take approximately ten minutes. During this time the library will reboot. The NTUTIL session will lose visibility of the library and will have to be restarted to enable communication.

Example 2-19 Update library firmware

```
enter selection: 82
Enter microcode image name (1 to 8 characters), or return to skip: V2_50_25
Drive = 0, Library = 1: 1
Image size = 1442272
Transferring 65536 image bytes, total bytes = 65536
Transferring 65536 image bytes, total bytes = 131072
Transferring 65536 image bytes, total bytes = 196608
Transferring 65536 image bytes, total bytes = 262144
Transferring 65536 image bytes, total bytes = 327680
Transferring 65536 image bytes, total bytes = 393216
Transferring 65536 image bytes, total bytes = 458752
Transferring 65536 image bytes, total bytes = 524288
Transferring 65536 image bytes, total bytes = 589824
Transferring 65536 image bytes, total bytes = 655360
Transferring 65536 image bytes, total bytes = 720896
Transferring 65536 image bytes, total bytes = 786432
Transferring 65536 image bytes, total bytes = 851968
Transferring 65536 image bytes, total bytes = 917504
Transferring 65536 image bytes, total bytes = 983040
Transferring 65536 image bytes, total bytes = 1048576
Transferring 65536 image bytes, total bytes = 1114112
Transferring 65536 image bytes, total bytes = 1179648
Transferring 65536 image bytes, total bytes = 1245184
Transferring 65536 image bytes, total bytes = 1310720
Transferring 65536 image bytes, total bytes = 1376256
Transferring 65536 image bytes, total bytes = 1441792
Transferring 480 image bytes, total bytes = 1442272
Waiting for tape device to write flash-prom
Do not touch drive until complete
analyze() called with rc 1 err 0 (ERROR_SUCCESS) data 0
```

```
Total elapsed time in seconds =   355.00
Return to continue:
```

The output has suggested that the firmware update has been successful (ERROR_SUCCESS). To verify that the firmware is installed correctly, go to the LTO tape library LCD operator console and press **More ->About**. Check to see if the information displayed is the same as the firmware version you used to update the library as shown in Figure 2-20 on page 117.

Example 2-20 Firmware version

```
(C) 2000 IBM

SerNum:xxxxxxx
Version:2.05.00025
```

2.5.3 Upgrading drive firmware using NTUTIL

The following procedure describes how to update the drive firmware, over the SCSI bus using the NTUTIL utility.

1. Download the latest library firmware from `ftp.software.ibm.com/storage/358x`,to a directory
2. If you have an application device driver other than the IBM Ultrium native device driver, you will need to stop it and start the IBM Ultrium device driver. NTUTIL will only work with this device driver, so you will need to install it if you haven't already done so.
3. Open an NTUTIL session on a command line from the directory where the library firmware image was saved in, by typing **NTUTIL** at a command prompt
4. Select manual test [1]

Example 2-21 NTUTIL main menu

```
Main Menu:
Microsoft Windows 2000 version
==========

  1: Manual test
  2: Batch  test
  9: Exit ntutil

Enter selection:
```

5. Open the device [20]

Example 2-22 Open tape device

```
enter selection: 20
Enter open mode (1) RW (2) RO: 1
special file (\\.\tape0) will be opened
analyze() called with  rc 6 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     8.00
Return to continue:
```

6. select read/write operations [1]
7. Update the microcode [82]
8. Enter the name of the .fmr file. Be sure to enter the name of the file **without the .fmr extension**
9. Press Enter. Do not touch the drive until the firmware load has completed.

Example 2-23 Update firmware

```
enter selection: 82
Enter microcode image name (1 to 8 characters), or return to skip: 16E0
Image size = 1048576
Transferring 65536 image bytes, total bytes = 65536
Transferring 65536 image bytes, total bytes = 131072
Transferring 65536 image bytes, total bytes = 196608
Transferring 65536 image bytes, total bytes = 262144
Transferring 65536 image bytes, total bytes = 327680
Transferring 65536 image bytes, total bytes = 393216
Transferring 65536 image bytes, total bytes = 458752
Transferring 65536 image bytes, total bytes = 524288
Transferring 65536 image bytes, total bytes = 589824
Transferring 65536 image bytes, total bytes = 655360
Transferring 65536 image bytes, total bytes = 720896
Transferring 65536 image bytes, total bytes = 786432
Transferring 65536 image bytes, total bytes = 851968
Transferring 65536 image bytes, total bytes = 917504
Transferring 65536 image bytes, total bytes = 983040
Transferring 65536 image bytes, total bytes = 1048576
=======================================================================
Waiting for tape device to write flash-prom
Do not touch drive until complete (Avg 45 - 50 sec)
Microcode updated, standby for the drive to initialize

analyze() called with  rc 1 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =    59.00
Return to continue:
```

10. The "rc 1 err 0 (ERROR_SUCCESS)" message will be displayed after a successful download and just above it, the instruction to exit NTUTIL and reboot the drive.

2.5.4 Upgrading RMU firmware using the StorWatch Specialist

To update the RMU firmware, use the StorWatch Specialist panels provided with the RMU unit installed.

1. Visit *ftp.software.ibm.com/storage/358x*, to download the latest drive firmware (xxxx.fmr) to a directory (it is usually called *rmucode.exe*)
2. Open the RMU web page and select the firmware tab (login if necessary). Put the library offline
3. Select **Update RMU Firmware**. Then enter the path and firmware filename or browse for the downloaded firmware file. Then select **Update Firmware**, as in Figure 2-98.

Figure 2-98 Ultrium Tape Library Specialist: updating RMU firmware

4. Check the StorWatch Ultrium Tape Library Specialist main panel for the updated RMU firmware level information after the successful completion of the operation.

3

Basic LTO setup for Linux

In this chapter we give you detailed information on the basic setup of the LTO drives and libraries on Linux. This includes:

- Device and library drivers installation
- Host Bus Adapter drivers installation

At the end of this chapter you should be able to understand and implement the tasks required to:

- Install the required device drivers
- Install and configure the required Host Bus Adapter drivers

An official statement which Linux and LTO hardware and software configurations are supported can be found in the Linux Support Matrix on:

http://www.storage.ibm.com/hardsoft/tape/3580/3580opn.html
http://www.storage.ibm.com/hardsoft/tape/3581/3581opn.html
http://www.storage.ibm.com/hardsoft/tape/3583/3583opn.html
http://www.storage.ibm.com/hardsoft/tape/3584/3584opn.html

3.1 Installing library and tape device drivers

After physically installing and connecting your LTO drive or library to your environment, the next step in the basic implementation of the LTO library and drives, is to make the devices accessible for your operating system.

In Linux you have the choice of using the IBM Ultrium drivers or the native Linux drivers to access the tape drive and library devices.

The IBM Ultrium tape and medium changer device drivers are designed specifically to take advantage of the features provided by the IBM Ultrium tape drives and medium changer devices. This means that you should use the IBM Ultrium device drivers wherever this is possible. Nevertheless you can use the Linux native drivers when it is required for your solution. The examples in the chapters on NetVault Bakbone, Chapter 8, “Configuring BakBone NetVault on Windows 2000 and Linux” on page 343 and Arkeia, Chapter 10, “Configuring Arkeia on Linux” on page 399, in this Redbook worked perfectly using the native Linux device drivers.

> **Note:** Some applications may require you to install and use their own device drivers. Follow the specific instructions for the application software that you are installing to determine which type of device drivers are suitable for your installation.

In the following we will show how to give access to the functions required for basic tape operations (such as backup and restore) and medium changer operations (such as cartridge mount and dismount).

For more information and specific installation instructions, refer to *IBM Ultrium Device Drivers: Installation and User's Guide,* GA32-0430. In addition there are several files in the IBM device driver download directory under

ftp://ftp.software.ibm.com/storage/devdrvr/Linux/

that provide up to date information regarding the use of IBM Ultrium tape drives and libraries with Linux. We recommend to read at least **IBMtape_Ultrium.ReadMe**, **IBMtape.fixlist**, and **LinuxLimitations.htm**. The files **IBMtapeutil.ReadMe**, **IBMtapeutil.fixlist** contain additional information for the users of **IBMtapeutil**.

The device drivers allow the operating system and the application software to manage tape devices and medium changer to automate the use of the tape media. The tape devices and medium changer are managed using a *special device file name*, that is the name used to address each operation (mount, dismount, write, read) to the tape or media changer device.

In our examples we used SuSE Linux 7.2 and Red Hat Linux 7.1 but the tools and methods are independent of the specific Linux distribution. With both distributions we used a 2.4.13 kernel. For the examples using the IBM Ultrium device driver, kernel 2.4.2-2 is required.

In the following section, we describe the built-in device drivers of the Linux kernel and the naming conventions for the Linux device file names. We will use a direct attached 3583 LTO library with two drives direct attached to an Adaptec SCSI controller as shown in Figure 3-1.

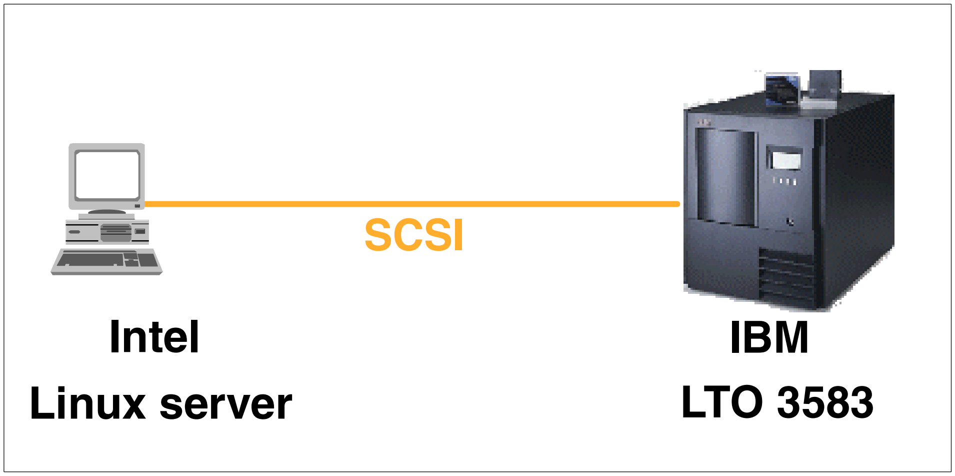

Figure 3-1 Linux SCSI lab environment

3.1.1 Native Linux device drivers

Basic support for SCSI devices has been available as part of the Linux kernel for several years. Typically the driver for the SCSI controller of a Linux system is already compiled into the Linux kernel and therefore available for use. This allows the Linux kernel to continue the boot process from a device connected to the SCSI controller after the kernel has been loaded and started from the Linux boot loader.

During startup the Linux kernel scans the SCSI busses of all available adapters and recognizes the disk and tape devices that are connected and accessible. As a result of this process every disk and tape device that has been recognized by the kernel will be accessible through a device file in the directory **/dev**. The concept of device files is common to all UNIX variants but every UNIX variant has its own naming conventions. Under Linux every SCSI bus is scanned from low to high SCSI IDs and the devices found are assigned to the device files in **/dev** in an ascending order. Disk devices are assigned to the device files **/dev/sda**, **/dev/sdb**, etc.. Tape devices are assigned to the device files **/dev/st0**,

/dev/st1, etc.. Additional device files provide access the same physical devices but result in a different behavior. For tape devices the device files **/dev/st?** will cause a rewind whenever the device file is closed. The device files following the naming convention **/dev/nst?** represent non rewinding devices. These devices will keep the tape in the position where it stopped after the last operation. Additional information can be found under the man pages for **st** and in the file **README.st** in the kernel sourcecode.

In addition to the device files mentioned before, *every* SCSI device detected by the kernel will be represented by a *generic* device file. This includes not only device types that are recognized by the kernel, such as disk and tape devices, but also every device that answers to an inquiry command on the SCSI bus. Generic devices are represented by the device files **/dev/sg0**, **/dev/sg1**, etc. For all device types that are recognized by the kernel, this device file exists in addition to the regular device file. For all device types that are not otherwise recognized by the kernel, this entry is the only device file representing the physical device. Additional information about the Linux generic device interface and the source code for a number of useful tools can be found at:

http://www.torque.net/sg/

The native drivers for tape devices as provided by the Linux kernel support basic read and write operations on IBM Ultrium tape drives via the **/dev/st?** and **/dev/nst?** device files. The medium changer device can be accessed via its **/dev/sg?** representation. Later in this chapter we will discuss additional device naming concepts that are available with Linux. Table 3-1 gives an overview of the possible device names on Linux. The middle column shows the device names which will be used if the **scsidev** utility is installed. We discuss this in 3.1.10, “Alternative device file names in Linux” on page 141.

Table 3-1 Special device file names used with Linux

	Native Linux device drivers	Native Linux device drivers with scsidev	IBM Ultrium device drivers
Medium changer	/dev/sg[0-32]	/dev/scsi/sgh0-0c0i1l0	/dev/IBMchanger[0-32]
Tape device	/dev/st[0-32] /dev/nst[0-32] /dev/sg[0-32]	/dev/scsi/sth0-0c0i1l0 /dev/scsi/nsth0-0c0i1l0 /dev/scsi/sgh0-0c0i1l0	/dev/IBMtape[0-32] /dev/IBMtape[0-32]n

While the Linux device support for SCSI devices is generally included in the kernel sources, some installations do not include the generic device utilities. This means the operating system will be missing some commands like **sg_scan**. If this is the case, download the package **sg3_utils-0.95.tgz** from the website mentioned above. The utilities can be installed as shown in Example 3-1. These tools will provide a convenient way to identify our library and tape drives later in this chapter.

Example 3-1 Installing the utilities related to Linux generic SCSI device support

```
[root@diomede /root]# tar xzf sg3_utils-0.95.tgz

[root@diomede /root]# cd sg3_utils-0.95

[root@diomede sg3_utils-0.95]# make
gcc -g -O2 -Wall -D_REENTRANT   -c -o sg_simple1.o sg_simple1.c
gcc -g -O2 -Wall -D_REENTRANT   -c -o sg_err.o sg_err.c
(...)
gcc -o scsi_devfs_scan  scsi_devfs_scan.o sg_err.o
gcc -g -O2 -Wall -D_REENTRANT   -c -o sg_start.o sg_start.c
gcc -o sg_start  sg_start.o
[root@diomede sg3_utils-0.95]#

[root@diomede sg3_utils-0.95]# make install
install -d //usr/local/bin
for name in sg_simple1 sg_simple2 sg_simple3 sg_dd sg_debug sg_scan
scsi_inquiry sg_rbuf sginfo sg_readcap sgp_dd sg_map sg_turs isosize sg_inq
sg_test_rwbuf scsi_devfs_scan sg_start; \
 do install -s -o root -g root -m 755 $name //usr/local/bin; \
done
for mp in sg_dd.8 sgp_dd.8 sg_map.8 sg_rbuf.8 isosize.8; \
 do install -o root -g root -m 644 $mp //usr/local/man/man8; \
 gzip -9f //usr/local/man/man8/$mp; \
done
```

3.1.2 Identifying and activating the SCSI controller

In most cases your Linux distribution will provide a kernel that automatically configures the most common SCSI adapters without requiring further configuration. This section describes how to identify and set up a SCSI adapter if it is not already supported by the kernel. In 3.3, “Linux Fibre Channel HBA installation” on page 152 we will use the same procedure to make a Fibre Channel HBA available to the system.

In the first step we will check if the adapter is visible on the SCSI bus of the system. For this purpose we use a tool called **lspci**. If **lspci** is not part of your Linux distribution it can be downloaded from:

http://atrey.karlin.mff.cuni.cz/~mj/pciutils.html

As shown in Example 3-2, the command **lspci** creates a listing of all PCI devices visible to our Linux system.

Example 3-2 Output of **lspci** *showing PCI devices including our SCSI adapter*

```
[root@diomede /root]# lspci
00:00.0 Host bridge: Intel Corporation 440BX/ZX - 82443BX/ZX Host bridge (rev
03)
00:01.0 PCI bridge: Intel Corporation 440BX/ZX - 82443BX/ZX AGP bridge (rev 03)
00:02.0 ISA bridge: Intel Corporation 82371AB PIIX4 ISA (rev 02)
00:02.1 IDE interface: Intel Corporation 82371AB PIIX4 IDE (rev 01)
00:02.2 USB Controller: Intel Corporation 82371AB PIIX4 USB (rev 01)
00:02.3 Bridge: Intel Corporation 82371AB PIIX4 ACPI (rev 02)
00:03.0 Ethernet controller: Intel Corporation 82557 [Ethernet Pro 100] (rev
05)
00:10.0 SCSI storage controller: Adaptec 7892A (rev 02)
01:01.0 VGA compatible controller: S3 Inc. Trio 64 3D (rev 01)
```

The result of **lspci** shows that an Adaptec 7892A SCSI controller is available in the system (second line from the bottom). Linux reports the type of the controller and not the product name which is in our case an Adaptec 29160 LVD adapter. If the adapter is not recognized during system startup (and is therefore not reported in the **lspci** output), we have to either activate the appropriate module or to install a kernel that includes support for this adapter. If we assume that our Linux distribution contains no precompiled modules or kernel that includes the required SCSI support, we have to compile and install a new kernel with the appropriate support.

Note: We will not describe the procedure of configuring, compiling and installing a Linux kernel in detail. This topic is covered by the manuals of the Linux distribution and the Linux Kernel HOWTO. The Linux Kernel-HOWTO can be found at:

http://www.linuxdoc.org/HOWTO/Kernel-HOWTO.html

The initial configuration of the kernel sources may not be identical with the kernel that is actually running. Therefore it is important to check that all the drivers required by the current system environment are really activated.

From the kernel source directory (which is usually **/usr/src/linux**) we can configure a new kernel using the **make xconfig** command. If the environment is not running XWindows, use **make menuconfig** or **make config** instead. The kernel configuration window will open as shown in Figure 3-2.

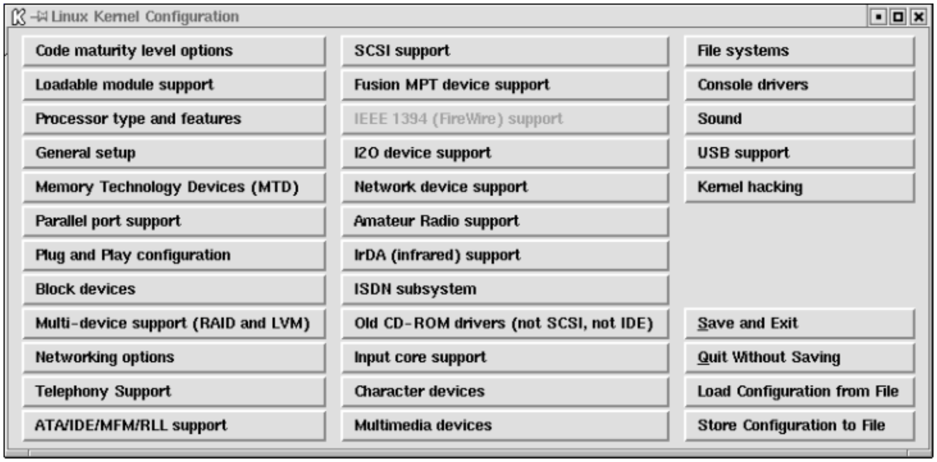

Figure 3-2 Kernel configuration main window

To activate support for our SCSI controller and devices we select the menu entry **`SCSI support`**. The SCSI configuration window will offer the options seen in Figure 3-3.

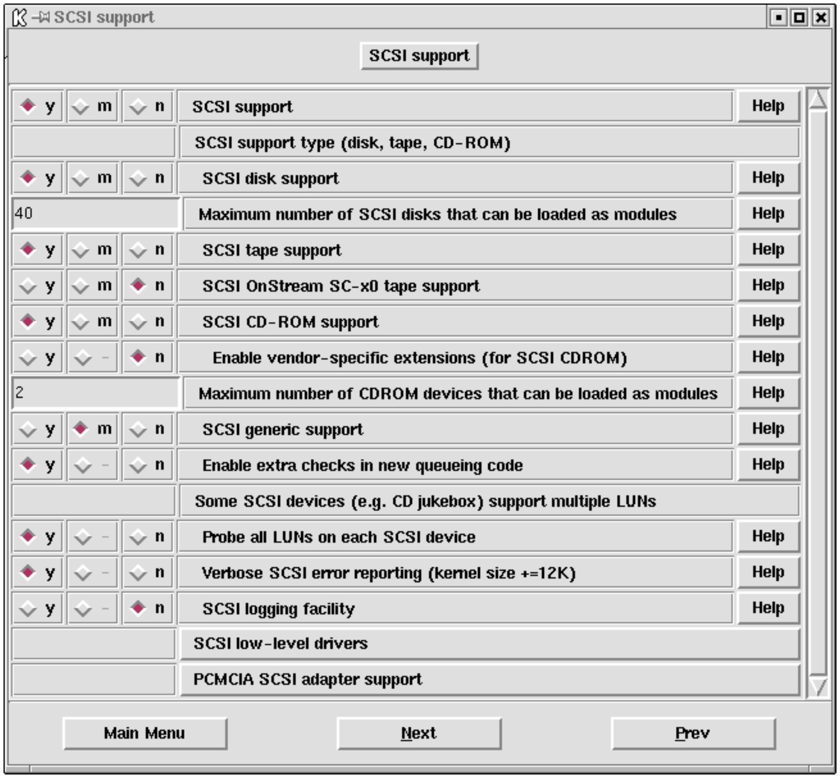

Figure 3-3 Configuration example for SCSI disk, tape and generic device support

The first entry enables SCSI support in general. All types of devices we want to access at boot time or before the kernel module support is available should be compiled into the kernel, that is, disk, tape and CD-ROM. For these devices we select ’y’. It is important that all drivers that are required to access the boot devices and boot file systems are compiled into the kernel. Most of the other kernel features can be configured as modules selecting ’m’. We recommend activating the feature **`Probe all LUNs on each SCSI device`**. This is especially important with the 3584 Library where the changer device appears as LUN 1 on the same SCSI ID as the first tape drive. It is also important in SAN environments where device addressing via LUNs is standard. If **`Probe all LUNs on each SCSI device`** is not enabled at kernel compile time it can be activated later via kernel or module parameter. Probing for 8 LUNs can be activated by the parameter

```
max_scsi_luns=8
```

which has to be present as a kernel parameter if the driver is compiled into the kernel. If the driver is loaded as a module, LUN probing can be activated by the following line in **`/etc/modules.conf`**:

```
options scsi_mod max_scsi_luns=8
```

The menu entry **`SCSI low level drivers`** brings up the configuration window for the SCSI adapters that are supported by the Linux kernel as shown in Figure 3-4. Here we activate the support for our Adaptec SCSI controller.

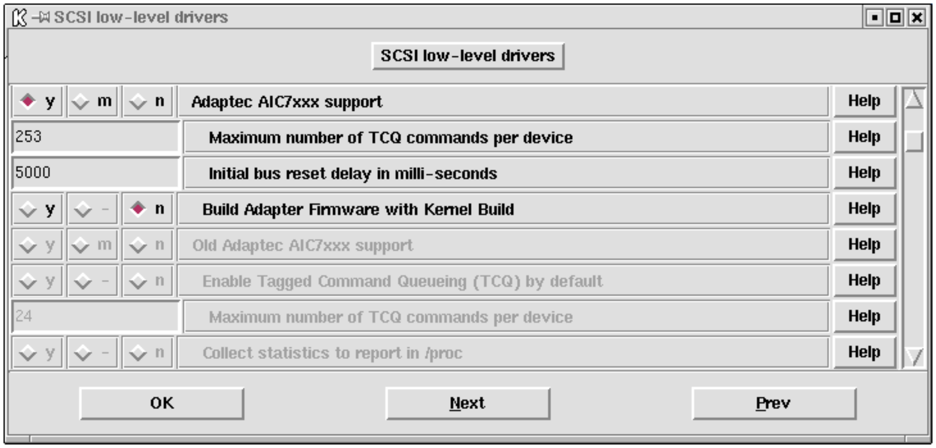

Figure 3-4 Kernel configuration for the Adaptec SCSI controller

Having completed the SCSI setup we are now ready to compile and install a new kernel. It is strongly recommended to review all kernel settings before doing this, to ensure that the entire setup of the new kernel matches the actual system environment. In addition it is a good idea, when compiling a new kernel, to save the old kernel in a way that allows the machine to reboot even if the new kernel fails.

3.1.3 Kernel compilation and installation checklist

We do not describe kernel configuration and installation in detail but provide this short checklist that should serve as a reminder of the individual steps in the process.

- **`cd /usr/src/linux*`**

  Go to the directory where the kernel version resides that we want to configure and install.

- **`make clean`** or **`make mrproper`**

  Throw away everything that remains from previous kernel builds that may interfere with the new kernel build. The command **`make mrproper`** can be used to clean up the kernel sources completely. It will also remove a previous kernel configuration!

- **`make xconfig &`**

  Configure the new kernel. Equivalent commands are **`make menuconfig`** and **`make config`** at an ASCII terminal.

- **`make dep`**

  Analyze dependencies for the newly configured kernel.

- **`make bzImage`**

  Create a compressed image of the new kernel.

- **`make modules`**

  Create the modules that have been selected during kernel configuration.

- **`make modules_install`**

  Install the modules generated by the previous step.

- **`cp arch/i386/boot/bzImage /boot/<ourkernelname>`**

  Copy the kernel image into the **`/boot`** directory and rename it to the appropriate name **`<ourkernelname>`**. The file **`/etc/lilo.conf`** should contain an entry that references **`<ourkernelname>`**.

- **`mkinitrd -f -v /boot/<ramdiskimg> 2.4.2-2`**

  If our boot process uses an initial ramdisk we should create a new image **`/boot/<ramdiskimg>`** for this ramdisk. Any changes to the modules and to **`/etc/modules.conf`** should be done before this step. The exact command depends on the version of our new kernel.

- **`lilo`**

  Create a new bootsector. If we want to have an emergency boot kernel available it should be configured in **`/etc/lilo.conf`** in addition to the new kernel. We are now ready to boot with the new kernel unless we want to boot our Linux system from a Windows NT or Windows 2000 boot menu. In this case the two following steps are also required.

- **`if=/dev/<ourbootdiskorpart> of=/<ourbootsect> bs=512 count=1`**

  Write the content of the bootsector on the bootdisk or partition **`/dev/<ourbootdiskorpart>`** to the file **`/<ourbootsect>`**.

- **`cp /<ourbootsect> /<ourwinbootdisk>`**

  Copy the file **`/<ourbootsect>`** containing the bootsector to the Windows boot disk **`/<ourwinbootdisk>`**. This assumes that the Windows boot menu has been edited to include a boot entry for Linux previously.

Following this checklist we prepare our Linux system for the reboot with a new kernel. As soon as the system is running with the new kernel we are able to access the IBM LTO Ultrium tape and library devices as shown in the next section.

3.1.4 Identifying and accessing the LTO device

When the driver for our SCSI controller is compiled into the kernel of our Linux system and the library is correctly attached to the SCSI controller, we will see messages similar to Example 3-3 while the system is booting or if we issue the **dmesg** command after boot. Note that at this stage we have not installed the IBM Ultrium device driver - we are simply using native Linux utilities and drivers.

Example 3-3 Detecting LTO tape drives and library during system boot

```
[root@diomede /root]# dmesg
(...)
SCSI subsystem driver Revision: 1.00
PCI: Found IRQ 10 for device 00:10.0
(scsi0) <Adaptec AIC-7892 Ultra 160/m SCSI host adapter> found at PCI 0/16/0
(scsi0) Wide Channel, SCSI ID=7, 32/255 SCBs
(scsi0) Downloading sequencer code... 396 instructions downloaded
scsi0 : Adaptec AHA274x/284x/294x (EISA/VLB/PCI-Fast SCSI) 5.2.4/5.2.0
       <Adaptec AIC-7892 Ultra 160/m SCSI host adapter>
  Vendor: IBM       Model: ULT3580-TD1       Rev: 16E0
  Type:   Sequential-Access                  ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3580-TD1       Rev: 16E0
  Type:   Sequential-Access                  ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3583-TL        Rev: 2.50
  Type:   Medium Changer                     ANSI SCSI revision: 02
(...)
st: bufsize 32768, wrt 30720, max init. buffers 4, s/g segs 16.
Attached scsi tape st0 at scsi0, channel 0, id 0, lun 0
Attached scsi tape st1 at scsi0, channel 0, id 1, lun 0
```

In our case the SCSI driver reports two tape drives of type ULT3580-TD1 and one device for the tape library, ULT3583-TL. The Ultrium tape drives are recognized as tape devices and made available under **/dev/st0** and **/dev/st1**. The media changer will be accessible as a generic SCSI device.

To identify the correct **/dev/sg?** device file for the changer device we can use the information from the **/proc** directory. using the **device_strs** command.

Example 3-4 Identifying the generic device that represents the Ultrium library

```
[root@diomede /root]# cat /proc/scsi/sg/device_strs
IBM             ULT3580-TD1             16E0
IBM             ULT3580-TD1             16E0
```

```
IBM            ULT3583-TL             2.50
```

The IBM Ultrium tape library appears in line three and should therefore be accessible as **/dev/sg2** (**/dev/sg0** is the first device and would in this case represent the first tape drive).

With the **sg_scan** command (from the **sg** utilities we installed in Example 3-1 on page 125) we get a more detailed list of generic SCSI devices which we see in Figure 3-5.

Example 3-5 Listing generic SCSI devices using **sg_scan**

```
[root@diomede /root]# sg_scan -i
/dev/sg0: scsi0 channel=0 id=0 lun=0  type=1
    IBM       ULT3580-TD1       16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg1: scsi0 channel=0 id=1 lun=0  type=1
    IBM       ULT3580-TD1       16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg2: scsi0 channel=0 id=6 lun=0  type=8
    IBM       ULT3583-TL        2.50 [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
```

Tools like **scsi_info** or **scsiinfo** may be used to retrieve and check device information.

Example 3-6 Retrieving device information with **scsi_info**

```
[root@diomede /root]# scsi_info /dev/sg2
SCSI_ID="0,6,0"
MODEL="IBM ULT3583-TL"
FW_REV="2.50"
```

Example 3-7 Retrieving device information with **scsiinfo**

```
[root@diomede /root]# scsiinfo -i /dev/sg2

Inquiry command
---------------
Relative Address                  0
Wide bus 32                       0
Wide bus 16                       0
Synchronous neg.                  0
Linked Commands                   0
Command Queueing                  0
SftRe                             0
Device Type                       8
Peripheral Qualifier              0
Removable?                        1
Device Type Modifier              0
ISO Version                       0
ECMA Version                      0
```

```
ANSI Version                   2
AENC                           0
TrmIOP                         0
Response Data Format           2
Vendor:                    IBM
Product:                   ULT3583-TL
Revision level:            2.502.50.0025
```

3.1.5 The mtx driver

A set of low level driver utilities, known as **mtx**, is available to control features of SCSI backup related devices such as autoloaders, tape changers, media jukeboxes, and tape drives. These utilities can also report data including serial numbers, maximum block sizes, and messages from the tape drives. They are designed to be a low level driver for use in larger scripted backup solutions, rather than a high level interface to the SCSI devices that it controls. In our context this utility set is very useful for checking the basic operation of the LTO Ultrium tape library.

We download and install the latest mtx version from:

http://mtx.sourceforge.net/

The source code comes as a compressed tar-file and can be unpacked and installed as shown in Example 3-8.

Example 3-8 Unpacking and installing mtx

```
[root@bonnie /root]# tar xzf mtx-1.2.13.tar.gz

[root@bonnie /root]# cd mtx-1.2.13

[root@bonnie mtx-1.2.13]# ./configure
creating cache ./config.cache
checking host system type... i686-pc-linux-gnu
checking target system type... i686-pc-linux-gnu
checking build system type... i686-pc-linux-gnu
checking for gcc... gcc
(...)
updating cache ./config.cache
creating ./config.status
creating Makefile
creating config.h
config.h is unchanged

[root@bonnie mtx-1.2.13]# make
gcc -g -O2 -Wall -DVERSION="\"1.2.13\"" -I/usr/src/linux/include
-DLONG_PRINT_REQUEST_SENSE=1  -c -o mtx.o mtx.c
```

```
(...)
gcc -g -O2 -Wall -DVERSION="\"1.2.13\"" -I/usr/src/linux/include
-DLONG_PRINT_REQUEST_SENSE=1  -c -o scsitape.o scsitape.c
scsitape.c:99: warning: `PeripheralDeviceType' defined but not used
gcc  -o scsitape scsitape.o mtxl.o

[root@bonnie mtx-1.2.13]# make install
for file in mtx tapeinfo loaderinfo scsitape; do \
strip $file;    \
done
/usr/bin/install -c -m 755 -d /usr/local/sbin
/usr/bin/install -c -m 755 mtx tapeinfo loaderinfo scsitape /usr/local/sbin
/usr/bin/install -c -m 755 -d /usr/local/man /usr/local/man/man1
/usr/bin/install -c -m 644 mtx.1 tapeinfo.1 scsitape.1 loaderinfo.1
/usr/local/man/man1
```

Now we have the **mtx** command available and can have a closer look on our LTO Ultrium tape library. We use the **status** subcommand of **mtx** to get detailed status information from our LTO Ultrium tape library. Immediately after system startup or whenever cartridges have been put into or taken out of the library we recommend issuing an **inventory** subcommand via **mtx** to be sure that the information we get from the **status** subcommand is correct.

Example 3-9 Using **mtx** *to get a detailed inventory of the LTO Ultrium tape library*

```
bonnie:/usr/src/linux # mtx -f /dev/sg2 status
  Storage Changer /dev/sg2:2 Drives, 54 Slots ( 12 Import/Export )
Data Transfer Element 0:Empty
Data Transfer Element 1:Empty
      Storage Element 1:Empty
      Storage Element 2:Empty
      Storage Element 3:Empty
      Storage Element 4:Empty
      Storage Element 5:Empty
      Storage Element 6:Empty
      Storage Element 7:Full :VolumeTag=ABA927L1
      Storage Element 8:Empty
      Storage Element 9:Empty
      Storage Element 10:Empty
      Storage Element 11:Empty
      Storage Element 12:Empty
      Storage Element 13:Empty
      Storage Element 14:Full :VolumeTag=ABA926L1
      Storage Element 15:Empty
(...)
      Storage Element 39:Empty
      Storage Element 40:Full :VolumeTag=ABA928L1
      Storage Element 41:Full :VolumeTag=ABA990L1
      Storage Element 42:Full :VolumeTag=ABA922L1
```

```
     Storage Element 43 IMPORT/EXPORT:Empty
(...)
     Storage Element 54 IMPORT/EXPORT:Empty
```

The result shows that our tape library has two tape drives and 54 storage elements for cartridges. Twelve of the storage elements (numbers 43 to 54) are part of the IMPORT/EXPORT unit. The tape drives are designated as *Data Transfer Elements*. In addition, the command output shows which storage elements contain cartridges and the labels found on these cartridges.

Apart from the subcommands **inventory** and **status** that request information from the library, **mtx** will allow us to move cartridges in the library. The subcommand **load** allows to load a tape into a tape drive. In Example 3-10 we insert the cassette from storage element 41 into the second drive.

Example 3-10 Using **mtx** *to insert a tape into the tape drive*

```
[root@diomede /root]# mtx -f /dev/sg2 load 41 1
```

Now we are ready to use the second tape drive **/dev/st1** for read or write operations on the tape. Programs like **tar**, **cpio** or **mt** can be used to work with the tape drive. At the time of writing this book the **dump** utility is not recommended due to performance and reliability problems.

We have to unload the tape drive as shown in Figure 3-11 before we can move the tape back to the storage element

Example 3-11 Using **mt** *to unload a tape from the tape drive*

```
[root@diomede /root]# mt -f /dev/st1 offline
```

Finally we can move the tape back to its storage element using the **unload** subcommand(Example 3-12).

Example 3-12 Using **mtx** *to remove a tape from the tape drive*

```
[root@diomede /root]# mtx -f /dev/sg2 unload 41 1
Unloading Data Transfer Element into Storage Element 41...done
```

Another useful command from the **mtx** package is **loaderinfo**. Example 3-13 shows the information that **loaderinfo** retrieves from the 3583 LTO library.

Example 3-13 Using **loaderinfo** *to retrieve information from the LTO library*

```
[root@diomede /root]# loaderinfo -f /dev/sg2
Product Type: Medium Changer
Vendor ID: 'IBM     '
Product ID: 'ULT3583-TL      '
Revision: '2.50'
```

```
Attached Changer: No
Bar Code Reader: Yes
EAAP: Yes
Number of Medium Transport Elements: 1
Number of Storage Elements: 42
Number of Import/Export Element Elements: 12
Number of Data Transfer Elements: 2
Transport Geometry Descriptor Page: Yes
Invertable: No
Device Configuration Page: Yes
Can Transfer: Yes
```

The **loaderinfo** command provides some additional information about the features of the library, such as the availability of a barcode reader.

For some operations **mt** and **mtx** may return before the device really finished its operation. If this happens it is important to wait until the device operation has finished before the next command starts. If a tape or library command fails it is a good idea to retry the command after waiting for a few seconds.

3.1.6 Identification and correct implementation of mt

Linux provides the standard **mt** command to control most aspects of tape operation except writing and reading data from the tape. For example, you can use **mt** to position the tape, set parameters, or request status information. Depending on the Linux distribution and installation there are two different implementations of **mt** available. One of them is **GNU mt**, the other one is called **mt-st**. We strongly recommend using **mt-st** because it has been developed specifically for the operation of SCSI tape devices on Linux and offers a comprehensive set of commands that is not available with **GNU mt**. Sometimes both **mt** implementations are installed. In this case the **mt-st** version may be available as the command **mtst**. If this is the case we recommend deinstalling the **GNU mt** command and making a symbolic link to the **mtst** command.

The source code for the latest version of **mt-st** can be downloaded from:

ftp://metalab.unc.edu/pub/Linux/system/backup/

Example 3-14 shows how both implementations of mt can be identified. The two systems, BONNIE and DIOMEDE each have a different version of the commands. You can see that they also use different syntax.

Example 3-14 Identifying which **mt** *implementation is installed*

```
[root@diomede /root]# mt -v
mt-st v. 0.5b

bonnie:~ # mt -v
```

```
mt: invalid option -- v
Usage: mt [-V] [-f device] [--file=device] [--help] [--version] operation
[count]

bonnie:~ # mt --version
GNU mt version 2.4.2
```

In the previous section (Example 3-11) we showed how a tape can be unloaded from the drive using the **mt** command. In Section 3.1.8, “Working with user defined block sizes” on page 139 and Section 3.1.9, “Controlling hardware compression” on page 140 we will provide some additional examples using **mt**.

3.1.7 Module and kernel parameters for the Linux tape driver

Up to this point we have used the native Linux tape drivers with the default setup provided by our Linux system. There are several way to modify the behavior of the Linux tape device driver and the tape drives. Some of them can be changed via module or kernel parameters, others can be controlled using subcommands of **mt**.The buffers of the Linux tape device driver can be specified by module or kernel parameters.

If the Linux tape device driver is loaded as a module the following parameters are available:

```
buffer_kbs=xxx              the buffer size in kilobytes is set to xxx
write_threshold_kbs=xxx     the write threshold in kilobytes is set to xxx
max_buffers=xxx             the maximum number of tape buffer is set to xxx
```

Note that if the buffer size is changed but the write threshold is not set, the write threshold is set to the new buffer size - 2 kB. To optimize the buffer settings for your specific application it may be necessary to do some benchmarking with different settings.

If the Linux tape device driver is compiled into the kernel the same parameters can be provided to the kernel, for example via the LILO configuration file - **/etc/lilo.conf**. The keywords are the same as when loading the driver as a module. If several parameters are set, the keyword-value pairs are separated with a comma (no spaces allowed). A colon can be used instead of the equals sign. The definition is prefixed by the string **st=**. Example 3-15 shows how kernel parameters for the Linux tape device driver are defined in **/etc/lilo.conf**.

Example 3-15 **/etc/lilo.conf** *with kernel parameters that define larger tape buffers*

```
boot=/dev/hda1
map=/boot/map
install=/boot/boot.b
prompt
```

```
timeout=50
message=/boot/message
linear
default=linux

image=/boot/vmlinuz-2.4.13
   label=linux
   read-only
   root=/dev/hda7
   append="max_scsi_luns=128 st=buffer_kbs:256,write_threshold_kbs:64"
```

After a reboot of the Linux system we can see if our changes to the tape buffer settings have been successful. During startup and in the information displayed by **dmesg** we should see that the new buffer settings are active as shown in Example 3-16. Compare the new value for *wrt* with the default shown in Example 3-3 on page 131.

Example 3-16 Boot messages with modified SCSI tape buffer settings

```
[root@diomede /etc]# dmesg
(...)
SCSI subsystem driver Revision: 1.00
PCI: Found IRQ 10 for device 00:10.0
scsi0 : Adaptec AIC7XXX EISA/VLB/PCI SCSI HBA DRIVER, Rev 6.2.1
        <Adaptec 29160 Ultra160 SCSI adapter>
        aic7892: Ultra160 Wide Channel A, SCSI Id=7, 32/255 SCBs

  Vendor: IBM       Model: ULT3580-TD1       Rev: 16E0
  Type:   Sequential-Access                  ANSI SCSI revision: 03
(scsi0:A:0): 80.000MB/s transfers (40.000MHz, offset 23, 16bit)
  Vendor: IBM       Model: ULT3580-TD1       Rev: 16E0
  Type:   Sequential-Access                  ANSI SCSI revision: 03
(scsi0:A:1): 80.000MB/s transfers (40.000MHz, offset 23, 16bit)
  Vendor: IBM       Model: ULT3583-TL        Rev: 2.50
  Type:   Medium Changer                     ANSI SCSI revision: 02
st: Version 20011003, bufsize 262144, wrt 65536, max init. bufs 4, s/g segs 16
Attached scsi tape st0 at scsi0, channel 0, id 0, lun 0
Attached scsi tape st1 at scsi0, channel 0, id 1, lun 0
Attached scsi generic sg2 at scsi0, channel 0, id 6, lun 0,  type 8
(...)
```

Note that the value for **write_threshold_kbs** has been set only for demonstration purposes and does not represent a typical value for real use.

The buffer settings for the Linux tape device driver are the only tape related parameters that can be set by module or kernel parameters. Some additional parameters of the device driver and several parameters of the tape device can be modified via the **mt** command.

3.1.8 Working with user defined block sizes

To optimize tape performance it will often be useful to define a blocksize that is larger than the 1024 bytes that are predefined by the default settings. Before we change any parameters we will have a look on the initial settings. Example 3-17 shows a status request to our first tape drive.

Example 3-17 Requesting the status from **/dev/st0**

```
[root@diomede /etc]# mt -f /dev/st0 status
SCSI 2 tape drive:
File number=0, block number=0, partition=0.
Tape block size 1024 bytes. Density code 0x40 (unknown to this mt).
Soft error count since last status=0
General status bits on (41010000):
 BOT ONLINE IM_REP_EN
```

We can see that the block size is set at 1024 bytes. One of the status bits indicates that the tape drive is **ONLINE** which means that there is a tape mounted in the drive. **BOT** indicates that the drive is at the beginning of the tape. With the **mt** command shown in Example 3-18 we change the blocksize to 32 kbytes.

Example 3-18 Setting the tape block size with **mt**

```
[root@diomede /root]# mt -f /dev/st0 setblk 32768
```

As we see in Example 3-19, the following status request shows the change of the tape block size. Note that this change only applies until the system is rebooted - the easiest way to make it permanent is to put the **mt** command into a startup file.

Example 3-19 .Using **mt** *to check if the block size was changed successfully*

```
[root@diomede /root]# mt -f /dev/st0 status
SCSI 2 tape drive:
File number=0, block number=0, partition=0.
Tape block size 32768 bytes. Density code 0x40 (unknown to this mt).
Soft error count since last status=0
General status bits on (41010000):
 BOT ONLINE IM_REP_EN
```

Now we can use the tape drive with the new blocksize. In Example 3-20 we write to the tape with the **tar** command. Note that the blocksize for the **tar** command has to be specified according to our tape block size definition. The **-b** parameter of **tar** specifies the blocksize in 512 byte units.

Example 3-20 Writing 32 kbyte blocks with **tar**

```
[root@diomede /root]# tar -b 64 -cf /dev/st0 /usr
tar: Removing leading `/' from member names
```

3.1.9 Controlling hardware compression

In some situations, for example when storing already compressed material like audio or video files it may be useful to switch off the built-in compression of the LTO Ultrium tape drive. In Example 3-21 we show the output of the **tapeinfo** command. The **tapeinfo** command is the equivalent to the **loaderinfo** command and is included with the **mtx** software. Like the **loaderinfo** command it works on the generic SCSI device and provides more information about the tape drive than the **mt** command. As the example shows it reports also some information about the compression settings of the tape drive.

Example 3-21 Using **tapeinfo** *to get a detailed status report from the tape drive*

```
[root@diomede /root]# tapeinfo -f /dev/sg0
Product Type: Tape Drive
Vendor ID: 'IBM     '
Product ID: 'ULT3580-TD1     '
Revision: '16E0'
Attached Changer: No
SerialNumber: '6811020764'
MinBlock:1
MaxBlock:16777215
SCSI ID: 0
SCSI LUN: 0
Ready: yes
BufferedMode: yes
Medium Type: Not Loaded
Density Code: 0x40
BlockSize: 32768
DataCompEnabled: yes
DataCompCapable: yes
DataDeCompEnabled: yes
CompType: 0x1
DeCompType: 0x1
BOP: yes
Block Position: 0
```

We use another **mt** subcommand to switch off data compression on our tape drive as shown in Example 3-22.

Example 3-22 Using **mt** *to switch off data compression*

```
[root@diomede /root]# mt -f /dev/st0 datcompression 0
Compression off.
```

Example 3-23 shows a second call to **tapeinfo** which reports that we switched off compression successfully. Note that this change only applies until the system is rebooted - the easiest way to make it permanent is to put the **mt** command into a startup file.

Example 3-23 Checking the effect of the previous **mt** *command*

```
[root@diomede /root]# tapeinfo -f /dev/sg0
Product Type: Tape Drive
Vendor ID: 'IBM     '
Product ID: 'ULT3580-TD1     '
Revision: '16E0'
Attached Changer: No
SerialNumber: '6811020764'
MinBlock:1
MaxBlock:16777215
SCSI ID: 0
SCSI LUN: 0
Ready: yes
BufferedMode: yes
Medium Type: Not Loaded
Density Code: 0x40
BlockSize: 32768
DataCompEnabled: no
DataCompCapable: yes
DataDeCompEnabled: yes
CompType: 0x1
DeCompType: 0x1
BOP: yes
Block Position: 0
```

The examples in this section and in the previous sections represent only a small part of the available **mt** subcommands. The manual page for **mt** contains a complete overview of the available subcommands.

3.1.10 Alternative device file names in Linux

The device naming concept we describe in 3.1.1, “Native Linux device drivers” on page 123 has the advantage of creating short and easy to remember device file names. A disadvantage of the concept can be seen in the fact that device file names are created dynamically during the boot process. For larger installations this means that device names may change if a tape drive is removed temporarily from a library, for example, for maintenance purposes. If this happens, an application that uses the tape library will have incorrect device definitions. We know of two methods for avoiding this using alternative device file names.

The utilily scsidev

To avoid this effect the software **scsidev** creates the directory **/dev/scsi** and populates it with device names that are independent of SCSI bus reconfiguration. The **scsidev** software is available from:

http://www.garloff.de/kurt/linux/scsidev

After downloading the latest version we install the **scsidev** package as shown in Example 3-24.

Example 3-24 Installing the **scsidev** *package*

```
[root@diomede /root]# tar xzf scsidev-2.22.tar.gz

[root@diomede /root]# cd scsidev

[root@diomede scsidev]# ./configure
creating cache ./config.cache
checking for gcc... gcc
checking whether the C compiler (gcc  ) works... yes
checking whether the C compiler (gcc  ) is a cross-compiler... no
checking whether we are using GNU C... yes
checking whether gcc accepts -g... yes
checking for working const... yes
checking how to run the C preprocessor... gcc -E
checking for linux/scsi.h... no
checking for scsi/scsi.h... yes
checking for /usr/src/linux/drivers/scsi/scsi.h... yes
checking for a BSD compatible install... /usr/bin/install -c
updating cache ./config.cache
creating ./config.status
creating Makefile
creating config.h
[root@diomede scsidev]#
[root@diomede scsidev]# make
gcc -g -O2 -Wall -DVERSION=\"2.22\"  -o scsidev scsidev.c

[root@diomede scsidev]# make install
install -o root -g root -m 755 -s scsidev /bin
install -o root -g root -m 644 scsidev.8 /usr/share/man/man8
gzip -9f /usr/share/man/man8/scsidev.8
if [ ! -d /dev/scsi ]; then mkdir /dev/scsi; fi
#install -d /usr/share/doc/packages/scsidev
#install COPYING boot.diff README scsi.alias /usr/share/doc/packages/scsidev/
```

Example 3-25 shows how **scsidev** can be used to create an alternative set of device files.

Example 3-25 Creating SCSI device files with **scsidev**

```
[root@diomede scsidev]# scsidev -sdn
Found /dev/scsi/sgh0-0c0i0l0 (Type 01) R on Adaptec AHA274x/284x/294x
(EISA/VLB/PCI-Fast SCSI) 5.2.4/5.2.0

Found /dev/scsi/sgh0-0c0i1l0 (Type 01) R on Adaptec AHA274x/284x/294x
(EISA/VLB/PCI-Fast SCSI) 5.2.4/5.2.0
```

```
Found /dev/scsi/sgh0-0c0i6l0 (Type 08) R on Adaptec AHA274x/284x/294x
(EISA/VLB/PCI-Fast SCSI) 5.2.4/5.2.0

Serial number of /dev/scsi/sgh0-0c0i6l0: "IBM7801954"
Serial number of /dev/scsi/sth0-0c0i1l0: "6811007030"
Serial number of /dev/scsi/sgh0-0c0i1l0: "6811007030"
Serial number of /dev/scsi/sth0-0c0i0l0: "6811020764"
Serial number of /dev/scsi/sgh0-0c0i0l0: "6811020764"
```

Example 3-26 shows the device files that **scsidev** generates.

Example 3-26 SCSI device files generated by **scsidev**

```
[root@diomede scsidev]# ls /dev/scsi/
nsth0-0c0i0l0  sgh0-0c0i0l0  sgh0-0c0i6l0  sth0-0c0i1l0
nsth0-0c0i1l0  sgh0-0c0i1l0  sth0-0c0i0l0
```

The set of device special files created by **scsidev** contains the same devices that are available in the standard **/dev** directory but it uses a different naming convention. The naming is based on the address of the SCSI adapter and the SCSI address of every device. Therefore the name of a device special file will not change even if a device with a lower SCSI address is temporary unavailable. Similar to the standard Linux SCSI handling, **scsidev** recognizes disk and tape devices. The device file names for disks start with **sd**, tapes are represented by device file names that start with **st** for the rewinding and **nst** for the non-rewinding behavior of the tape drive. Generic SCSI device file names start with **sg**. The rest of the device name is created from device addressing information. The device name **sgh0-0c0i6l0** for example can be read as **S**CSI **g**eneric device on **h**ost **0 -** hostid 0x00**0** (IOPORT) **c**hannel **0** scsi **i**d **6** **l**un **0**. Example 3-27 shows that our LTO tape library is also available under the new naming scheme.

Example 3-27 Accessing the LTO library independent from SCSI reconfiguration

```
[root@diomede scsidev]# scsi_info /dev/scsi/sgh0-0c0i6l0
SCSI_ID="0,6,0"
MODEL="IBM ULT3583-TL"
FW_REV="2.50"
```

The **scsidev** command (as shown in Example 3-25) should be executed at every system boot. If we access our LTO tape library and drives via the device files created by **scsidev** it is possible to remove or add a tape drive from the library without needing to reconfigure the application software. In addition to the **scsidev** package, the script **rescan-scsi-bus.sh** should be copied into the **/bin** directory with the permissions shown in Example 3-28. The script **rescan-scsi-bus.sh** is available at:

http://www.garloff.de/kurt/linux/rescan-scsi-bus.sh

Example 3-28 Permissions for **rescan-scsi-bus.sh**

```
[root@diomede /root]# ll /bin/rescan-scsi-bus.sh
-rwxr-xr-x    1 root     root         2675 Oct 30 11:59 /bin/rescan-scsi-bus.sh
```

Whenever the configuration of the SCSI bus changes the script **rescan-scsi-bus.sh** must be executed to make the system aware of the change. Example 3-29 shows which parameters are available for **rescan-scsi-bus.sh**. For SAN environments **-l** is especially important. It is very common to use several LUNs in a SAN and without this parameter only LUN 0 will be recognized.

Example 3-29 Command line parameters for **rescan-scsi-bus.sh**

```
[root@diomede /root]# rescan-scsi-bus.sh --help
Usage: rescan-scsi-bus.sh [-l] [-w] [-c] [host [host ...]]
 -l activates scanning for LUNs 0 .. 7 [default: 0]
 -w enables scanning for device IDs 0 .. 15 [def.: 0 .. 7]
 -r enables removing of devices        [default: disabled]
 -c enables scanning of channels 0 1   [default: 0]
 If hosts are given, only these are scanned [default: all]
```

The devfs special device file system

Another alternative to the traditional Linux device naming scheme is offered by the **devfs** special device file system. We do not discuss this approach in our redbook. For further reading on this topic we recommend the **devfs** homepage at:

http://www.atnf.csiro.au/~rgooch/linux/docs/devfs.html

3.2 IBM Ultrium device drivers and IBM tapeutil

The IBM Ultrium device drivers are certified specifically to a particular Linux distribution and kernel version (version 2.4.2-2 with the Red Hat 7.1 distribution at the time of writing). If you want to use another kernel version you will need to use the native Linux device drivers as shown in the previous sections.

The IBM Ultrium device driver for Linux can be downloaded from

ftp://ftp.software.ibm.com/storage/devdrvr/Linux/

or one of its mirror sites. The driver is contained in the file `IBMtape.x.x.x.i386.tar.bin`.

3.2.1 Installing the Ultrium device drivers and utilities

Example 3-30 shows how to unpack and install the driver package.

Example 3-30 Installing the IBM Ultrium tape and library device driver on Linux

```
[root@diomede /root]# tar xvf IBMtape.1.0.7.i386.tar.bin
IBMtape.1.0.7.i386/
IBMtape.1.0.7.i386/IBMtape_Magstar.ReadMe
IBMtape.1.0.7.i386/License
IBMtape.1.0.7.i386/IBMtape_Ultrium.ReadMe
IBMtape.1.0.7.i386/install
IBMtape.1.0.7.i386/uninstall
IBMtape.1.0.7.i386/IBMtape-smp.o
IBMtape.1.0.7.i386/IBMtape-up.o
IBMtape.1.0.7.i386/IBM_tape.h

[root@diomede /root]# cd IBMtape.1.0.7.i386

[root@diomede IBMtape.1.0.7.i386]# ls
IBM_tape.h             IBMtape-smp.o          IBMtape-up.o  License
IBMtape_Magstar.ReadMe IBMtape_Ultrium.ReadMe install       uninstall

[root@diomede IBMtape.1.0.7.i386]# ./install
Copying files to system directories...
cp: cannot create regular file
`/lib/modules/2.4.2-2smp/kernel/drivers/scsi/IBMtape.o': No such file or
directory
patching file /etc/rc.sysinit
Finish to install the IBMtape...
```

The download directory also has a package with the Linux version of the **tapeutil** program and a tool to create the device files that access the Ultrium devices via the IBM device driver. The package is called **IBMtapeutil.x.x.x.i386.tar.bin**. The installation procedure is shown in Example 3-31.

Example 3-31 Installing IBM tape drive and library utilities on Linux

```
[root@diomede /root]# tar xvf IBMtapeutil.1.0.5.i386.tar.bin
IBMtapeutil.1.0.5/
IBMtapeutil.1.0.5/IBMtapeutil
IBMtapeutil.1.0.5/IBMtapeutil.h
IBMtapeutil.1.0.5/IBMtapeutil.c
IBMtapeutil.1.0.5/IBMtapeconfig
IBMtapeutil.1.0.5/makefile
IBMtapeutil.1.0.5/IBMtapeutil.ReadMe
IBMtapeutil.1.0.5/IPL.License

[root@diomede /root]# cd IBMtapeutil.1.0.5/
```

```
[root@diomede IBMtapeutil.1.0.5]# make
make: `IBMtapeutil' is up to date.

[root@diomede IBMtapeutil.1.0.5]# make install
cp -f IBMtapeutil /usr/bin/.
cp -f IBMtapeconfig /usr/bin/.
```

In Example 3-32 we call **IBMtapeconfig** to check if the Ultrium devices are accessible to our system and to create the device files that provide access via the IBM driver.

Example 3-32 Creating Linux device special files with **IBMtapeconfig**

```
[root@diomede IBMtapeutil.1.0.5]# IBMtapeconfig

Creating IBMtape special files
 major number: 254
 Attached devices: 0 1
 mknod -m 0666 /dev/IBMtape0 c 254 0
 mknod -m 0666 /dev/IBMtape0n c 254 64
 mknod -m 0666 /dev/IBMtape1 c 254 1
 mknod -m 0666 /dev/IBMtape1n c 254 65

Creating IBMchanger special files
 major number: 254
 Attached devices: 0
 mknod -m 0666 /dev/IBMchanger0 c 254 128
```

We can see that **IBMtapeconfig** creates device entries for the tape drives and for the library device. The drives are represented by **/dev/IBMtape?** for the rewinding behavior and **/dev/IBMtape?n** for the non-rewinding behavior. The changer device is available as **/dev/IBMchanger0**. The IBM Ultrium device drivers are installed in addition to the native Linux device drivers. Only the devices created via **IBMtapeconfig** will use the IBM drivers. The standard Linux devices remain unchanged. The **mt** command allows you to check if the installation was successful as Example 3-33 shows.

Example 3-33 Checking the IBM Ultrium driver with **mt**

```
[root@diomede IBMtapeutil.1.0.5]# mt -f /dev/IBMtape0 status
SCSI 2 tape drive:
File number=-1, block number=1203, partition=0.
Tape block size 0 bytes. Density code 0x40 (unknown to this mt).
Soft error count since last status=0
General status bits on (1000000):
 ONLINE
```

Now we are ready to use the Ultrium tape and library devices via the IBM driver. Even if you plan to use the Ultrium tape and library devices with the native Linux drivers we recommend to have the IBM drivers installed to be able to do microcode updates of the Ultrium tape and library devices. If you are using a Linux kernel version that is not supported by the IBM drivers we recommend to install a 2.4.2-2 kernel as an alternative boot kernel especially for this purpose. This is especially important when using the 3580 and 3581 models, as there is no StorWatch alternative for downloading microcode.

`IBMtapeutil` provides a comprehensive collection of tape and library commands. Example 3-34 shows the initial invokation screen for **`IBMtapeutil`**.

Example 3-34 Start screen of **`IBMtapeutil`**

```
[root@diomede /root]# IBMtapeutil

IBMtapeutil for Linux, Version 1.0.5, August 9, 2001
=========================================
        1. Tape
        2. Changer
        3. Quit
=========================================

Enter your choice:
```

Example 3-35 shows the general SCSI commands as well as the tape specific commands that are available via **`IBMtapeutil`**.

Example 3-35 Tape command selection screen of **`IBMtapeutil`** *for Linux*

```
--------------------------- General Commands: -----------------------------
    1. Open a Device                  7. Request Sense
    2. Close a Device                 8. Log Sense Page
    3. Inquiry                        9. Mode Sense Page
    4. Test Unit Ready               10. Switch Tape/Changer Device
    5. Reserve Device               11. Create Special Files
    6. Release Device               12. Query Driver Version
    Q. Quit IBMtapeutil
--------------------------- Tape Commands: --------------------------------
   20. Rewind                       33. Set Block Size
   21. Forward Space Filemarks      34. Retension Tape
   22. Backward Space Filemarks     35. Query/Set Tape Position
   23. Forward Space Records        36. Query Tape Status
   24. Backward Space Records       37. Load Tape
   25. FSFM                         38. Unload Tape
   26. BSFM                         39. Lock Tape Drive Door
   27. Space to End of Data         40. Unlock Tape Drive Door
   28. Read and Write Tests         41. Take Tape Offline
```

```
   29. Write Filemarks              42. Enable/Disable Compression
   30. Read or Write Files          43. Flush Driver's Buffer
   31. Erase                        44. Self Test
   32. Reset Drive                  45. Display Message
--------------------------- IBMtape Commands: -------------------------------
   46. Query Sense                  52. Locate Tape Position
   47. Query Inquiry                53. Read Tape Position
   48. Query/Set Tape Parameters    54. Query Mtdevice Number
   49. Query/Set Tape Position      55. Synchronize Buffers
   50. Query/Set MT/ST Mode         56. List Tape Filemarks
   51. Report Density Support
--------------------------- Service Aid Commands: -------------------------
   70. Dump Device                  72. Load Ucode
   71. Force Dump                   73. Reset Drive
---------------------------------------------------------------------------
   99. Back To Main Menu

Enter Selection:
```

Example 3-36 shows as an example for using **IBMtapeutil**, how a SCSI inquiry command can be sent to the tape device.

Example 3-36 Sending a SCSI inquiry command to an LTO tape drive with tapeutil

```
Enter Selection: 1

Enter device name (<enter> for /dev/IBMtape0):
Select mode (<enter> or 1=Read/Write, 2=Read Only, 3=Write Only, 4=Append): 1

Opening device...

Hit <enter> to continue...

(...)

Enter Selection for /dev/IBMtape0: 3


Enter page code in hex or <enter> for standard inquiry:
Issuing inquiry...

Inquiry Data:
Peripheral Qualifer-------------------0x00
Peripheral Device Type----------------0x01
Removal Medium Bit--------------------1
Device Type Modifier------------------0x00
ISO version---------------------------0x00
ECMA version--------------------------0x00
ANSI version--------------------------0x03
```

```
Asynchronous Event Notification Bit---0
Terminate I/O Process Message Bit-----0
Response Data Format------------------0x02
Additional Length---------------------0x21
Medium Changer Mode-------------------0x00
Relative Addressing Bit---------------0
32 Bit Wide Data Transfers Bit--------0
16 Bit Wide Data Transfers Bit--------1
Synchronous Data Transfers Bit--------1
Linked Commands Bit-------------------0
Command Queueing Bit------------------0
Soft Reset Bit------------------------0
Vendor ID-----------------------------IBM
Product ID----------------------------ULT3580-TD1
Product Revision Level----------------16E0

vendor1,  Length 20

            0 1  2 3  4 5  6 7  8 9  A B  C D  E F   0123456789ABCDEF
    0000 - 0000 0000 0000 0000 0000 0000 0000 0000  [................]
    0010 - 0000 0000                                [....            ]


vendor2,  Length 31

            0 1  2 3  4 5  6 7  8 9  A B  C D  E F   0123456789ABCDEF
    0000 - 0000 0000 0000 0000 0000 0000 0000 0000  [................]
    0010 - 0000 0000 0000 0000 0000 0000 0000 00    [............... ]

Hit <enter> to continue...

(...)

Enter Selection for /dev/IBMtape0: 2

Device closed...

Hit <enter> to continue...
```

Example 3-37 shows that a similar set of commands is available to interact with the tape library (option 2 from the start screen in Example 3-34 on page 147).

Example 3-37 Library command selection screen of **IBMtapeutil** *for Linux*

```
-------------------------- General Commands: -----------------------------
    1. Open a Device                   7. Request Sense
    2. Close a Device                  8. Log Sense Page
    3. Inquiry                         9. Mode Sense Page
    4. Test Unit Ready                10. Switch Tape/Changer Device
```

```
    5. Reserve Device                  11. Create Special Files
    6. Release Device                  12. Query Driver Version
    Q. Quit IBMtapeutil
------------------------- Medium Changer Commands: -----------------------
   60. Element Information             65. Load/Unload Medium
   61. Position To Element             66. Initialize Element Status
   62. Element Inventory               67. Prevent/Allow Medium Removal
   63. Exchange Medium                 68. Initialize Element Status Range
   64. Move Medium                     69. Read Device Identifiers
-------------------------- Service Aid Commands: ------------------------
   70. Dump Device                     72. Load Ucode
   71. Force Dump                      73. Reset Drive
---------------------------------------------------------------------------
   99. Back To Main Menu

Enter Selection:
```

Example 3-38 shows how the Ultrium tape library medium changer answers to a SCSI inquiry command.

Example 3-38 Sending a SCSI inquiry command to an LTO library with tapeutil

```
Enter Selection: 1

Enter device name (<enter> for /dev/IBMchanger0):
Opening device...

Hit <enter> to continue...

(...)

Enter Selection for /dev/IBMchanger0: 3


Enter page code in hex or <enter> for standard inquiry:
Issuing inquiry...

Inquiry Data:
Peripheral Qualifer-------------------0x00
Peripheral Device Type----------------0x08
Removal Medium Bit--------------------1
Device Type Modifier------------------0x00
ISO version---------------------------0x00
ECMA version--------------------------0x00
ANSI version--------------------------0x02
Asynchronous Event Notification Bit---0
Terminate I/O Process Message Bit-----0
Response Data Format------------------0x02
```

```
Additional Length---------------------0x33
Medium Changer Mode-------------------0x00
Relative Addressing Bit---------------0
32 Bit Wide Data Transfers Bit--------0
16 Bit Wide Data Transfers Bit--------0
Synchronous Data Transfers Bit--------0
Linked Commands Bit-------------------0
Command Queueing Bit------------------0
Soft Reset Bit------------------------0
Vendor ID-----------------------------IBM
Product ID----------------------------ULT3583-TL
Product Revision Level----------------2.50

vendor1,  Length 20

            0 1  2 3  4 5  6 7  8 9  A B  C D  E F   0123456789ABCDEF
    0000 - 322E 3530 2E30 3032 3520 2020 2020 2020  [2.50.0025       ]
    0010 - 2020 2001                                [    .           ]


vendor2,  Length 31

            0 1  2 3  4 5  6 7  8 9  A B  C D  E F   0123456789ABCDEF
    0000 - 0000 0000 0000 0000 0000 0000 0000 0000  [................]
    0010 - 0000 0000 0000 0000 0000 0000 0000 00    [............... ]


Hit <enter> to continue...

(...)

Enter Selection for /dev/IBMchanger0: 2

Device closed...

Hit <enter> to continue...
```

3.2.2 Uninstalling the Ultrium device drivers and utilities

If it is ever necessary to deinstall the IBM Ultrium specific software from the Linux system this can be done in two steps. In the first step **IBMtapeutil** and **IBMtapeconfig** are removed from the system as shown in Example 3-39. The **make uninstall** command is part of the installation package for **IBMtapeutil** and **IBMtapeconfig** and can only be called from the directory where the installation package for these tools resides.

Example 3-39 Deinstalling **IBMtapeutil** *and* **IBMtapeconfig**

```
[root@diomede IBMtapeutil.1.0.5]# make uninstall
rm -f /usr/bin/IBMtapeutil
rm -f /usr/bin/IBMtapeconfig
```

Calling `./uninstall` from the directory where the driver package resides completes the deinstallation procedure.

Example 3-40 Deinstalling the IBM Ultrium tape and library device driver on Linux

```
[root@diomede IBMtape.1.0.7.i386]# ./uninstall
Removing the IBMtape loadable kernel module from the system
Removing the system files...
Removing /lib/modules/2.4.2-2/kernel/drivers/scsi/IBMtape.o
Removing /usr/include/sys/IBM_tape.h
Removing /usr/share/doc/IBMtape/IBMtape_Magstar.ReadMe
Removing /usr/share/doc/IBMtape/IBMtape_Ultrium.ReadMe
Removing /usr/share/doc/IBMtape/License
Removing /usr/share/doc/IBMtape directory
Removing IBMtape special files in /dev
patching file /etc/rc.sysinit
Finish to uninstall IBMtape
```

3.3 Linux Fibre Channel HBA installation

The following sections show how two of the most common Fibre Channel host bus adapters, the QLogic 2200 and the Emulex LP8000 can be used in a Linux environment. The Linux kernels of the major distributions will often already contain a driver for one or both types of Fibre Channel host adapters. Nevertheless we will describe how the latest drivers can be integrated into a Linux kernel that does not contain the Fibre Channel drivers yet. This will be necessary in any case, whenever the latest driver or the latest kernel is required in our Linux environment. We use the following environment as shown in Figure 3-5 for our SAN testing:

- Intel Pentium server with Red Hat Linux version 7.1, kernel 2.4
- QLogic 2200 and Emulex LP8000 FC HBA
- IBM 2109 Fibre Channel switch
- IBM 2108 SAN Data Gateway (SDG)
- IBM 3583 library attached via SCSI port to the SAN Data Gateway. A single SCSI bus supported both the library controller and the two 3580 tape drive

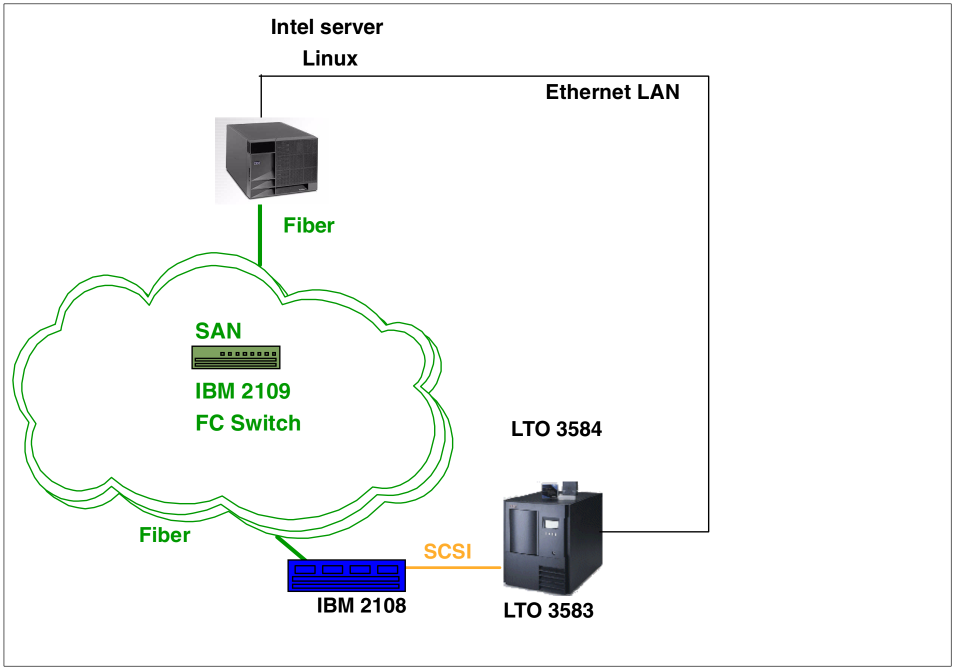

Figure 3-5 SAN lab setup

3.3.1 QLogic 2200

For the QLogic 2200 fibre channel adapter the driver can be found at:

http://www.qlogic.com/support/product_resources.asp?id=112

Check carefully for the correct driver version related to the Linux and kernel version. At the time of writing, a beta driver version was required to support Linux kernels of the 2.4 series. The driver for the QLogic card comes as a source code tgz-archive. We create a directory and unpack the device driver into this directory as shown in Example 3-41.

Example 3-41 Unpacking the QLogic device driver

```
[root@diomede itso]# mkdir qlogic
[root@diomede itso]# cd qlogic
[root@diomede qlogic]# tar xzf ../qla2x00src-v4.27Beta.tgz
```

After unpacking the QLogic driver we find a number of source files for the driver together with the installation instructions from QLogic. The installation instructions from QLogic can be found in the files README.qla2x00 and AddKernel.txt. However we found these installation instructions were not quite accurate for recent Linux kernels. This is the procudure which we followed.

Copy the source code for the drivers into the **/drivers/scsi** subdirectory of our kernel as Example 3-42 shows.

Example 3-42 Copying the driver source code into the appropriate kernel subdirectory

```
[root@diomede qlogic]# cp *.c /usr/src/linux-2.4/drivers/scsi
[root@diomede qlogic]# cp *.h /usr/src/linux-2.4/drivers/scsi
```

Next, we have to make a few changes to existing kernel source files so that our new driver can be configured and compiled as part of the kernel. To make the driver available during kernel configuration we must introduce an additional line into the file **Config.in** as Example 3-43 shows in **bold**.

Example 3-43 Changes in **/usr/src/linux*/drivers/scsi/Config.in**

```
(...)
dep_tristate 'Qlogic FAS SCSI support' CONFIG_SCSI_QLOGIC_FAS $CONFIG_SCSI
if [ "$CONFIG_PCI" = "y" ]; then
   dep_tristate 'Qlogic ISP SCSI support' CONFIG_SCSI_QLOGIC_ISP $CONFIG_SCSI
   dep_tristate 'Qlogic ISP FC SCSI support' CONFIG_SCSI_QLOGIC_FC $CONFIG_SCSI
   if [ "$CONFIG_SCSI_QLOGIC_FC" != "n" ]; then
      bool '   Include loadable firmware in driver'
CONFIG_SCSI_QLOGIC_FC_FIRMWARE
   fi
   dep_tristate 'Qlogic QLA 1280 SCSI support' CONFIG_SCSI_QLOGIC_1280
$CONFIG_SCSI
   dep_tristate 'QLA2100 QLC driver support' CONFIG_SCSI_QLOGIC_QLA2100
$CONFIG_SCSI
fi
(...)
```

To include the new driver into the kernel compile and link process additional changes are necessary. Example 3-44 shows the two lines that must be added to the **Makefile** of the **scsi** subdirectory in **bold**.

Example 3-44 Changes in **/usr/src/linux*/drivers/scsi/Makefile**

```
(...)
obj-$(CONFIG_SCSI_QLOGIC_1280)+= qla1280.o
obj-$(CONFIG_SCSI_QLOGIC_QLA2100)  += qla2x00.o
obj-$(CONFIG_SCSI_PAS16)+= pas16.o
(...)
53c700.o: 53c700_d.h
```

```
qla2x00.o: ql2100_fw.h ql2200_fw.h ql2300_fw.h qla2x00.h qla2x00.c
```

The changes we describe in Example 3-43 and Example 3-44 are sufficient to configure and build a kernel with support for the QLogic adapter. Further changes that are described in the QLogic instructions as for example the changes in **hosts.c** are not necessary. We are now ready to configure, make and install a new kernel as usual. This will offer us an additional driver for the QLA2100 series of adapters as one of the SCSI system-level drivers as we can see in Figure 3-6. The QLogic QLA2200 adapter belongs to this family of adapters. Fibre channel adapters will generally appear as SCSI adapters in the Linux kernel with their SCSI over FC functionality. If a FC adapter supports IP over FC it will show up as a network adapter as well.

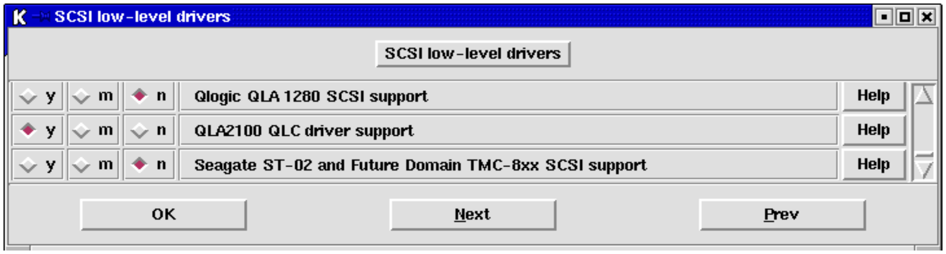

Figure 3-6 Kernel configuration for the QLogic QLA2200 fibre channel adapter

As always it is a good idea to review all kernel settings and to keep a backup kernel that allows the machine to be rebooted in case anything goees wrong with the new kernel. At this point check in 3.1.3, “Kernel compilation and installation checklist” on page 129 to ensure that no steps are overlooked in the kernel build process. If the new kernel boots successfully the boot messages should look similar to the output in Example 3-45.

Example 3-45 Boot messages from the QLA2200 adapter

```
[root@diomede /root]# dmesg
(...)
SCSI subsystem driver Revision: 1.00
PCI: Found IRQ 9 for device 00:12.0
PCI: Sharing IRQ 9 with 01:01.0
qla2x00: detect() found an HBA
qla2x00: VID=1077 DID=2200 SSVID=1077 SSDID=2
(scsi): Found a QLA2200  @ bus 0, device 0x12, irq 9, iobase 0x7800
scsi(0): Configure NVRAM parameters...
scsi(0): Verifying loaded RISC code...
scsi(0): Verifying chip...
scsi(0): LIP reset occurred
scsi(0): Waiting for LIP to complete...
scsi(0): LOOP UP detected
scsi(0): Waiting for LIP to complete...
```

```
scsi0: Topology - (F_Port), Host Loop address  0xffff
scsi(0): Waiting for LIP to complete...
scsi0: Topology - (F_Port), Host Loop address  0xffff
scsi-qla0-adapter-node=200000e08b02a72d;
scsi-qla0-adapter-port=210000e08b02a72d;
scsi-qla0-target-0=1000006045161ff5;
scsi0 : QLogic QLA2200 PCI to Fibre Channel Host Adapter: bus 0 device 18 irq 9
Firmware version:  2.01.27, Driver version 4.27b
scsi: unknown type 12
  Vendor: PATHLGHT  Model: SAN Router       Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3583-TL       Rev: 2.50
  Type:   Medium Changer                    ANSI SCSI revision: 02
  Vendor: IBM       Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                 ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                 ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi(0:0:0:0): Enabled tagged queuing, queue depth 16.
scsi(0:0:0:1):Device does not supoort tags queuing!!!.
scsi(0:0:0:2):Device does not supoort tags queuing!!!.
scsi(0:0:0:3):Device does not supoort tags queuing!!!.
scsi(0:0:0:4):Device does not supoort tags queuing!!!.
scsi(0:0:0:5):Device does not supoort tags queuing!!!.
scsi(0:0:0:6):Device does not supoort tags queuing!!!.
scsi(0:0:0:7):Device does not supoort tags queuing!!!.
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
st: Version 20011003, bufsize 262144, wrt 65536, max init. bufs 4, s/g segs 16
Attached scsi tape st0 at scsi0, channel 0, id 0, lun 2
Attached scsi tape st1 at scsi0, channel 0, id 0, lun 4
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
```

```
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
Attached scsi generic sg0 at scsi0, channel 0, id 0, lun 0,  type 12
Attached scsi generic sg1 at scsi0, channel 0, id 0, lun 1,  type 8
Attached scsi generic sg3 at scsi0, channel 0, id 0, lun 3,  type 31
Attached scsi generic sg5 at scsi0, channel 0, id 0, lun 5,  type 31
Attached scsi generic sg6 at scsi0, channel 0, id 0, lun 6,  type 31
Attached scsi generic sg7 at scsi0, channel 0, id 0, lun 7,  type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
(...)
```

As we can see, a lot of SCSI devices appear on our SAN. Some of them are representations of the SAN Data Gateway that is connecting our LTO library to the SAN. The LTO library device and the LTO tape drives appear as well. All the devices found at the fibre channel are made available via a generic device entry (sgx). For the tape drives, tape device entries (st0 and st1) are also generated. The warning messages as well as the devices files that are created for the SAN Data Gateway can be safely ignored and have no influence on the operation of the library and the tape drives. In Example 3-46 we can see how the **sg_scan** command displays the devices that are available on our SAN.

Example 3-46 Showing all devices accessible via the FC HBA

```
[root@diomede /root]# sg_scan -i
/dev/sg0: scsi0 channel=0 id=0 lun=0  type=12
    PATHLGHT  SAN Router       32aC [wide=1 sync=1 cmdq=1 sftre=0 pq=0x0]
/dev/sg1: scsi0 channel=0 id=0 lun=1  type=8
    IBM       ULT3583-TL       2.50 [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg2: scsi0 channel=0 id=0 lun=2  type=1
    IBM       ULT3580-TD1      16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg3: scsi0 channel=0 id=0 lun=3  type=31
    PATHLGHT  SAN Router Invl  32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg4: scsi0 channel=0 id=0 lun=4  type=1
    IBM       ULT3580-TD1      16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg5: scsi0 channel=0 id=0 lun=5  type=31
    PATHLGHT  SAN Router Invl  32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg6: scsi0 channel=0 id=0 lun=6  type=31
    PATHLGHT  SAN Router Invl  32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg7: scsi0 channel=0 id=0 lun=7  type=31
    PATHLGHT  SAN Router Invl  32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
```

Since our tapes are attached to the SAN via a SAN Data Gateway we should show the SAN Data Gateway settings. Example 3-47 shows the output. Note that we set the host type parameter of the SAN Data Gateway to "aix" because we noticed reliability problems with the host type setting "nt".

Example 3-47 SAN Data Gateway settings

```
ITSOSDG2 > hostTypeShow
FC 1: Type 2 - aix
value = 0 = 0x0

ITSOSDG2 > sysConfigShow
Current System Parameter Settings:
Comamnd and Control Device (CC) : 2 Fully Disabled
                           LUN  : 0
Allow Early Write Status for Tape : 1 Enabled
Allow R/W Acceleration for Tape    : 1 Enabled
Enet MAC Address: 0.60.45.16.1f.f5
Active System Node Name Mode is 0
FC Node WWN: 10000060.45161ff5
Memory Snoop: Enabled
Device Inquiry after Host SCSI Bus Reset: Disabled
value = 0 = 0x0
```

Example 3-48 shows that a second FC HBA is recognized without problem. Because the second HBA is also connected to our SAN all devices are visible to the second adapter as well. As a result we see two libraries and four tape drives now which in fact represent different paths to the same devices.

Example 3-48 Boot messages for a system with 2 QLogic adapters

```
[root@diomede /root]# dmesg
(...)
SCSI subsystem driver Revision: 1.00
PCI: Found IRQ 10 for device 00:10.0
qla2x00: detect() found an HBA
qla2x00: VID=1077 DID=2200 SSVID=1077 SSDID=2
(scsi): Found a QLA2200  @ bus 0, device 0x10, irq 10, iobase 0x7400
scsi(0): Configure NVRAM parameters...
scsi(0): Verifying loaded RISC code...
scsi(0): Verifying chip...
scsi(0): LIP reset occurred
scsi(0): Waiting for LIP to complete...
scsi(0): LOOP UP detected
scsi(0): Waiting for LIP to complete...
scsi0: Topology - (F_Port), Host Loop address  0xffff
scsi(0): Waiting for LIP to complete...
scsi0: Topology - (F_Port), Host Loop address  0xffff
scsi-qla0-adapter-node=200000e08b023629;
scsi-qla0-adapter-port=210000e08b023629;
scsi-qla0-target-0=1000006045161ff5;
```

```
PCI: Found IRQ 9 for device 00:12.0
PCI: Sharing IRQ 9 with 01:01.0
qla2x00: detect() found an HBA
qla2x00: VID=1077 DID=2200 SSVID=1077 SSDID=2
(scsi): Found a QLA2200  @ bus 0, device 0x12, irq 9, iobase 0x7800
scsi(1): Configure NVRAM parameters...
scsi(1): Verifying loaded RISC code...
scsi(1): Verifying chip...
scsi(1): LIP reset occurred
scsi(1): Waiting for LIP to complete...
scsi(1): LOOP UP detected
scsi(1): Waiting for LIP to complete...
scsi1: Topology - (F_Port), Host Loop address  0xffff
scsi(1): Waiting for LIP to complete...
scsi1: Topology - (F_Port), Host Loop address  0xffff
scsi-qla1-adapter-node=200000e08b02a72d;
scsi-qla1-adapter-port=210000e08b02a72d;
scsi-qla1-target-0=1000006045161ff5;
scsi0 : QLogic QLA2200 PCI to Fibre Channel Host Adapter: bus 0 device 16 irq 10
Firmware version:  2.01.27, Driver version 4.27b
scsi1 : QLogic QLA2200 PCI to Fibre Channel Host Adapter: bus 0 device 18 irq 9
Firmware version:  2.01.27, Driver version 4.27b
scsi(0): Waiting for LIP to complete...
scsi0: Topology - (F_Port), Host Loop address  0xffff
scsi: unknown type 12
  Vendor: PATHLGHT  Model: SAN Router        Rev: 32aC
  Type:   Unknown                            ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3583-TL        Rev: 2.50
  Type:   Medium Changer                     ANSI SCSI revision: 02
  Vendor: IBM       Model: ULT3580-TD1       Rev: 16E0
  Type:   Sequential-Access                  ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl   Rev: 32aC
  Type:   Unknown                            ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3580-TD1       Rev: 16E0
  Type:   Sequential-Access                  ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl   Rev: 32aC
  Type:   Unknown                            ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl   Rev: 32aC
  Type:   Unknown                            ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl   Rev: 32aC
  Type:   Unknown                            ANSI SCSI revision: 03
scsi(0:0:0:0): Enabled tagged queuing, queue depth 16.
scsi(0:0:0:1):Device does not supoort tags queuing!!!.
scsi(0:0:0:2):Device does not supoort tags queuing!!!.
scsi(0:0:0:3):Device does not supoort tags queuing!!!.
scsi(0:0:0:4):Device does not supoort tags queuing!!!.
scsi(0:0:0:5):Device does not supoort tags queuing!!!.
scsi(0:0:0:6):Device does not supoort tags queuing!!!.
scsi(0:0:0:7):Device does not supoort tags queuing!!!.
scsi: unknown type 12
```

```
  Vendor: PATHLGHT  Model: SAN Router       Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3583-TL       Rev: 2.50
  Type:   Medium Changer                    ANSI SCSI revision: 02
  Vendor: IBM       Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                 ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                 ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi(1:0:0:0): Enabled tagged queuing, queue depth 16.
scsi(1:0:0:1):Device does not supoort tags queuing!!!.
scsi(1:0:0:2):Device does not supoort tags queuing!!!.
scsi(1:0:0:3):Device does not supoort tags queuing!!!.
scsi(1:0:0:4):Device does not supoort tags queuing!!!.
scsi(1:0:0:5):Device does not supoort tags queuing!!!.
scsi(1:0:0:6):Device does not supoort tags queuing!!!.
scsi(1:0:0:7):Device does not supoort tags queuing!!!.
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
st: Version 20011003, bufsize 262144, wrt 65536, max init. bufs 4, s/g segs 16
Attached scsi tape st0 at scsi0, channel 0, id 0, lun 2
Attached scsi tape st1 at scsi0, channel 0, id 0, lun 4
Attached scsi tape st2 at scsi1, channel 0, id 0, lun 2
Attached scsi tape st3 at scsi1, channel 0, id 0, lun 4
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 12
```

```
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
Attached scsi generic sg0 at scsi0, channel 0, id 0, lun 0,  type 12
Attached scsi generic sg1 at scsi0, channel 0, id 0, lun 1,  type 8
Attached scsi generic sg3 at scsi0, channel 0, id 0, lun 3,  type 31
Attached scsi generic sg5 at scsi0, channel 0, id 0, lun 5,  type 31
Attached scsi generic sg6 at scsi0, channel 0, id 0, lun 6,  type 31
Attached scsi generic sg7 at scsi0, channel 0, id 0, lun 7,  type 31
Attached scsi generic sg8 at scsi1, channel 0, id 0, lun 0,  type 12
Attached scsi generic sg9 at scsi1, channel 0, id 0, lun 1,  type 8
Attached scsi generic sg11 at scsi1, channel 0, id 0, lun 3,  type 31
Attached scsi generic sg13 at scsi1, channel 0, id 0, lun 5,  type 31
Attached scsi generic sg14 at scsi1, channel 0, id 0, lun 6,  type 31
Attached scsi generic sg15 at scsi1, channel 0, id 0, lun 7,  type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
(...)
```

Example 3-49 shows how the setup with two HBAs looks with an **sg_scan** command.

Example 3-49 Executing an **sg_scan** *command on a system with 2 OLogic adapters*

```
[root@diomede /root]# sg_scan -i
/dev/sg0: scsi0 channel=0 id=0 lun=0  type=12
    PATHLGHT  SAN Router        32aC [wide=1 sync=1 cmdq=1 sftre=0 pq=0x0]
/dev/sg1: scsi0 channel=0 id=0 lun=1  type=8
    IBM       ULT3583-TL        2.50 [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg2: scsi0 channel=0 id=0 lun=2  type=1
    IBM       ULT3580-TD1       16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg3: scsi0 channel=0 id=0 lun=3  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg4: scsi0 channel=0 id=0 lun=4  type=1
    IBM       ULT3580-TD1       16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg5: scsi0 channel=0 id=0 lun=5  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg6: scsi0 channel=0 id=0 lun=6  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
```

```
/dev/sg7: scsi0 channel=0 id=0 lun=7  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg8: scsi1 channel=0 id=0 lun=0  type=12
    PATHLGHT  SAN Router        32aC [wide=1 sync=1 cmdq=1 sftre=0 pq=0x0]
/dev/sg9: scsi1 channel=0 id=0 lun=1  type=8
    IBM       ULT3583-TL        2.50 [wide=0 sync=0 cmdq=0 sftre=0 pq=0x0]
/dev/sg10: scsi1 channel=0 id=0 lun=2  type=1
    IBM       ULT3580-TD1       16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg11: scsi1 channel=0 id=0 lun=3  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg12: scsi1 channel=0 id=0 lun=4  type=1
    IBM       ULT3580-TD1       16E0 [wide=1 sync=1 cmdq=0 sftre=0 pq=0x0]
/dev/sg13: scsi1 channel=0 id=0 lun=5  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg14: scsi1 channel=0 id=0 lun=6  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
/dev/sg15: scsi1 channel=0 id=0 lun=7  type=31
    PATHLGHT  SAN Router Invl   32aC [wide=0 sync=0 cmdq=0 sftre=0 pq=0x1]
```

There are three possibilities to handle the duplicate devices generated by 2 HBAs:

1. Configure only one device representation in the backup application. The second representation can be used for a manual failover solution if the backup application provides an easy way to update the device definitions.
2. Hide the second appearance via LUN masking on the FC switch. We discuss LUN masking in 4.4, “LUN masking” on page 186.
3. Assign a specific device to a specific host adapter via persistent binding (see 3.4, “Persistent binding” on page 167 for a definition).

While the first two alternatives are always possible the third possibility depends on the capabilities of the FC device driver. At the time of writing, persistent binding was not available for either the QLogic or Emulex HBAs on Linux.

3.3.2 Emulex LP8000

To be able to use the Emulex LP8000 fibre channel adapter we have to download the driver source code from:

http://www.emulex.com/ts/dds.html

The driver is available as a source code **tar** file. After unpacking the **tar** file the driver can be compiled and installed as a module as shown in Example 3-50. Before calling **make build** it is important to adapt the environment and the **Makefile** as it is described in the **README** file coming with the driver package.

Example 3-50 Unpacking, compiling and installing the Emulex LP8000 driver

```
[root@diomede /root]# tar xf lpfc-i386.tar
```

```
[root@diomede /root]# cd SourceBuild
[root@diomede SourceBuild]# make build
Build Environment root: /usr/src/linux
cc -D__GENKSYMS__ -D__KERNEL__=1 -DMODULE -DMODVERSIONS -include
/usr/src/linux/include/linux/modversions.h  -I./include
-I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include -DLP6000 -D_LINUX -I./include
-I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include  -E fcLINUXfcp.c > lpfc.ver1
cat lpfc.ver1 | /sbin/genksyms -k 2.2.5 > lpfc.ver
cc -Wall -O2 -fomit-frame-pointer -D__KERNEL__=1 -DMODULE -DMODVERSIONS
-include /usr/src/linux/include/linux/modversions.h  -I./include
-I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include -DLP6000 -D_LINUX -I./include
-I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include  -c fcLINUXfcp.c
fcLINUXfcp.c: In function `fc_malloc':
fcLINUXfcp.c:3281: warning: cast to pointer from integer of different size
fcLINUXfcp.c:3290: warning: cast to pointer from integer of different size
fcLINUXfcp.c: In function `fc_fcp_bufmap':
fcLINUXfcp.c:3964: warning: cast to pointer from integer of different size
fcLINUXfcp.c: In function `lpfc_mpdata_sync':
fcLINUXfcp.c:6266: warning: cast from pointer to integer of different size
fcLINUXfcp.c:6268: warning: cast from pointer to integer of different size
rm -f lpfc.ver1
cc -Wall -O2 -fomit-frame-pointer -D__KERNEL__=1 -DMODULE -DMODVERSIONS
-include /usr/src/linux/include/linux/modversions.h  -I./include
-I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include -DLP6000 -D_LINUX
-I./include -I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include -c fcLINUXlan.c
rm -f lpfc.ver
cc -Wall -O2 -fomit-frame-pointer -D__KERNEL__=1 -DMODULE -DMODVERSIONS
-include /usr/src/linux/include/linux/modversions.h  -I./include
-I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include -DLP6000 -D_LINUX
-I./include -I/usr/src/linux/drivers/scsi -I/usr/src/linux/include/scsi
-I/usr/src/linux/include -c lpfc.conf.c
cp lpfcdriver lpfcdriver.o
ld -r -o lpfcdd.2.4.13.o lpfcdriver.o fcLINUXfcp.o lpfc.conf.o
ld -r -o lpfndd.2.4.13.o fcLINUXlan.o
[root@diomede SourceBuild]# make install
Installing under /lib/modules/2.4.13
[root@diomede SourceBuild]# sh Install.sh
cat: //etc/hba.conf: No such file or directory
```

Now we are ready to load the driver module as shown in Example 3-51.

Example 3-51 Loading the Emulex LP8000 driver module

```
[root@diomede /root]# insmod lpfcdd
Using /lib/modules/2.4.13/scsi/lpfcdd.o
```

We use **lsmod** to check if the driver is loaded successfully as shown in Example 3-52.

Example 3-52 Checking the availability of the Emulex LP8000 driver module

```
[root@diomede /root]# lsmod
Module                  Size  Used by
(...)
lpfcdd                181744   0  (unused)
(...)
```

The module **lpfndd** that is mentioned in the installation instructions by Emulex is not required in our case, because we are not planning to use IP over Fibre Channel. Example 3-53 shows that the Emulex LP8000 is now present as part of the Linux SCSI subsystem. The listing of the available SAN devices is similar to the configuration we had with the QLogic adapter.

Example 3-53 Listing information about the Emulex HBA and available SAN devices

```
[root@diomede /root]# cat /proc/scsi/
lpfc     scsi     sg
[root@diomede /root]# cat /proc/scsi/lpfc/1
Emulex LPFC (DRAGONFLY) SCSI on PCI bus 00 device 80 irq 10
[root@diomede /root]# cat /proc/scsi/scsi
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
  Vendor: PATHLGHT Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                          ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 01
  Vendor: IBM      Model: ULT3583-TL       Rev: 2.50
  Type:   Medium Changer                   ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 02
  Vendor: IBM      Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 03
  Vendor: PATHLGHT Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                          ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 04
  Vendor: IBM      Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 05
  Vendor: PATHLGHT Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                          ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 06
  Vendor: PATHLGHT Model: SAN Router Invl  Rev: 32aC
```

```
  Type:   Unknown                          ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 07
  Vendor: PATHLGHT Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                          ANSI SCSI revision: 03
```

As an alternative to the driver installation as a loadable module, Emulex provides detailed installation instructions which enables integration of the driver into the Linux kernel source. Following the instructions by Emulex, we copy the source files for the Emulex driver into the kernel sources and modify the original kernel source files as described by these installation instructions. The instructions describe how to activate SCSI over fibre channel support and how to activate IP over fibre channel support. Only the changes to activate SCSI over Fibre Channel are necessary in our environment. Options for the LP8000 driver can be configured in the file **lpfc.conf.c**. This file can be found in the subtree **/drivers/scsi/lpfc/** of the kernel directory. In our setup we did not make any changes to this file. Finally we can create a new kernel configuration using **make xconfig**. If the environment does not have Xwindows installed we have to use **make menuconfig** or **make config** instead. In the configuration options for SCSI low-level drivers we find a new entry for the Emulex adapter. We select this menu entry as shown in Figure 3-7. We save the new configuration and compile and install the new kernel. At this point, review Section 3.1.3, “Kernel compilation and installation checklist” on page 129 to ensure that we do not forget any steps in the kernel build process.

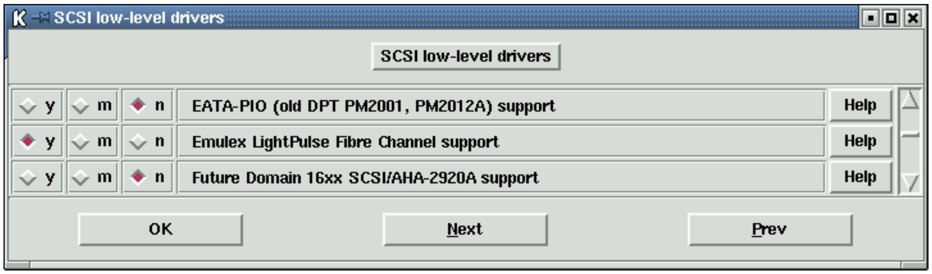

Figure 3-7 Using **make xconfig** *to configure the kernel for the LP8000 adapter*

As soon as the system boots with the new kernel the Emulex adapter will be activated. The driver initializes the adapter, activates the Fibre Channel link and reports which fibre channel devices are available as shown in Example 3-54.

Example 3-54 Boot messages of the Emulex fibre channel driver

```
Emulex LightPulse FC SCSI/IP 4.10n
!lpfc0:045:Vital Product Data  Data: 82 23 0 36
!lpfc0:031:Link Up Event received  Data: 1 1 1 2
scsi2 : Emulex LPFC (DRAGONFLY) SCSI on PCI bus 01 device 08 irq 10
scsi: unknown type 12
```

```
  Vendor: PATHLGHT  Model: SAN Router       Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3583-TL       Rev: 2.50
  Type:   Medium Changer                    ANSI SCSI revision: 02
  Vendor: IBM       Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                 ANSI SCSI revision: 02
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
  Vendor: IBM       Model: ULT3580-TD1      Rev: 16E0
  Type:   Sequential-Access                 ANSI SCSI revision: 02
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
scsi: unknown type 31
  Vendor: PATHLGHT  Model: SAN Router Invl  Rev: 32aC
  Type:   Unknown                           ANSI SCSI revision: 03
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
Detected scsi tape st0 at scsi2, channel 0, id 1, lun 2
Detected scsi tape st1 at scsi2, channel 0, id 1, lun 4
st: bufsize 32768, wrt 30720, max init. buffers 4, s/g segs 16.
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
Detected scsi disk sda at scsi0, channel 0, id 0, lun 0
SCSI device sda: 35547136 512-byte hdwr sectors (18200 MB)
Partition check:
 sda: sda1 sda2 sda3 < sda5 sda6 sda7 sda8 >
resize_dma_pool: unknown device type 12
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
resize_dma_pool: unknown device type 31
```

The SAN Data Gateway appears several times and causes several messages about unknown device types which can be safely ignored. The messages about the IBM Ultrium tape drives and library are important in our context. Both tape drives and the changer device are recognized correctly. They are accessible via the **/dev/st?**, **/dev/nst?** and **/dev/sg?** device files or via the alternative device files we describe in Section 3.1.10, “Alternative device file names in Linux” on page 141. At the time of writing this book we did not succeed in getting the **lputil** software up and running.

3.4 Persistent binding

At the time of writing this book persistent binding is not documented for the Linux FC drivers by QLogic and Emulex.

4

SAN Considerations

In this chapter we discuss considerations for SAN attached tapes and libraries. We are emphasizing issues generally relevant to SAN tape attachment including:

- design considerations for SAN attached tape libraries
- switch fabric zoning
- persistent binding
- LUN masking

We will provide additional information on SAN setup for the 3583 Ultrium Scalable Tape Library and 3584 Ultrium UltraScalable Tape Library where necessary.

We assume the reader is already familiar with the basic concepts of Storage Area Networks. For more Information about general SAN concepts and design, please refer to

- *Designing an IBM Storage Area Network,* SG24-5758
- *Planning and Implementing an IBM SAN*, SG24-6116
- *IBM SAN Survival Guide,* SG24-6143

4.1 SAN design considerations for LTO libraries

In this section we cover the following LTO SAN design considerations:

- How many LTO tape drives can I connect to a FC HBA?
- How should I connect tape drives to a SAN Data Gateway (SDG)?
- How to handle multiple paths to tape drives

Currently all IBM LTO tape drives with native FC connections use FC-AL protocol. If you connect an LTO tape drive to a SAN, then the FC-AL protocol must be supported at that physical connection.

4.1.1 How many tape drives can I attach to a FC HBA?

If you want to attach one drive to a single server, you can cable it directly to the HBA - this is called a point-to-point connection. This configuration immediately restricts you to one physical tape device per HBA. If you have more than one drive and/or more than one server, you need additional components such as a SAN switch or hub.

Using a SAN fabric configuration you can potentially attach and access many tape drives through one or more HBA's. But how will this affect performance? The theoretical maximum data transfer rate for one FC connection in a SAN is 100 MB/sec. In reality we typically see an effective data transfer rate of about 80 MB/sec.

Note: With the introduction of the 2GB FC SAN fabric, the maximum data transfer rate will increase and hence the number of effective attached storage devices. We will only discuss the 1GB SAN in this redbook.

LTO tape drives have a sustained data transfer rate of 15 MB/second uncompressed and 30 MB/second using compression. In theory, this means you should be able to connect five uncompressed tape drives or two compressed tape drives through one HBA without performance degradation. However it is quite dependent on the type of data.

Most systems generally have a mix of data types achieving quiet different compression rates. If you write very large files with a good compression ratio you may get a transfer rate of up to 30 MB/sec. In that case you should only attach 2 or 3 drives on one HBA. On the other hand if you write small files or files with no compression then you may see transfer rates less than 15 MB/sec. For this case, greater than 3 tape drives could be attached to a HBA. Nevertheless it is not recommended to try to access more than 8 drives with a single HBA.

Most SAN fabric hardware provides the ability to measure the real data transfer rate achieved on the SAN. For example, if you have an IBM SAN Fibre Channel Switch (2109) you can use the StorWatch Fibre Channel Switch Specialist to measure data throughput. Using a Web browser, enter the TCP/IP address of one of the IBM SAN Fibre Channel switches. Select the switch to which your HBA is attached (Figure 4-1) to bring up the Switch View.

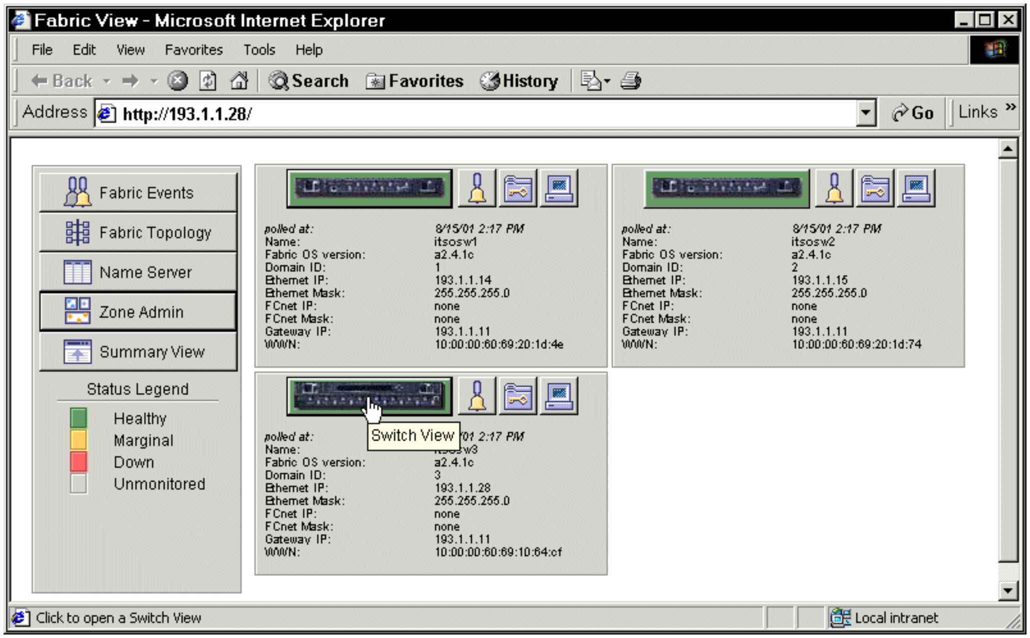

Figure 4-1 IBM 2109 StorWatch - Fabric View

On the Switch Management Application (Figure 4-2) click on the performance icon in order to the see the performance window.

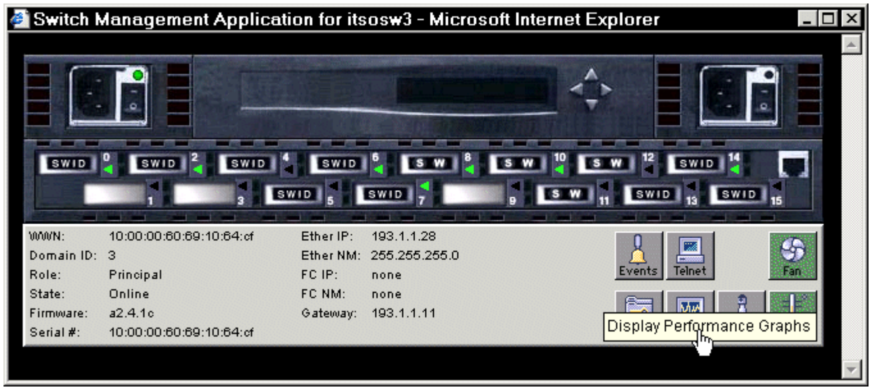

Figure 4-2 Switch Management Window

In Figure 4-3 you see the performance panel from a switch in the ITSO lab. The display shows traffic on Ports 0 and 7 of around 15 MB/sec. If you find that any ports are consistently showing traffic around 80 MB/sec, you should consider load balancing those ports by adding additional HBA’s or extra FC attachments to the SAN Data Gateway.

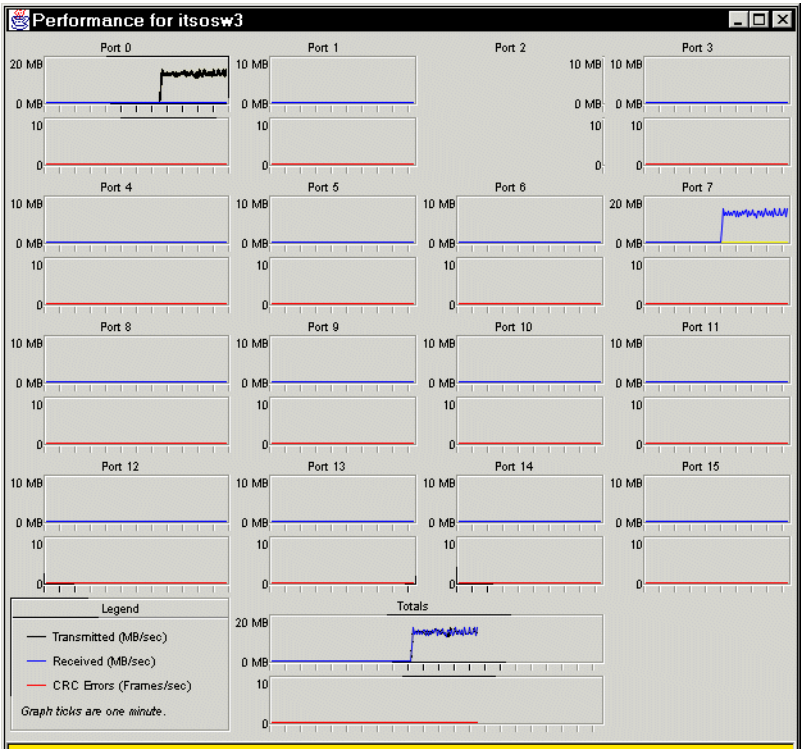

Figure 4-3 Port performance

4.1.2 Connecting tape drives to a SDG

The data transfer throughput for an IBM SAN Data Gateway 2108 G07 is 100 MB/sec. For a SAN Data Gateway 2108 R03, the data transfer throughput is about 50 MB/sec.

Our suggestions for achieving the best effective data rate on the SDG are:

- Avoid daisy-chaining drives. If this is necessary (for example, if there are more than three drives to be connected), then do not connect more than two drives per SCSI Bus.
- If possible, do not install more than two drives on a 2108 R03 or four drives on a 2108 G07.

In Figure 4-4 you see an example of a connection with SDG and a 3583. The 3583 contains 6 LTO drives. Each SCSI connection has two LTO drives. The SCSI Medium Changer is attached to its own SCSI bus. The server is connected to the SDG using two HBAs and FC ports. If you have more drives to attach you can move the SCSI medium changer to share any of the SCSI ports on the SDG.

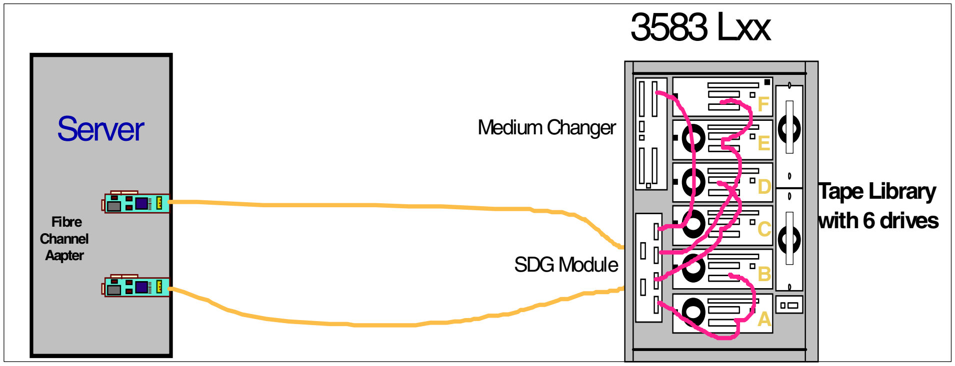

Figure 4-4 Example of a connection with SDG

4.1.3 Multiple paths to tape drives

We have discussed the reasons for using more than one HBA on the server to give good performance for all drives. However, if you implement this configuration you will see duplicate tape drive definitions on your server. Let us discuss this in the context of our lab configuration:

We have an Intel server running Windows 2000 with two FC HBAs. These HBAs are connected to a SAN Fabric consisting of IBM 2109 switches. We have a 3583 Ultrium Scalable Tape Library with two drives installed. The 3583 is connected to a SAN Data Gateway. The SDG is connected to the fabric with one FC port. See Figure 4-5.

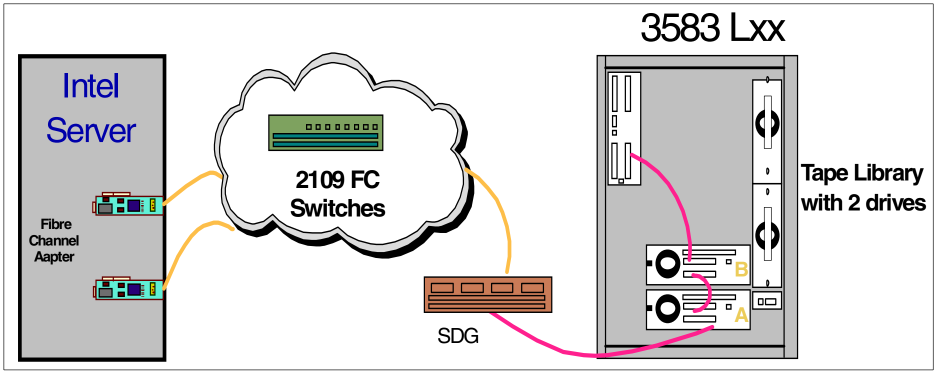

Figure 4-5 Our lab configuration

The IBM Ultrium drivers have been installed.

Boot the server to detect the new devices. To display the devices select **Start -> Settings -> Control Panel -> System -> Hardware -> Device Manager**.In Figure 4-6, you can see that the medium changer and two tape drives have been detected twice - once on each HBA in the server, giving a total of 4 tape drives and two SCSI Medium Changers. This gives the impression there are more devices available than are actually physically present.

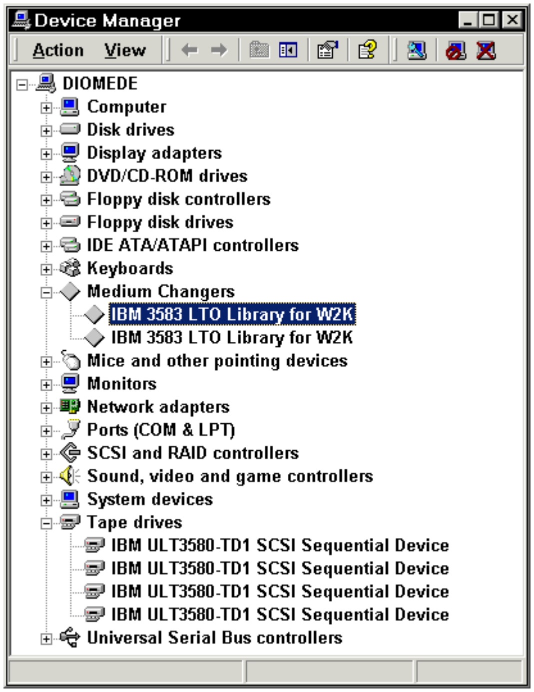

Figure 4-6 Device Manager

There are at least three ways to solve this problem:

1. You can enable zoning which allows only certain physical ports or WWNs to see one another.
2. You can use the HBA function called persistent binding so that the HBA will see only certain WWNs.
3. You can use LUN masking.

The different options are described in the following section.

4.2 Zoning

Zoning allows you to partition your SAN into logical groupings of devices so that each group is isolated from each other and can only access the devices in their own group. Using zoning, you can arrange fabric-connected devices into logical groups, or zones, over the physical configuration of the fabric. Zones can be configured dynamically. They can vary in size depending on the number of fabric connected devices, and devices can belong to more than one zone. Because zone members can access only other members of the same zone, a device not included in a zone is not available to members of that zone. Therefore, you can use zones to:

- Create closed user groups, for example between test and development environments
- Create a barrier between different environments such as Windows and UNIX operating systems
- Secure fabric areas

Figure 4-7 below illustrates two slightly overlapping zones represented by the green solid lines and the red dotted lines.

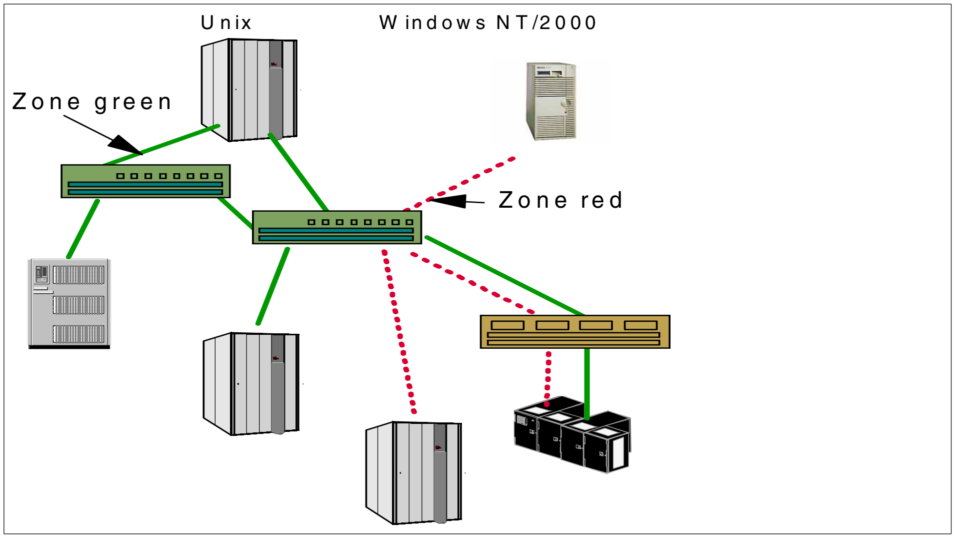

Figure 4-7 Zoning

Unlike some disk devices, such as the IBM Enterprise Storage System, most tape device drivers (including the IBM Ultrium device driver) do not support multi-pathing to the same physical device. This means that servers can use multiple HBAs and multiple connections to the SAN fabric but there is no automatic failover or load balancing to an individual tape device. Support for this capability needs to included into the device driver. What generally occurs is that the physical device is represented twice by the operating system. To solve this, we must *hide* the additional paths to the library and tapes using zoning, LUN masking, persistent binding or software. Figure 4-8 shows how we could setup a zone to eliminate dual pathing so that there is only one connection from the host to the tape devices. The physical FC connections enclosed in the circled zone could be zoned by WWN or physical port connection on the FC switch creating a single path between host and tape drive.

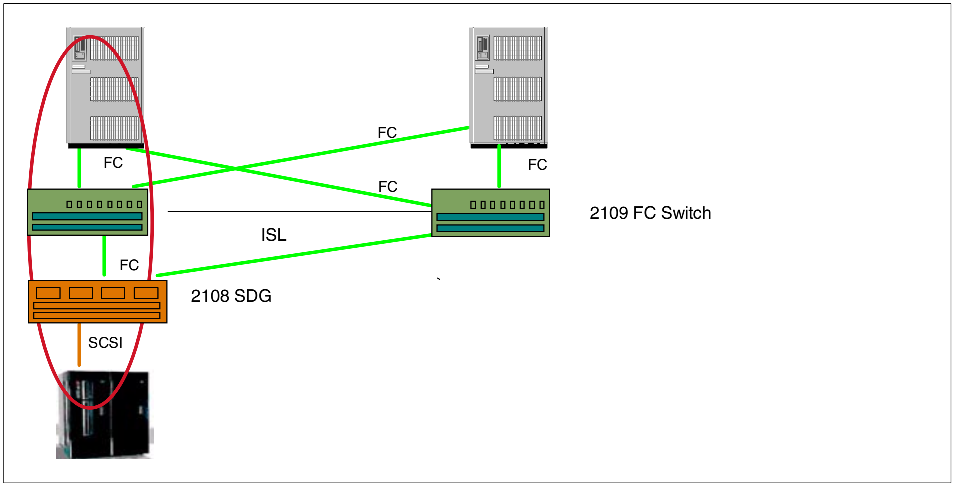

Figure 4-8 Zone to restrict the tapes to one HBA only

Some common information about zoning:

- Zones can be configured dynamically.
- Configuring new zones does not interrupt traffic on unaffected ports or devices. Also new zones do not affect data traffic across interswitch links (ISLs) in cascaded switch configurations.
- Zoning configuration is generally a function of the Switch device/devices. For an IBM 2109, zoning can be configured and administered by telneting to the switch or using the GUI IBM StorWatch Specialist.
- Devices can belong to more than one zone.
- Zoning can be administered from any switch in the fabric.
- Changes that are configured to one switch automatically replicate to all switches in the fabric; if a new switch is added to an existing fabric, all zone characteristics are automatically applied to the new switch. Because each switch stores zoning information, zoning ensures a high level of reliability and redundancy.

For detailed information on setting up zoning, please refer to the SAN redbooks cited in the introduction to this chapter.

4.2.1 Types of zoning

There are two types of zoning used: hardware zoning and software zoning.

Hardware zoning

Hardware zoning is based on the physical fabric port number. It can be implemented in the following configurations:

- One to one
- One to many
- Many to many

Disadvantage:

Zoning configuration can become unusable if the device is connected to a different port, since hardware zoning relies on each device being connected to a specific port.

Advantage:

Hardware zoning works independently of influence from other sources, such as HBA firmware. The switch hardware ensures that there is no data transfer between unauthorized zone members. However, devices can transfer data between ports within the same zone. Consequently, hard zoning provides the greatest security possible. Use it where security must be rigidly enforced. Hardware zoning also has a very low impact on the routing performance.

If you use hardware zoning you must carefully document and update your SAN Fabric - but then, documentation is a necessary task anyway for managing a SAN.

Software Zoning

Software zoning is implemented within the Simple Name Server (SNS) running inside the fabric switch. In a soft zone, at least one zone member is specified by WWN. When a device logs in, it queries the name server for devices within the fabric. If zoning is in effect, only the devices in the same zone(s) are returned. Other devices are hidden from the name server query reply.

The members of a zone can be defined with:

- Node WWN (WWNN)
- Port WWN (WWPN)

Advantage:

Software zoning is not affected by moving devices to different physical switch ports. If you use WWNs for the zone members, even if a device is connected to another physical ports, it will still remain in the same zoning definition because the device’s WWN remains the same.

Disadvantage:

Each component of the SAN fabric must support soft zoning.

The switch does not control data transfer so there is no guarantee against data transfer from unauthorized zone members.

You can intermix hardware and software zoning.

4.2.2 Another zoning example

In this example, shown in Figure 4-9, there are multiple tape drives and HBAs. You might use zones as shown so that the drives are split between the HBAs for performance or security reasons. Without zoning or other configuration, you would see the same dual pathing issue as shown in the previous section.

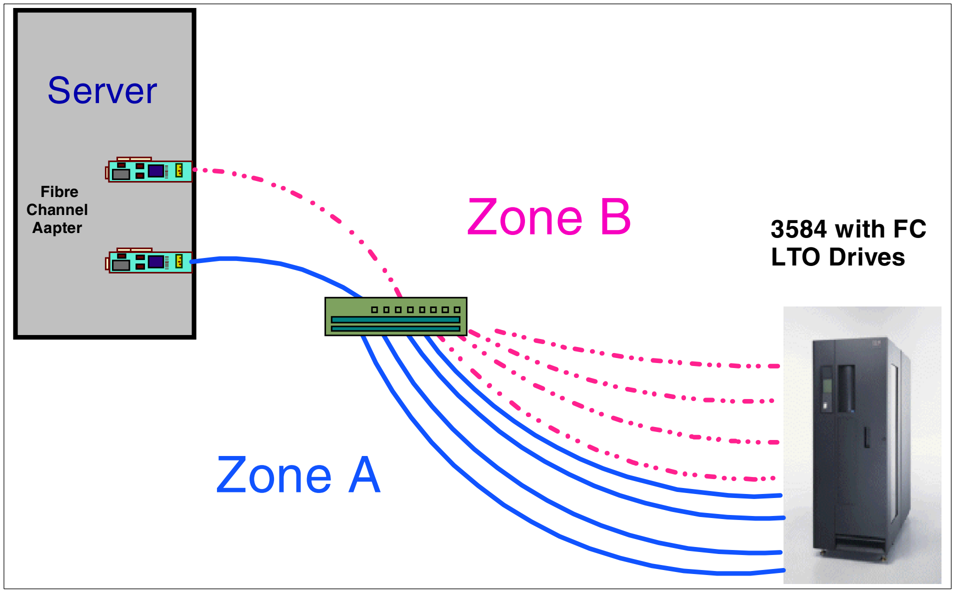

Figure 4-9 3584 with 8 FC LTO Drives, one Server with 2 HBA and 2 Zones

But you may also manage this scenario by using persistent binding as the next section will show.

Note: For performance reasons, it is strongly recommended not to mix tape and disk devices on the same HBA.

4.3 Persistent binding

This function allows a subset of discovered targets to be bound to a HBA. Some operating systems do not guarantee that devices will be allocated the same SCSI target ID after a system or device outage. This can cause problems for application software that expect tape devices to always have the same SCSI target ID/LUN. Persistent binding allows a tape device's WWN to be bound to a specific SCSI LUN.

4.3.1 Persistent binding with a QLogic HBA

The QLogic QLA-2200F HBA does not currently support persistent binding or mapping of LUNs with Windows 2000.

4.3.2 Persistent binding with a Emulex HBA

Emulex provides a configuration tool with the multiport driver called **elxcfg** which provides persistent mapping of device LUN's to HBA's.

In order to control persistent mapping the multiport driver needs to be installed. See 2.3.7, "Emulex Multiport driver" on page 90 for more details.

Having installed the multiport driver, we can now use **elxcfg** to configure persistent LUN mapping. Run **Start -> Program -> Emulex_Configuration_Tool**.

Under **Adapter Controls** select LUN Mapping, but not Automatic LUN Mapping as shown in Figure 4-10.

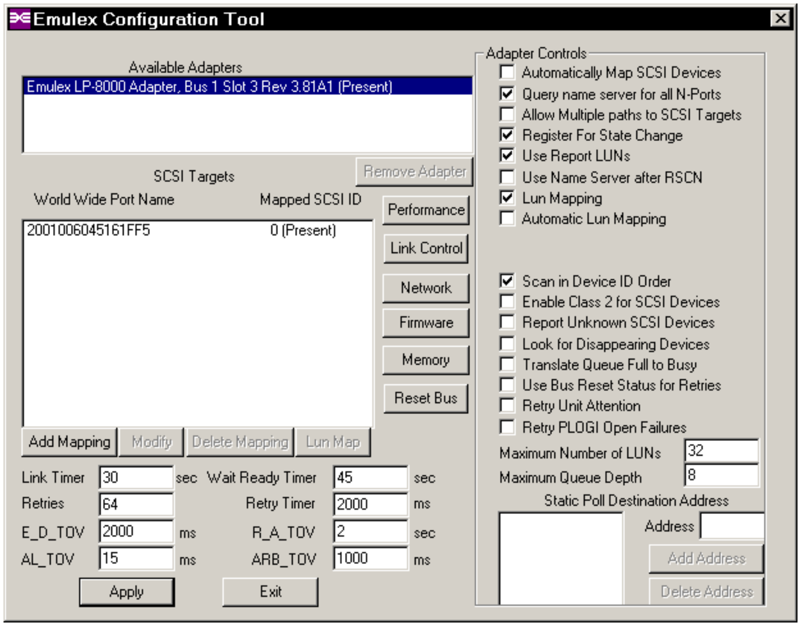

Figure 4-10 Configuring LUN Mapping

Select the WWN to which the LUN's to be mapped are attached (Figure 4-11). In our case, it was a SAN Data Gateway with a 3583 library.

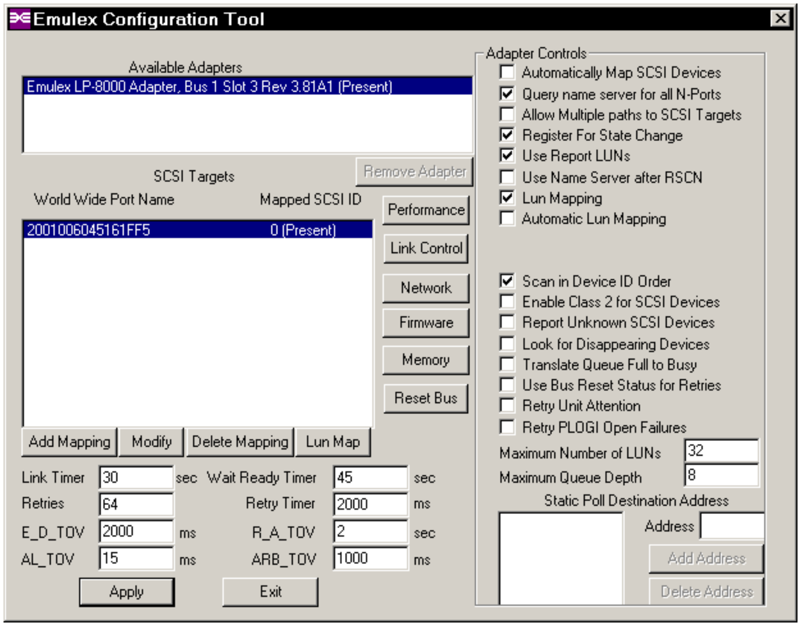

Figure 4-11 Select WWN

After selecting the WWN, the options for mapping LUN’s are enabled. Select **Add Mapping**. The Lun Mapping window will display as shown in Figure 4-12.

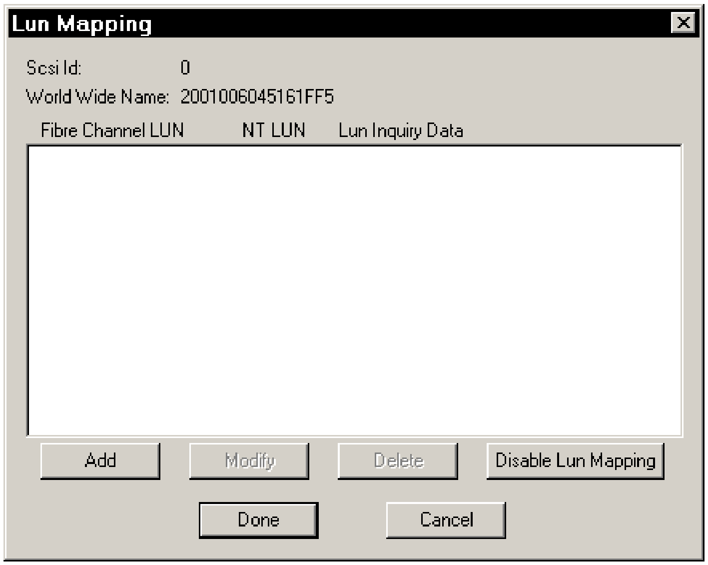

Figure 4-12 LUN Mapping window

Click the **Add** button and a list of LUN's associated with the SAN Data Gateway appears (Figure 4-13).

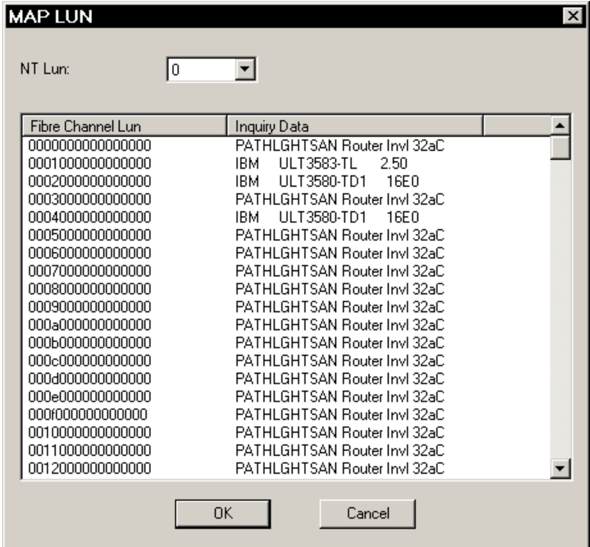

Figure 4-13 LUN list

You cannot select all the LUN's to be mapped in one step - you have to map each LUN individually. Select the LUN to be mapped (Figure 4-14) and click **OK**. It will be moved from this table into the previous window. in our case we want to select the LUNs associated with the two drives and the medium changer.

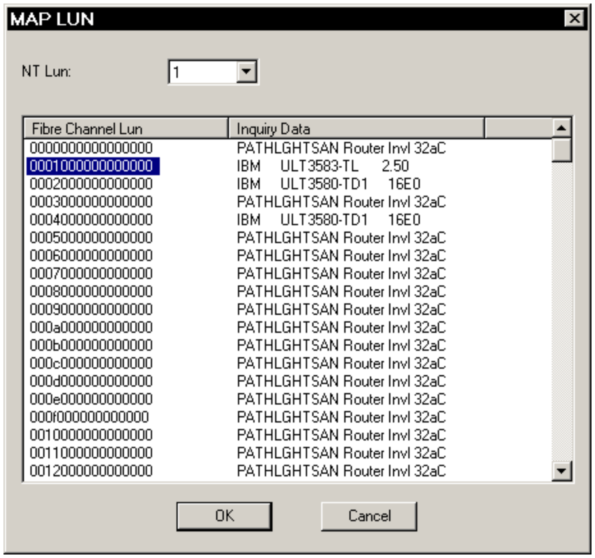

Figure 4-14 Selecting a LUN to be mapped

Repeat for each of the two drive LUNs. After all the LUN’s have been added, they are now displayed in the LUN Mapping window, shown again in Figure 4-15. Select **Done** to complete the configuration.

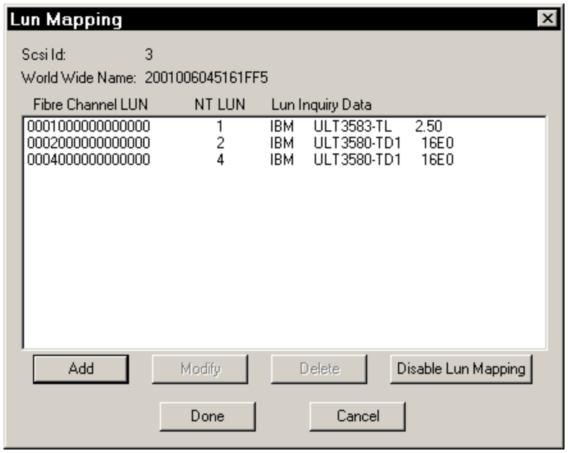

Figure 4-15 LUN’s to be mapped

The primary window is now displayed (Figure 4-16). Note that the WWN from which we mapped the LUNs, now shows three managed LUNs (in the Mapped SCSI ID column). Select **Apply** to apply and save the configuration. The LUN's are now mapped to the HBA. Note that one or more system reboots might be needed to activate the function.

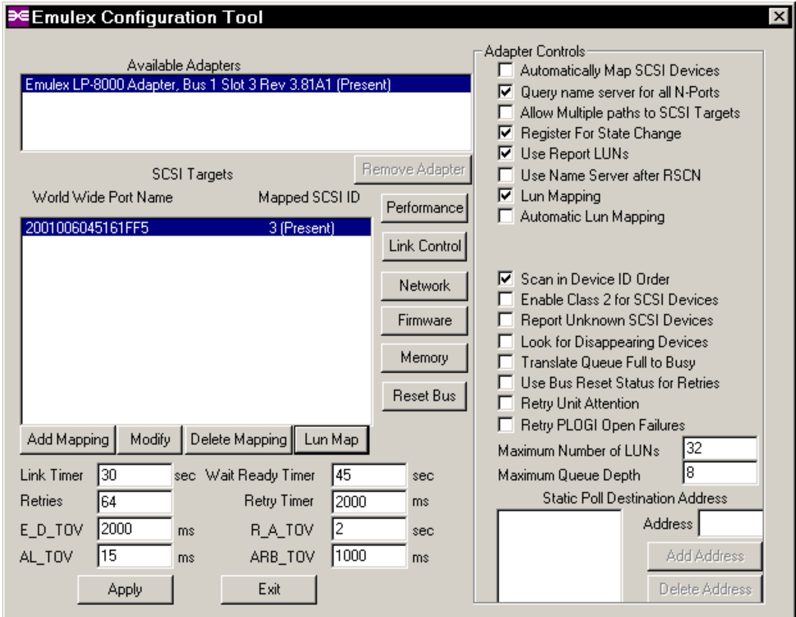

Figure 4-16 Saving the LUN map

Having mapped the LUN's, if devices were to fail or go missing, those devices remaining should retain their mapped LUN values.

4.4 LUN masking

LUN masking is used to control host access to storage objects (LUNs). These storage objects are typically a subset of storage from a much larger physical device that is connected to the SAN. A SAN connected tape drive also exhibits the same SCSI ID characteristics as a disk LUN. Hence, host access to tape devices can be controlled using LUN masking.

LUN masking can be implemented in three different ways:

- LUN masking in the SAN fabric
- LUN masking at the server

- LUN masking at the storage device

We will not consider LUN masking at the SAN level. It would unacceptably increase the latency time for data transfers due to the mechanisms needed to manage each LUN/target pair.

LUN masking can be implemented at the server system. The server system would have access to all LUN devices, and the server would have a table indicating which LUNs to ignore. The LUN masking method will only work based on trust. There are HBAs available that implement the LUN masking function at the HBA driver level. Using this mechanism, a tape LUN could be masked to specific HBAs in the SAN or a specific HBA on server hosting multiple adapters resolving dual pathing problems.

The most common method of LUN masking in a SAN is at the storage device. Most storage subsystems and data gateway devices support LUN masking. In the case of the IBM SAN Data Gateway (SDG), LUN masking is supported in the device and this allows us to control HBA access to any attached tape devices.

4.4.1 LUN masking using QLConfig

LUN masking is available for the QLogic 2200 HBAs. The QLConfig program comes as a seperate program from the QLogic HBA device drivers. The installation and setup of the QLConfig program is discussed in 2.3.2, “QLogic QLA2200F HBA driver configuration” on page 69.

In this example using one server, we will display duplicate HBA paths to the same physical devices and show how to use QLConfig to limit access to each device via a single HBA FC path.

Execute the QLConfig program, select the target machine and enter the connection password (Figure 4-17).

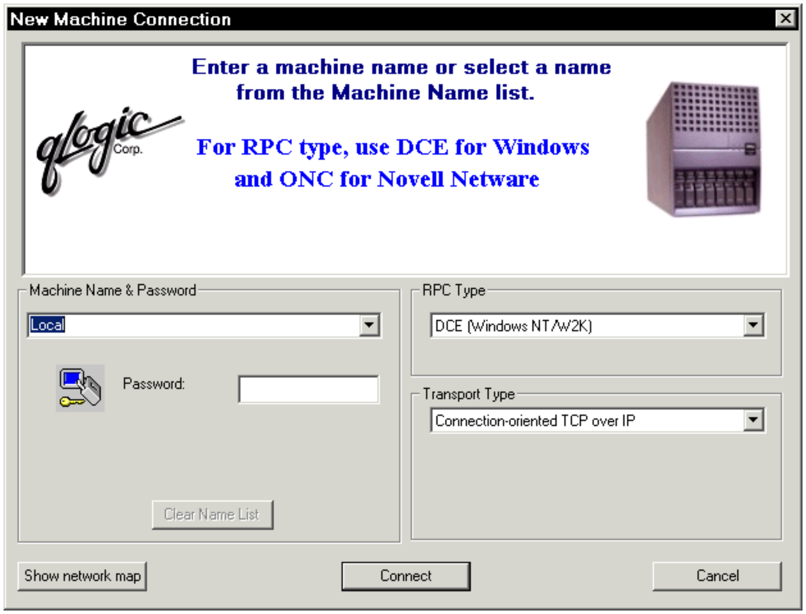

Figure 4-17 QLConfig main window

The HBA's in the selected machine will now be displayed as in Figure 4-18. From this screen we can drill down each entry and list the attached LUN's and any existing LUN masks or create new LUN mask configurations. Drill down each HBA by clicking on the Plus signs.

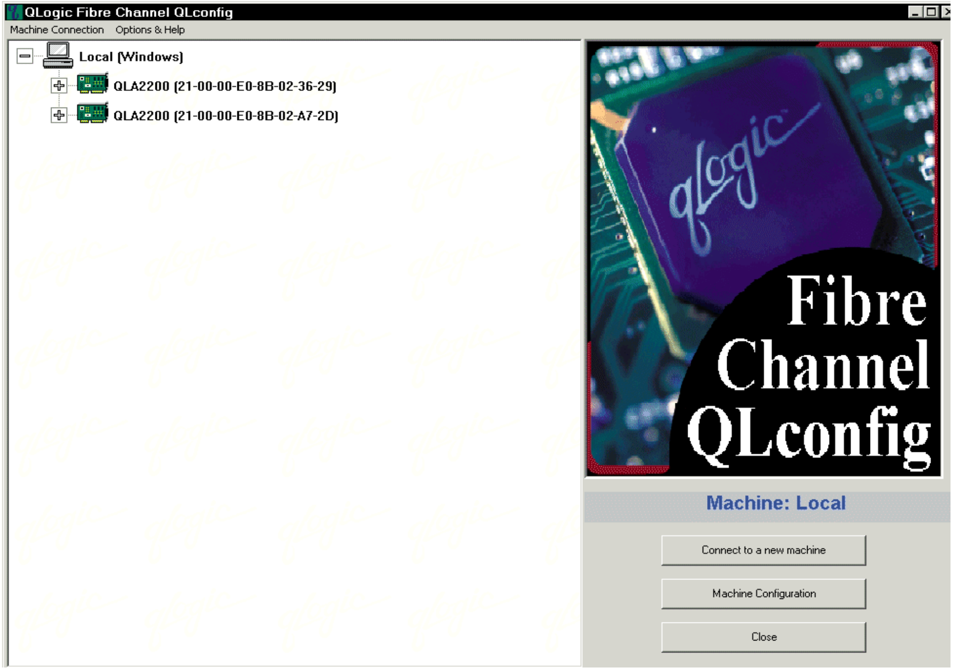

Figure 4-18 HBA Configuration

The LUN's associated with each HBA are displayed (Figure 4-19).

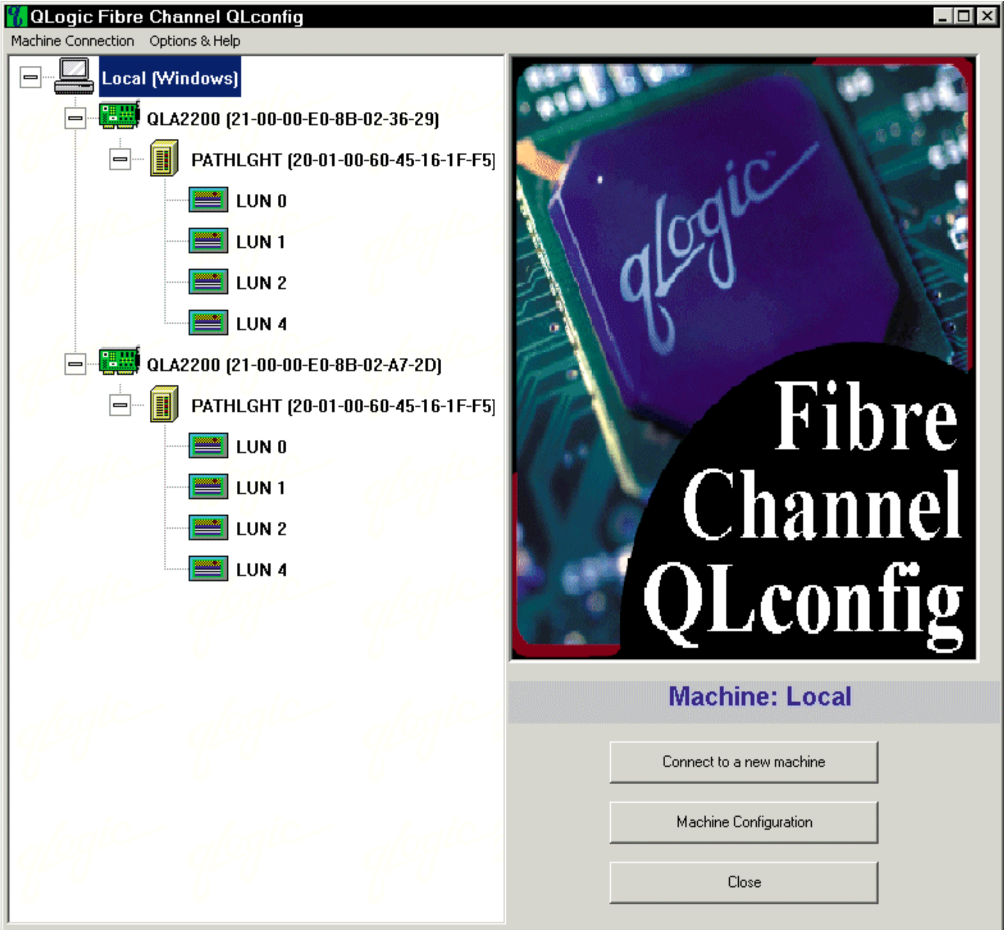

Figure 4-19 LUN Configuration

Windows traverses each FC path seperately during device configuration and will configure each device it discovers as a seperately managed device. Hence, two changers and four drives are shown in Device Manager as in Figure 4-6 on page 176. Figure 4-19 represents the FC paths and the devices associated with each HBA. The LUN 0 entries are the SAN Data Gateway, LUN 1 entries are the changer, LUN's 2 and 4 entries are the tape drives.

With LUN masking we can restrict access to individual LUN's for each FC path. Windows does not control this function, this is a function of the HBA driver. Windows Device Manager will still show two changers and four drives, but the QLogic driver will restrict access to masked LUNs based on the rules for each FC path. Should you attempt to access a masked LUN, you will get an I/O error.

To create the LUN masking, select **Machine Configuration** from the lower right hand corner to display the Device and LUN Configuration window (Figure 4-20).

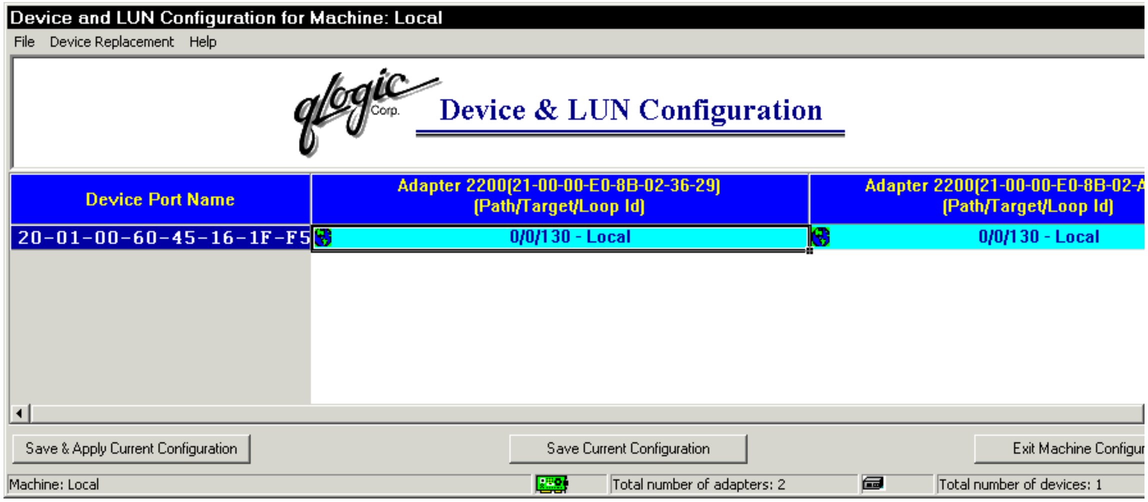

Figure 4-20 Device and LUN configuration

The WWN name of the SAN Data Gateway is listed above. Each HBA is listed to the right, indicating that there are two paths to the Gateway. If we right mouse click on an HBA entry we can display the list of attached LUNs with descriptions (Figure 4-21).

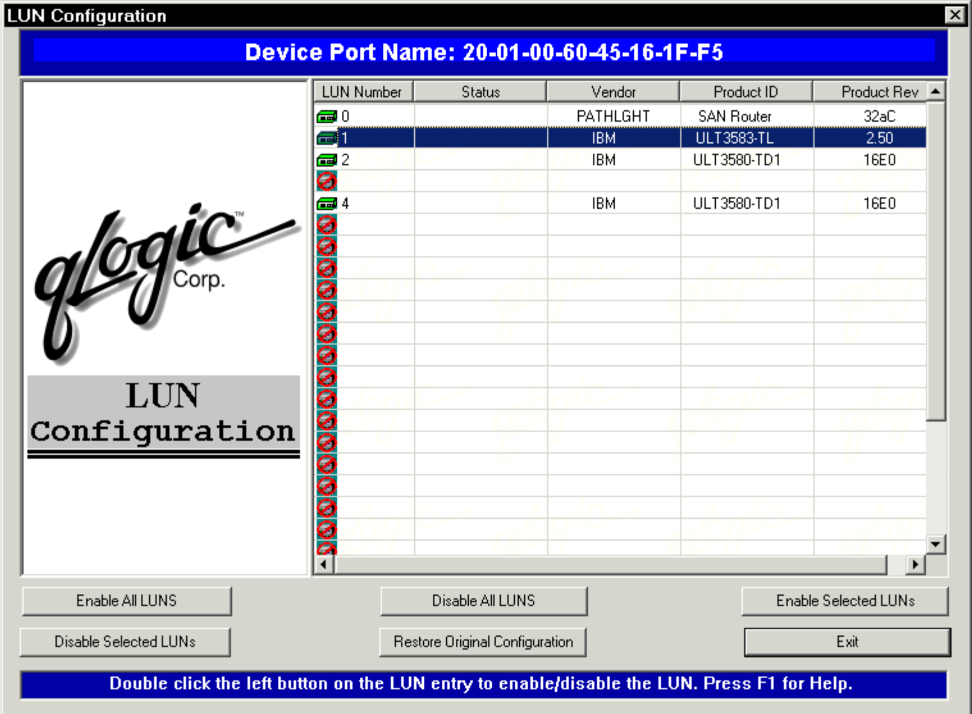

Figure 4-21 LUN devices

Having displayed the individual LUN’s, we can now enable or disable access to these devices on this HBA. Select the LUNs to be disabled then use the **Disable Selected LUNs** button. Alternatively, you can double click the left button on the LUN entry to toggle enable/disable. Highlight the device/devices to be masked from this adapter and disable the selected device/devices. The display wil now show as in Figure 4-22.

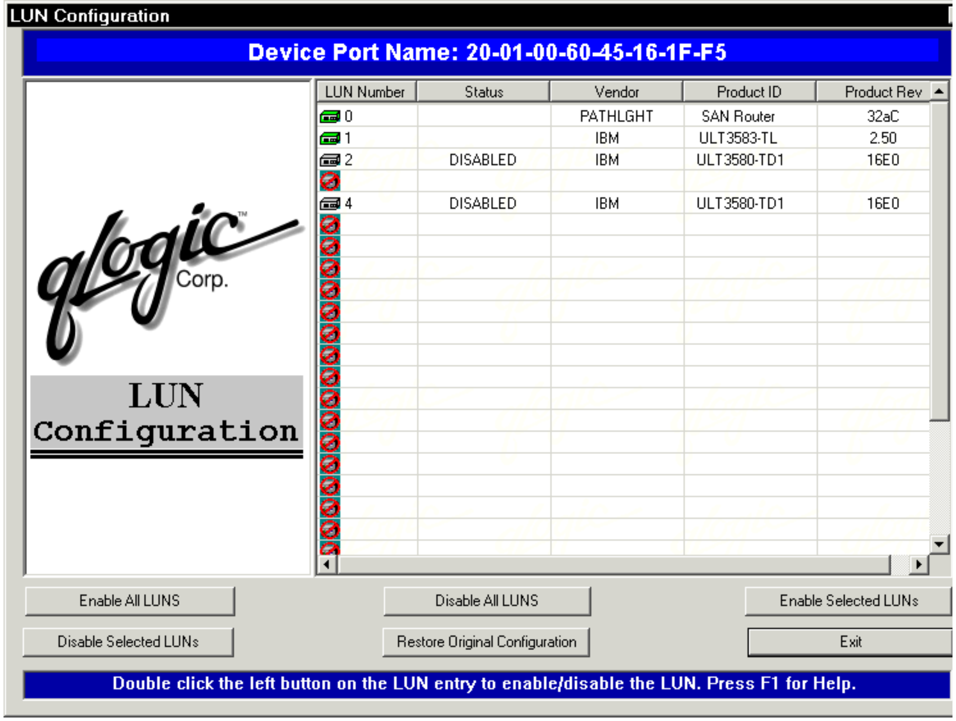

Figure 4-22 Disabled LUN's

Exit the LUN configuration window. In the Device and LUN Configuration window (Figure 4-20), save the configuration.

Exit the Device and LUN Configuration window. The masked LUN's can now be displayed by drilling down each HBA (Figure 4-23).

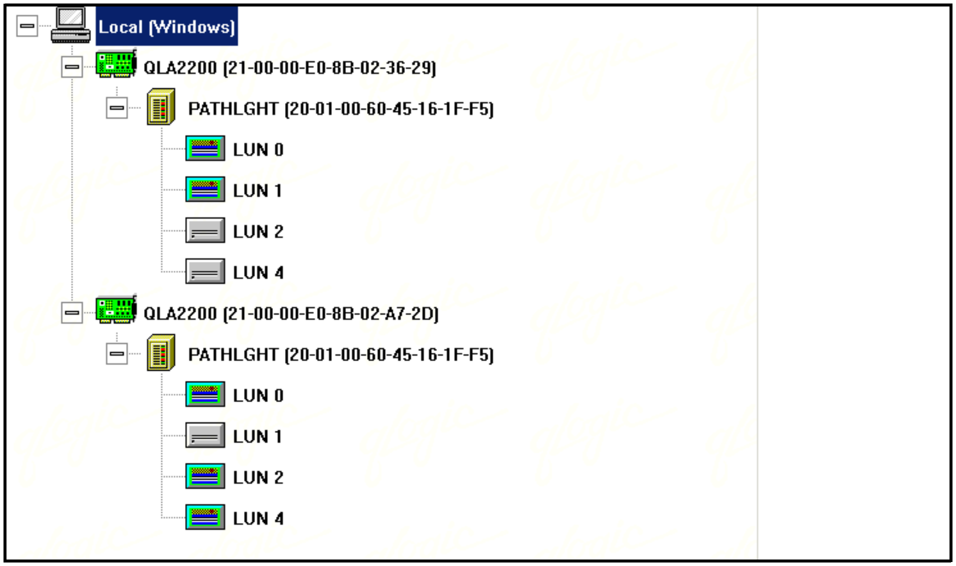

Figure 4-23 Masked LUN's

Those LUN's highlighted in green are accessable. The LUN's in grey are masked. Compared with the original LUN configuration shown in Figure 4-19 on page 190, LUN 2 and LUN 4 have been masked from the first HBA and LUN1 has been masked from the second HBA.

Part 2

LTO Ultrium with applications

In this part we describe how to implement LTO Ultrium drives and libraries with popular backup software packages.

5

Configuring RSM

This chapter describes the steps necessary to enable Microsoft Removable Storage Manager (RSM) to use an LTO library.

5.1 Removable Storage Manager

Removable Storage Manager (RSM) is a standard interface in Microsoft Windows 2000 to control most types of removable media, including CD-ROM, DVD-ROM, magneto-optical, Jaz, and Zip in both standalone and library configurations. RSM is installed by default on all version of Windows 2000 and can be used to manage anything except the A and B floppy drives.

RSM is available on all versions of Windows 2000 -- Professional, Server, Advanced Server, and Datacenter. RSM uses functionality that is new to the NTFS 5 filesystem, so there are no plans to port RSM to Windows 95/98 or Windows NT 4.0.

RSM models all changers as subsets of an "ideal" changer. A given minidriver tells RSM what functionality the actual changer implements so that RSM can treat it appropriately. The implementation of the features varies from changer to changer, but client applications can access them in the same way, using the ideal model. This library model supports changer-based libraries as well as stand-alone drives, by simply modeling them as changers with one drive, no slots, and no robot.

Client programs such as backup applications and Hierarchical Storage Management (HSM) services can RSM to gain access to their media. Essentially, RSM is an API that is called by these programs to make media accessible. Once media is accessible, these client programs use other Microsoft Win32 APIs to read and write the media. In addition, there is a Microsoft Management Console (MMC) snap-in client (called "Removable Storage") that provides a human interface to most functionality such as inject/eject, cleaning, and so on.

5.1.1 RSM benefits

Here are some of the benefits of including media and device management into the operating system with RSM.

Common drive model

RSM implements a common driver model. A single driver will allow a tape library to be used with any RSM-compatible application. Conversely, an RSM-aware application will work with all changers on the market that have RSM drivers.

Library sharing

Multiple applications can now share a single library. Previously, a user who wanted to use backup and HSM solutions from two different vendors needed two changers. With RSM, both applications can share the same changer.

Abstraction of offline media

A backup application does not need to worry about whether a tape is in a changer or on a shelf. It simply requests the media, and RSM loads it or asks an operator to fetch it, as appropriate.

Media tracking

RSM tracks recognised media in an internal database. Applications can register with RSM so that it can identify their media. They can also use the API to search the database and load particular media.

5.1.2 Software support

Care must be taken when using RSM with pre-existing or legacy storage management applications. By default, RSM binds exclusively to all media changers on the system. This will break applications that expect to access these changers through other methods. All legacy applications that are changer-aware must be reauthored to access changers through RSM. Disabling RSM control of the device might allow the application to function, but this has not been widely tested and will not be supported by Microsoft.

The Windows 2000 Backup application uses RSM for tape media, but not for media with file systems (such as Zip or Jaz). The HSM tool called RSS (Remote Storage Server) that is included with Windows 2000 Server uses RSM to interface with tapes. Many third-party data management application vendors are currently working on RSM-aware versions of their applications. If you have software partners, check if they are working or have available, RSM versions of their applications.

5.2 RSM implementation

RSM keeps a database of all media, organized by both pool and media type. Each application creates its own pool, so (for example) backup media and HSM media can be identified separately, even if they are present in the same library. The database is system-wide, so a tape removed from a library and inserted into a standalone drive on the same system will still be properly identified.

5.2.1 Enabling RSM

The environment for the RSM configuration is shown in Figure 5-1 and consisted of:

- Intel Pentium II server with Windows 2000 Advanced Server (build 2195).
- Adaptec 29160 LVD SCSI card

- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives
- VERITAS Backup Exec version 8.6. revision 3808.

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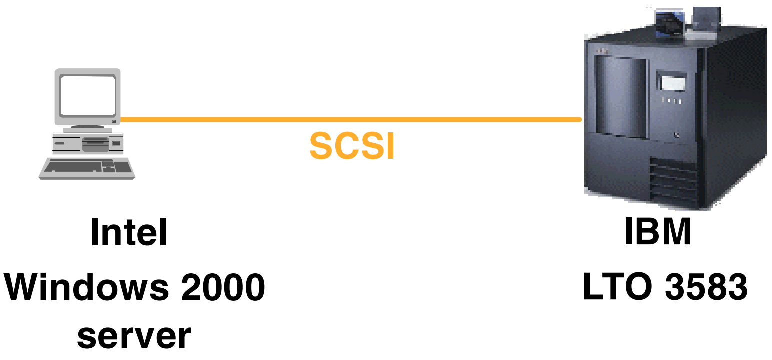


Figure 5-1 SCSI lab environment

5.2.2 Attaching the 3583

We performed the following steps to attach the 3583 library to the server:

1. Shutdown Windows
2. Install SCSI card
3. Boot system
4. Install latest Ultrium device drivers
5. Verify RSM service is enabled
6. Shutdown Windows
7. Attach 3583 library
8. Boot system

Install SCSI card

Follow the instructions in 2.2.2, “Installing the SCSI adapter” on page 30 to install and configure the SCSI card and drivers.

Verifying RSM

RSM comes as a base component of Windows 2000 and is installed as a service. The default behaviour of the RSM service is to start automatically. To verify everything is working correctly, first check the RSM services (**Start -> Programs -> Administrative Tools -> Computer Management -> Services and Applications -> Services.** Scroll to the RSM entry as shown in Figure 5-2.

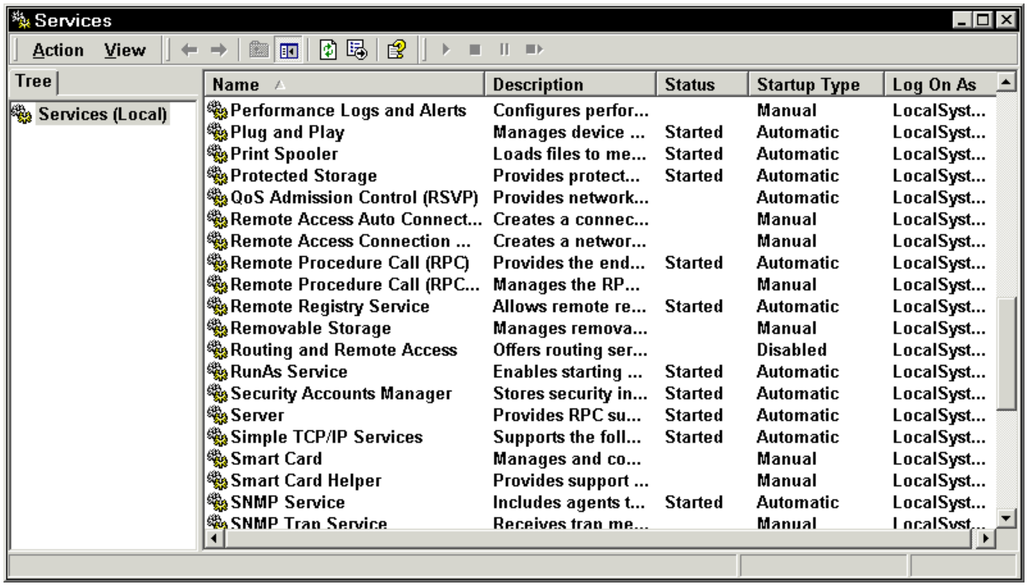


Figure 5-2 Windows 2000 system services

If you right mouse click on the **Removable Storage** entry and select **Properties**, you can display the service properties for RSM. Ensure that the startup is set to automatic. If not, change it as shown in Figure 5-3.

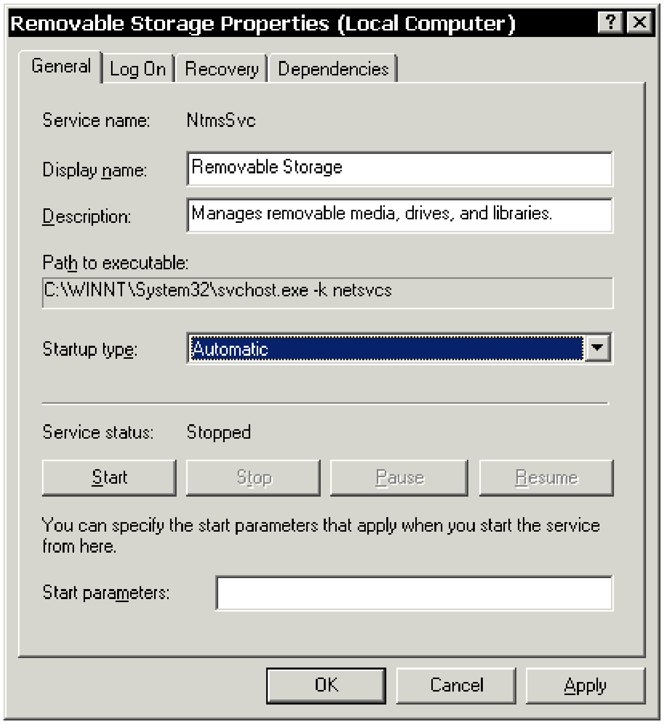


Figure 5-3 RSM Services properties

Now when we reboot the system, RSM will start automatically. Shut down the server, connect the 3583 library device, and reboot. RSM will discover the library and associated tape drives and make them available for data backup and restore.

Verifying 3583 connection

There are two parts for verifying the 3583 function:

- Determine that Windows 2000 has correctly seen the device.
- Determine that RSM has identified the device and is correctly manipulating the changer and drive functions.

The process of correctly installing the library and the Utrium drivers is described in 2.2, “LTO installation for Windows 2000 with SCSI” on page 29.

To verify RSM connectivity to the changer and drives using RSM, access the RSM interface: **Start -> Programs -> Administrative Tools -> Computer Management**.

From the **Storage** heading, select **Removeable Storage** as shown in Figure 5-4.

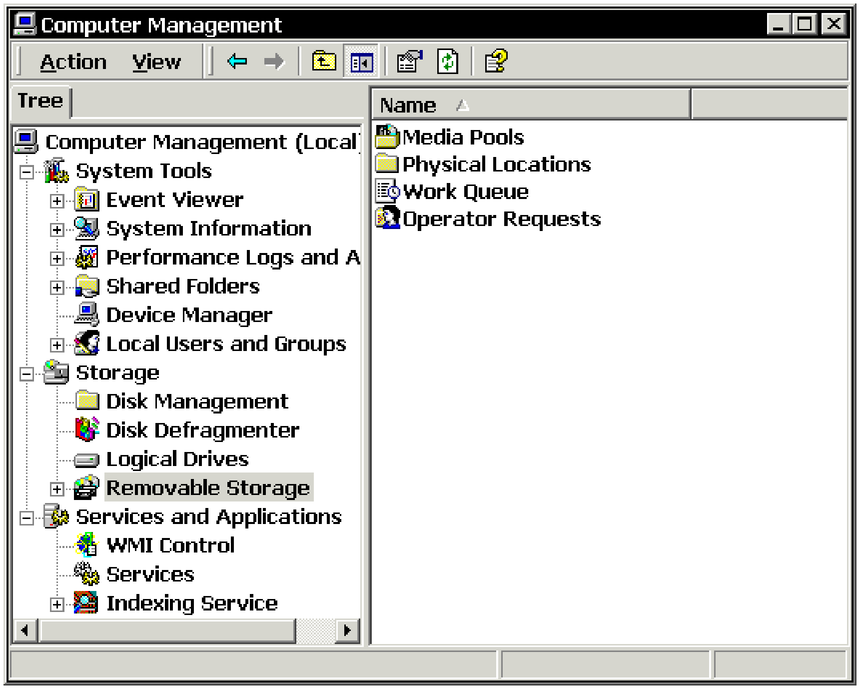


Figure 5-4 Removable Storage administration

This will display objects and fields associated with RSM. In Figure 5-5 we have selected the **Physical Locations** and the library.

.

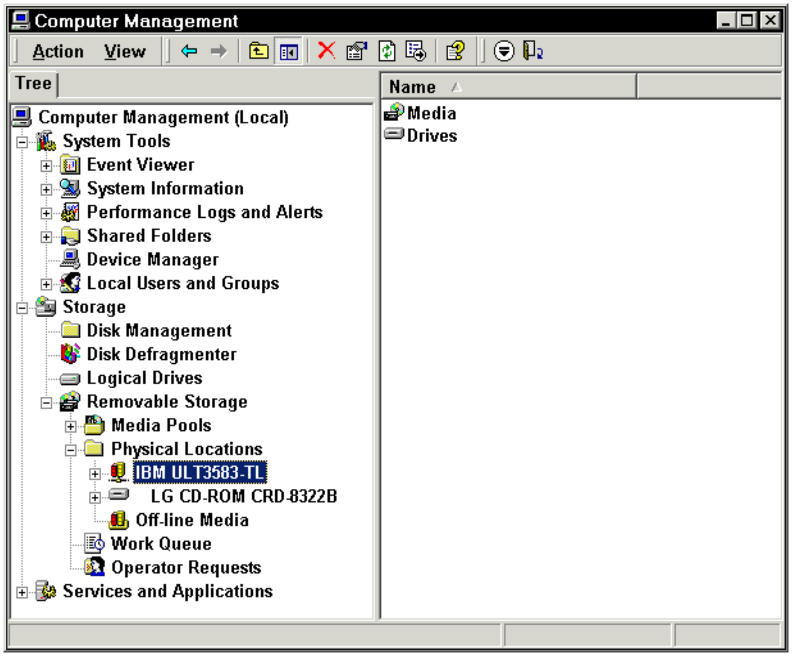


Figure 5-5 RSM library

We now select the drive objects associated with the library (Figure 5-6).

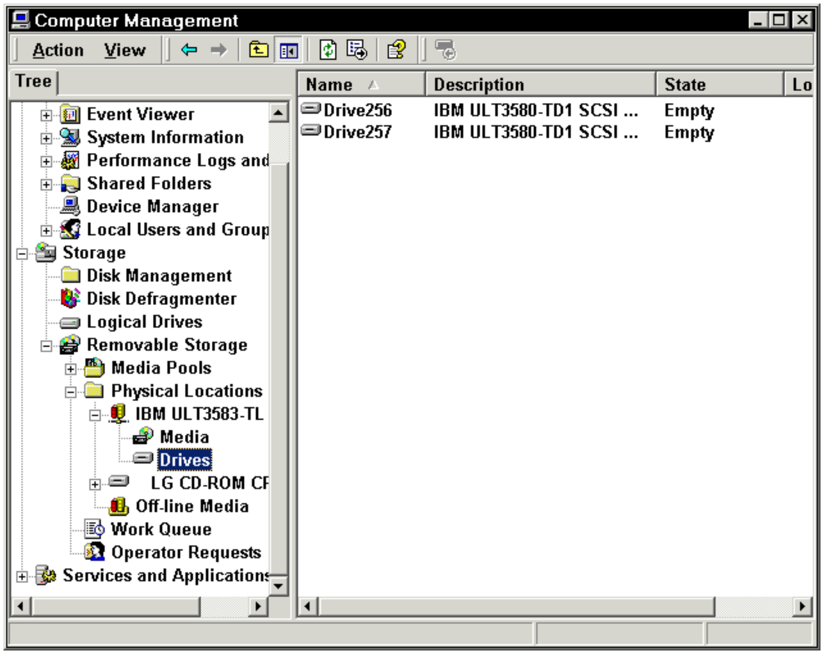


Figure 5-6 RSM drives

If we have been successful in seeing these physical objects then the configuration should be acceptable to RSM. The final check is to physically install media and then **prepare** the media for use. This process exercises the library and drives and verifies the configuration. Select **Media Pools** and expand each category. Media not containing valid data is listed under **Free->LTO Ultrium**. These tapes need to be "idle, available" for RSM usage.

The default media pools are:

- Free - tapes that do not contain backup data. These tapes are available for usage once they have been prepared
- Import - these are tapes that have been imported into the library through an I/O port. These tapes will be moved to the Free media pool once they have been prepared.
- Unrecognized - these tapes have formats that are not recognised by RSM.

In Figure 5-7, a volume from the Free media pool is being prepared. Select **Prepare** from the pulldown menu for this volume**.**

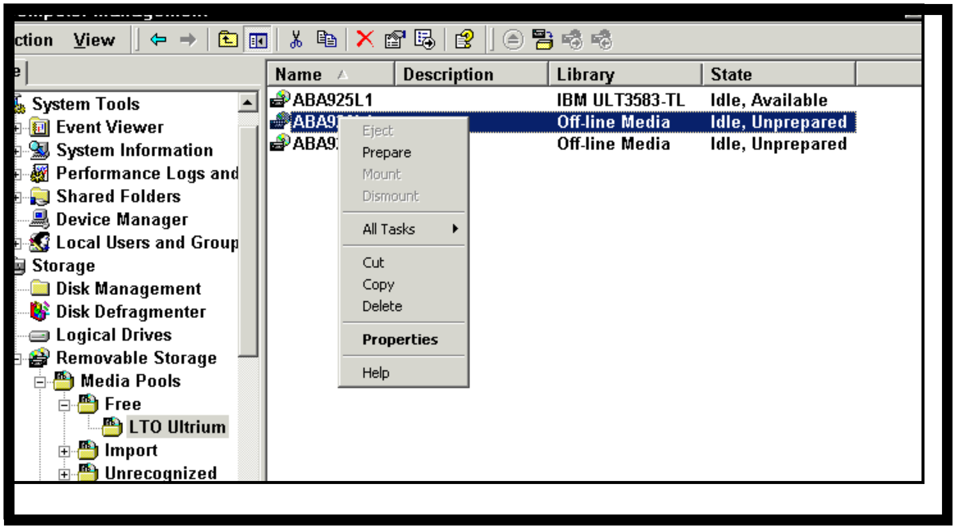


Figure 5-7 Preparing tapes

The Prepare step needs to be performed for any media you want RSM to use. A volume that contains valid backup data (ABA925L) is shown in Figure 5-8.

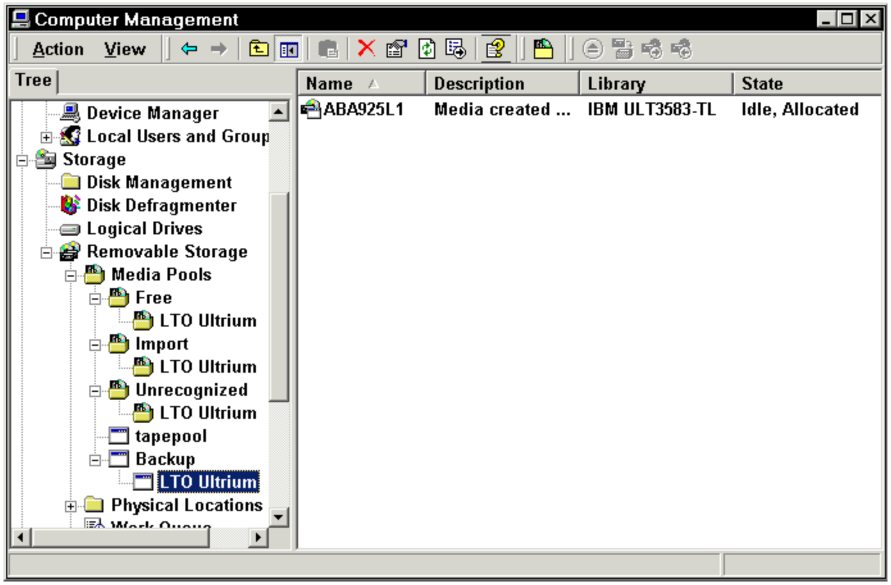


Figure 5-8 Allocated media

5.3 RSM with a SAN

It is not possible (by default) to use RSM to drive the LTO medium changer in a SAN attached configuration. RSM can only auto-configure a robotic library when the following conditions are true:

- The robotic library hardware unit supports drive element address reporting with the Read ElementStatus SCSI command. (Consult the manufacturer to find out if your library hardware unit supports this feature).
- All drives inside the robotic library are on the same SCSI bus as the library itself.
- The TAPE library is NOT attached to a Fibre Channel Switch. (This may change in future versions of RSM.)

RSM will attempt to auto-configure the libraries attached to the SAN Data Gateway (SDG) but is unable to do so, since the SDG remaps SCSI device ids and LUNs. Consequently, RSM is unable to resolve the SDG addresses with those contained in the Read Element Status data for the drives. For Fibre-Channel attached drives in a 3584, typically a switch would be involved. RSM devices, however, may be configured using the RSMConfg.exe tool in the Windows 2000 resource kit utility or manually by editing the registry. To edit the registry, the following procedure is required:

- Stop RSM by typing the following command at a command prompt:

```
net stop "removable storage"
```

- Backup the RSM database by copying the files in the %SystemRoot%\System32\Ntmsdata folder to another (secure) location
- Restart RSM by typing the following command at a command prompt:

```
net start "removable storage"
```

- Using the RSM console, make a note of all the drives that appear as stand-alone drive libraries. RSM displays all drives that are not mapped to a changer as stand-alone drive libraries, including drives that are actually in the changer but are unmapped.
- Eject any tapes that are located in the drives in the library.
- Place a disk in a drive in the library you are trying to configure, either by opening the library door or through a front panel and port (refer to your changer's documentation for details about how to do this). Click Refresh in the RSM console for each of the stand-alone drives, and locate the drive that now shows that it contains a tape. Open the Property sheet for that drive and note the device name on the Device Information property page (for example,

\\.\Tape0). Repeat this step for each drive in the changer that you are trying to configure.

- Click Start, click Run, type regedt32.exe, and then click OK.
- Locate the following registry key (as shown in Figure 5-9):
- HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\NtmsSvc\Config\Changerx

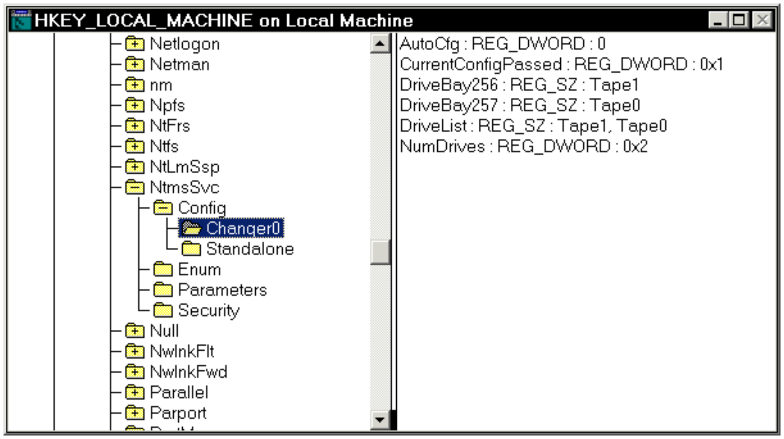


Figure 5-9 Registry changer key

- Change the AutoCfg:REG_DWORD:0x1 value to 0. If AutoCfg does not exist, create a new value called AutoCfg with a data type of REG_DWORD, and then type 0 for the data.
- Stop RSM again.
- In Registry Editor, locate the following registry key:
- HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\NtmsSvc\Config
- The Config key contains a subkey for each changer (for example, Changer0) and a subkey for each stand-alone drive. Each changer subkey contains an entry for each drive bay in the changer (for example, DriveBay0).
- For each DriveBayx entry that has a ??? value, replace that value with the device name extracted in step 6 with the drive in that bay without the leading "\\.\" characters (for example, Tape3). For example:
- DriveBay0:REG_SZ:Tape0
- DriveBay1:REG_SZ:Tape1
- Exit Registry Editor.

- Restart RSM. RSM reads the new configuration information and initializes the devices.
- Using the snap-in, put a tape in each drive in the library after RSM is initialized. If any of the configurations are incorrect, RSM generates an error message during the initialization or when you insert a tape in a drive.
- If the manual configuration is unsuccessful, stop the RSM process. Copy your backup version of the RSM database files back to the %SystemRoot%\System32\Ntmsdata folder to restore the database and restart the manual configuration process.

If RSM does not generate any error messages, the manual configuration was successful. You should be able to now use SAN-attached devices with RSM-aware applications.

6

Configuring Tivoli Storage Manager on Windows 2000

This chapter describes the installation and implementation of Tivoli Storage Manager (TSM) 4.2 in Windows 2000 environments. We tested the interaction of Tivoli Storage Manager with the 3583 Ultrium Scalable Tape Library. In particular we confirmed TSM's ability to:

- achieve normal backup/restore processing
- allow multiple servers to share the 3583 library
- provide LAN-free backup services
- backup a NAS system via NDMP

We begin with a brief overview of Tivoli Storage Manager. You can get more indepth information on this product in the following redbooks:

- *Tivoli Storage Management Concepts Guide*, SG24-4877
- *Getting Started with Tivoli Storage Manager: Implementation Guide*, SG24-5416
- *Using Tivoli Storage Manager in a SAN Environment,* SG24-6132

6.1 Tivoli Storage Manager overview

Tivoli Storage Manager is part of the Tivoli Storage Management product set - an enterprise-wide solution integrating automated network backup, archive and restore, storage management and disaster recovery. Tivoli Storage Manager is ideal for heterogeneous, data-intensive environments; supporting over 35 platforms and over 250 storage devices across LANs, WANs and SANs plus providing protection for leading databases and e-mail applications. See Figure 6-1.

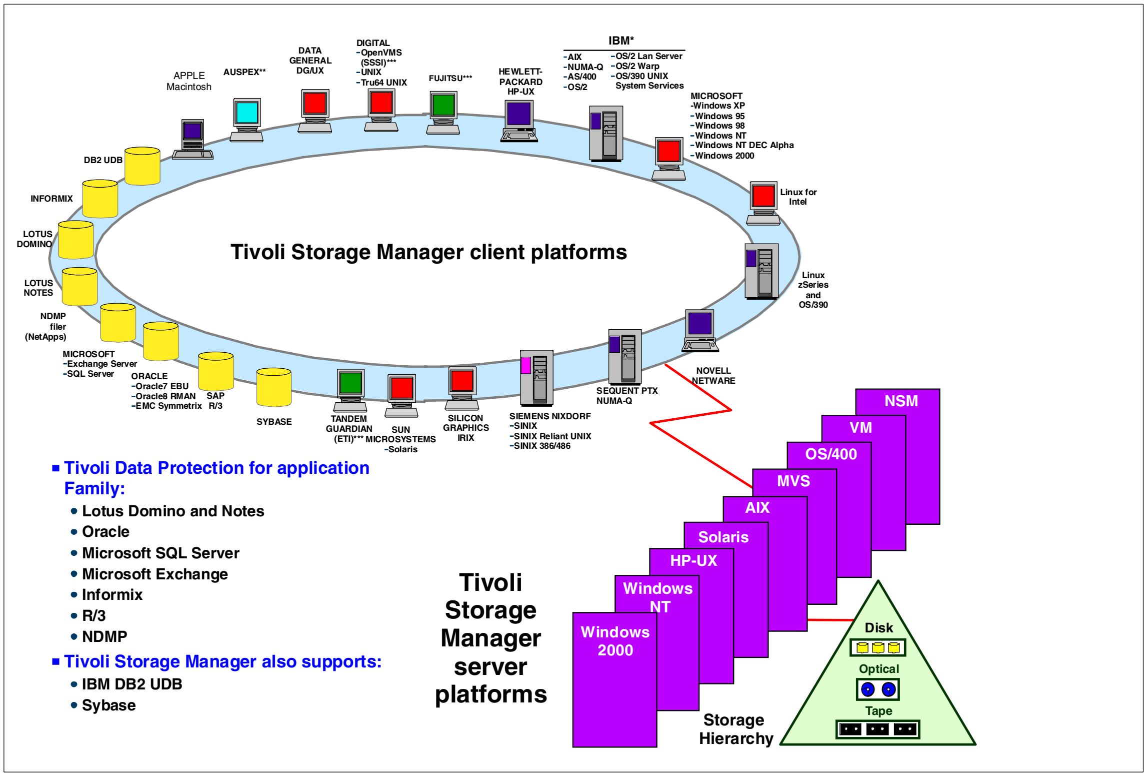


Figure 6-1 Tivoli Storage Manager supported platforms

Tivoli Storage Manager (TSM) allows users to confidently protect and manage information; it integrates unattended network backup and archive capabilities with centralized storage management and powerful disaster recovery functions. Tivoli Storage Manager is intended for companies with homogeneous or heterogeneous platforms and complex environments that include both traditional LANs as well as SANs. It is a best-of-breed, scalable storage management solution that helps provide consistent and reliable protection and management of mission-critical data that is spread across your company's enterprise. It protects a broad range of data across the enterprise from the laptop to the data center. Tivoli Storage Manager is an industrial-strength centralized storage management product for your enterprise. Tivoli Storage Manager can protect the following backup-archive clients: Windows 98/NT/2000, NetWare, Macintosh, as well as AIX, Sun Solaris, HP-UX, Linux and other UNIX variants as reflected in Figure 6-1. A Tivoli Storage Manager server is provided for OS/390, z/OS, Windows NT/2000, AIX, Solaris, HP-UX, and OS/400. This breadth of platform coverage affords you the choice in selecting the storage management platform that suits your environment and leverages your hardware and software investments. Tivoli Storage Manager can help control the cost of distributed storage management by leveraging storage resources, helping to reduce the cost of downtime and lost data, and helping to increase the productivity of storage administrators and end users.

Tivoli Storage Manager exploits the numerous advantages of SANs with its LAN-Free and Library Sharing functions. These help to remove traffic from the LAN, allow for multiple Tivoli Storage Manger servers to share a library, and off load backup processing from mission-critical servers.

Tivoli Storage Manager includes LAN-free backup/restore functionality for many Tivoli Data Protection platforms and databases as well as backup/archive clients. It exploits Tivoli SANergy to allow for LAN-free transfers to file-based storage pools on disk.

For more information about Tivoli Storage Management, visit its homepage

```
http://www.tivoli.com/products/index/storage_mgr
```

6.1.1 TSM commonly used terms

Here are a few basic TSM terms.

Server

A server is a computer system that provides services to one or more clients, or other devices over a network. A Tivoli Storage Manager server is the repository and manager of all the backed up client data. Administrative policies defined at the server control the types of backup performed and retention policies for the data. The server also manages the physical media and devices where the backed up data is stored.

Client

A client is a computer system that requests a service of another computer system that is typically referred to as a server. Multiple clients may share access to a common server. In Tivoli Storage Manager terms, a client is a computer system which has data assets requiring protection by the TSM server. The client decides what data will be backed up and is subject to the server's defined administrative policies for data retention. Typically, a client's data is backed up automatically by a server scheduled operation.

Tape library

A tape library consists of the physical robotics that move cartridges, one or more tape drives, and slots for tape storage. It must also have a mechanism for controlling the robotics (a library controller), and may also have a library manager which maintains inventory and mediates sharing. In most cases, a library does not have an built-in library manager so server-based software has to provide the library management function. As an example, the IBM 3494 has a built-in library manager, whereas the IBM 3583 does not.

Tape library sharing

Tape library sharing is two or more servers sharing the robotics of a tape library. The tape drives and slots within the library may or may not be shared among the attached servers.

TSM and tape library sharing

Now let's look at the TSM implementation of tape library sharing. This feature allows multiple TSM servers to use the same tape library and drives on a SAN to improve both tape hardware asset utilization and potentially backup/restore performance. When two or more TSM servers share a library, one server is defined as the library manager, and controls the library operations. Other servers, known as library clients, use server-to-server communications to contact the library manager and request library services. This process is shown in Figure 6-2.

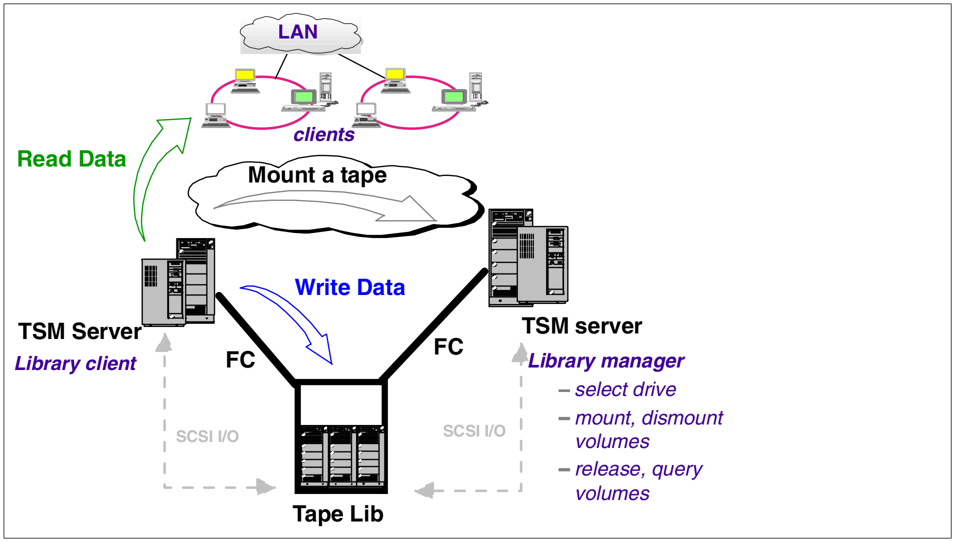


Figure 6-2 TSM library sharing overview

Library manager

The task of the library manager is to physically control the library. All the communication with the library is done by this server. The library manager will also serialize the access to the tape drives, so that only one server is using a tape drive at the same time. The checkin and checkout of volumes will be performed by the library manager. This server is the only server with a library inventory table for that library. The ownership is added to the inventory table to keep track which tape belongs to a certain library client. This is the only server in the environment that knows all the volumes The library manager can also use the library for its own purposes, without being a library client at the same time (no library client configuration is necessary on the manager)

Library client

The library client uses server-to-server communications to contact the library manager for the handling of the physical hardware. The client send the requests to the library manager, and afterwards reads or writes to the tape drive it was given access to. Server-to-server communication protocol is used to send requests from the library client to the library manager, and to send the response from the manager to the client.

LAN-free data transfer

LAN-free data transfer with TSM allows the SAN to be used as an alternative path for moving data between the TSM clients and the server. LAN-free data transfer exploits this SAN path by enabling the TSM client to backup and restore data directory to and from SAN-attached storage (disk and tape) which is shared between the TSM server and client, and managed by the client. This means that the data is not transferred over the LAN to the server as in traditional TSM backup, but transfers directly from the client to the SAN-attached storage devices. TSM currently provides LAN-free data transfer for both normal files as well as database applications through the Tivoli Data Protection products. The clients require an additional Storage Agent to be installed which directs the movement of the data from the client disk to the SAN-attached storage. This process is shown in Figure 6-3. For a complete list of operating systems and applications supported in a LAN-free environment, look at:

http://www.tivoli.com/support/storage_mgr/san/lanfree.html

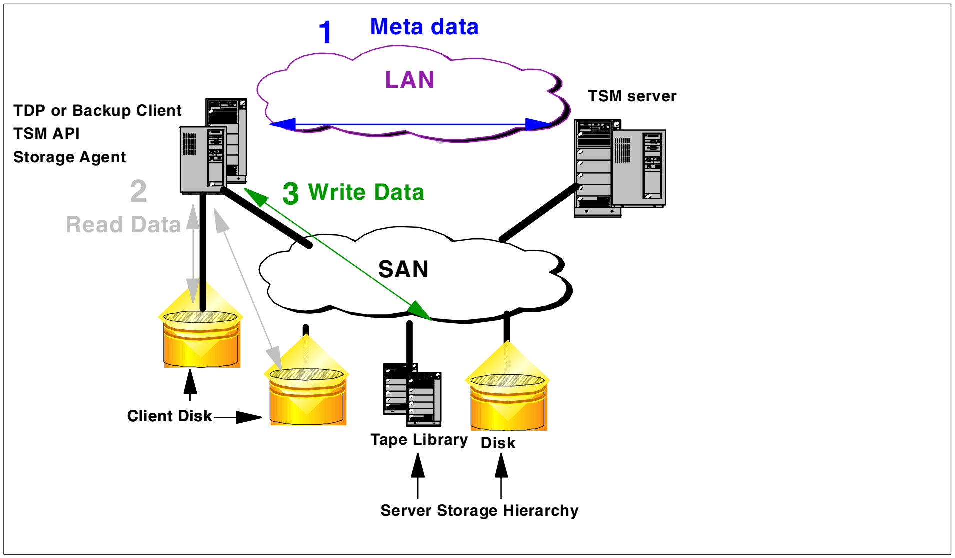


Figure 6-3 TSM LAN-free data transfer overview

6.2 Configuring LTO tape libraries with TSM

In this section we will discuss installing LTO devices with Tivoli Storage Manager in the Windows environment. We used a tape library with both Fibre Channel and direct SCSI connections.

The environment in our lab for the TSM installation with FC connected LTO was:

- Intel server with Windows 2000 SP2 (build 2195) and QLogic QLA2200 FC adapter
- IBM 2109 FC switch
- IBM 2108-R03 SAN Data Gateway
- 3583 Ultrium Scalable Tape Library with two LVD drives

For direct SCSI connected LTO, our environment was:

- Intel server with Windows 2000 SP2 (build 2195) and Adaptec 29160 Ultra 160 LVD adapter.
- 3583 Ultrium Scalable Tape Library with two LVD drives

We installed TSM Version 4.2 on an Intel server, BONNIE. Note that you need TSM Version 4.1.2 or later to support the Ultrium 3580, 3581, 3583 and 3584 models.

Before you can begin using a tape device as a backup destination, you must do the following:

1. Disable RSM (using the procedure in “Disabling RSM” on page 61)
2. Attach the devices to your system
3. Install the LTO Ultrium device drivers for Windows 2000 (as described in 2.2.3, “Installing the LTO Medium Changer and tape device drivers” on page 36)
4. Install the TSM Server software
5. Initialize the server
6. Define the library,
7. Define the drives in the library
8. Define a device class using the library
9. Define a storage pool associated with the device class.
10. Include the storage pool in the storage hierarchy.
11. Label tape library media

After completing steps up to 3, follow the instructions in *Tivoli Storage Manager for Windows Quick Start*, GC35-0409 to install TSM (step 4). We installed the TSM server first, (using the Custom option with the default features), then the TSM device driver (tsmscsi). Before installing, you should always check that you have the latest code fixes. Refer to the following websites for Tivoli product requirements, supported devices and code levels.

http://www.tivoli.com/support/storage_mgr/requirements.html
http://www.tivoli.com/support/storage_mgr/adsercli.htm

To perform the subsequent tasks you can use any one of the following interfaces:

- TSM configuration wizard
- Administrative client command line
- Web administration interface.

We will continue the configuration (step 5) by initializing the server using the TSM configuration wizard. All other configuration tasks will be shown using the configuration wizards and the administrative command line.

Initialize the server

After the TSM server and device driver installation, you will have rebooted the server to initialize the device driver. You may begin to configure your TSM server and in particular configure your LTO tape library and drives for use. The examples are shown using the TSM configuration wizard, with additional examples showing the commands associated with each action taken. You must use the wizard to initialize your server before running additional configuration commands via Web administrator or the command-line interface (CLI). If you wish to use the CLI (**dsmadmc**) to configure your server, you must install the client code on the TSM server using a 'Custom' installation, during which you may opt to install the administrative command line. If you are new to the product, we suggest you run through the wizard configuration first to quickly get the server up and running. The server parameters may be reconfigured later using the Web browser interface or the command line. It is our intention to explicity show how to get the TSM server up and running with the LTO Tape Library and Drives only. For more general information on the setup of the TSM server in Windows 2000, refer to *Tivoli Storage Manager for Windows Administrator's Guide* GC35-0410 and *Tivoli Storage Manager for Windows: Quick Start* GC35-0409-01.

You can start the configuration wizard by clicking the TSM Management Console icon on the desktop, or from **Start>Program Files>Tivoli Storage Manager>Management Console**. Note the TSM Management Console is an application for the Microsoft Management Console (MMC). Click on Tivoli Storage Manager and scroll down to the entry which matches the server just installed. In this instance this is server 'BONNIE'. Right click on the server name and select **Add a new TSM Server** as shown in Figure 6-4.

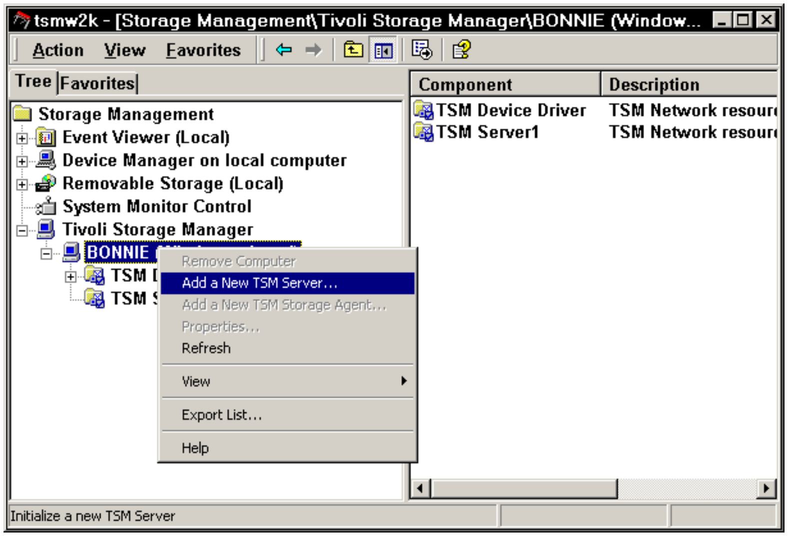


Figure 6-4 Initialising the TSM Server

This will begin the initial Configuration Task List (Figure 6-5) In the list window, click **Start** and the Wizard will commence. Note that the wizard will perform all of the listed tasks in succession. You may, however, cancel out of the wizard at any stage to configure the server later. We will only show the wizard configuration to the point of initializing the server for use.

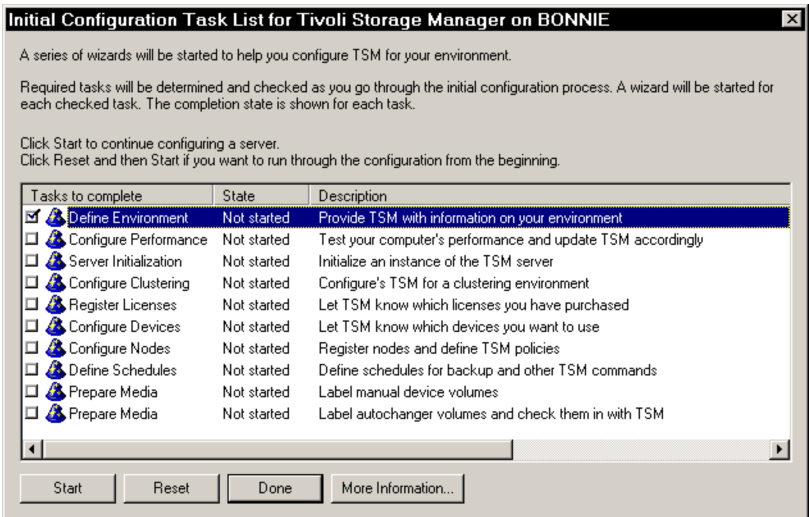


Figure 6-5 Initial Configuration Task List

Click **Next** when the Initial Configuration wizard appears. The wizard will then ask (Figure 6-6) if you would like extra information displayed which is helpful to understanding the configuration process. Select **Yes** if you are new to TSM, otherwise **No**.

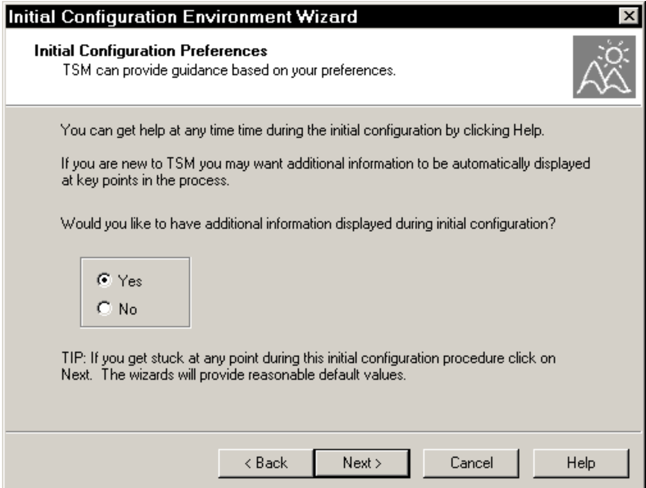


Figure 6-6 Initial Configuration preferences

Now select the type of environment your TSM Server is intended for, either a server backing up network connected clients or as a standalone server with one local client as shown in Figure 6-7.

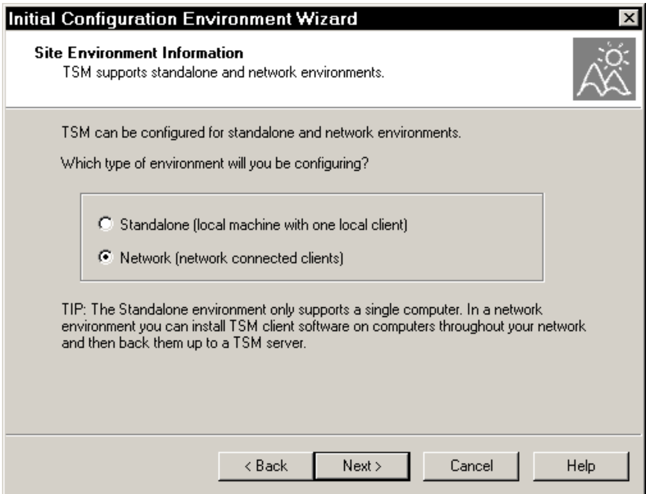


Figure 6-7 Site Environment Information

The initial Configuration Wizard will complete. Click **Finish** to complete this task.

The Performance configuration wizard will begin. The Performance Configuration Wizard will prompt you for the number of clients you will be backing up and the size of the files that will be transferred from the clients to the TSM server. It will build database and log volumes as well as a disk storage pool based on this information in such a way that the performance of the TSM server is optimized.

The database will store information regarding server operations and configuration as well as records of all client data which is stored on the server. It is central to the function of TSM. The recovery log stores database transactions until they are commited to the database, and the storage pool acts as the TSM client data repository. There is a general set of rules for sizing database, log and storage pool volumes which is beyond the scope of this document, but is detailed in the IBM Redbook *Getting Started with Tivoli Storage Manager: Implementation Guide* SG24-5416-01.

The Wizard then analyzes the performance of the local hard drive(s) The results of this operation will be used to determine the best location for the database, recovery log and storage pool volumes. It also decides on some suitable server options settings.

After the Performance wizard is complete, the Server Initialize wizard starts automatically. First, choose a directory to store the configuration files for the TSM server instance currently being configured (Figure 6-8).

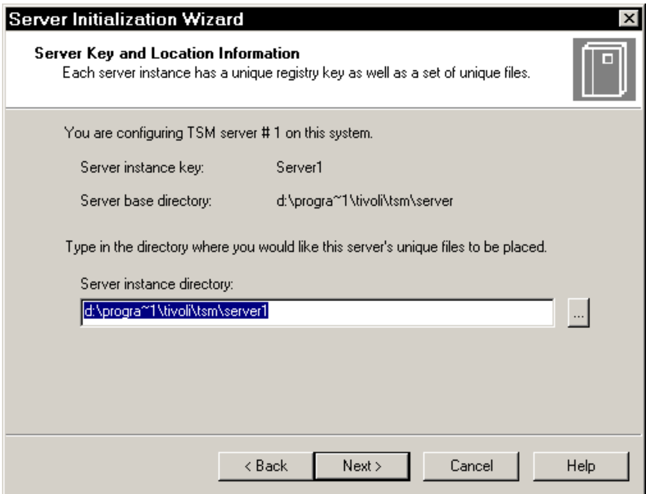


Figure 6-8 Server Key and Location Information

The next window (Figure 6-9) will allow you to specify the directories to store database, recovery log, and storage pool volumes. These defaults have been suggested, based on the results of the Performance Configuration Wizard analysis; however you can choose different disk locations and sizes based on your own specific requirements.

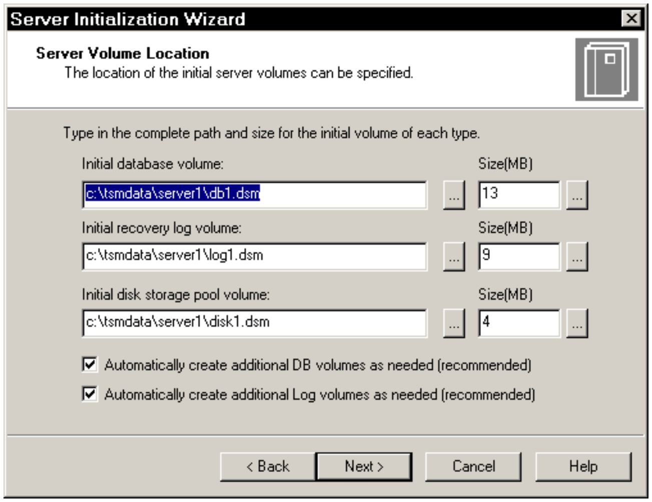


Figure 6-9 Server Volume Location

Now choose a logon account for the TSM server service, and choose whether the service is started manually or automatically (Figure 6-10). Click **Next** to install the service and associated logon account.

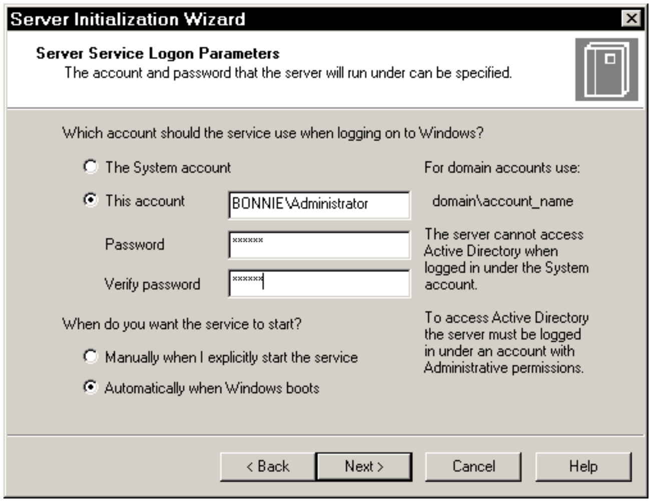


Figure 6-10 Server Service Logon Parameters

The *Log On As a Service* right is granted to the local administrator account which will be used to run the TSM Server if it is not already present. Click **Finish** to complete the server initialization.

6.2.1 Defining the library and drives using the Configuration Wizard

You should have already installed the tape drives and library using the IBM Ultrium device drivers for Windows 2000 according to Chapter 2, “Basic LTO setup for Windows 2000” on page 27.

For performance reasons we suggest that you use a variable block size length (Block Size=0) and have hardware compression turned on. This is the default for Windows 2000 servers. You can verify and modify this value through the NTUTIL program that comes packaged with the Ultrium device drivers as shown in Example 6-1 below.

Example 6-1 Turning hardware compression on

```
enter selection: 44
Compression off = 0, on = 1: 1
execute set_device_parameters compression = ON
analyze() called with  rc 0 err 0 (ERROR_SUCCESS) data 0
Total elapsed time in seconds =     4.00
Return to continue:
```

Note that hardware compression has been set to ‘ON’. However, TSM can override the device settings for hardware compression by using the FORMAT parameter in the DEFINE DEVICE class command (see 6.2.2, “Defining the library and drives using the command line” on page 233).

The block size may also be viewed from the NTUTIL manual mode menu. Option 3 in the manual test menu (Example 6-2) shows a tape drive configured with **Block Size = 0**, which means variable length blocks,

Example 6-2 Manual test menu

```
manual test menu:
=======================================================================
  1: set device special file          2: display symbols
  3: set block size R/W (now !0 fixed)
  5: set return error when fail       6: set/reset trace
  7: set exit on unexpected result    8: Library Mode
```

The Device Configuration Wizard will start automatically if we run through the TSM configuration wizard from the beginning as detailed in “Initialize the server” on page 218. Alternatively, you may run it at any time if you haven’t already done so, by accessing the TSM Management Console from the desktop**.** Click on the **Configure Devices** task and click **Start**. Note that the server must have been initialized for use before performing this step. The Device Configuration wizard will commence as in Figure 6-11. Click **Next**.

Figure 6-11 Device Configuration Wizard

The wizard will detect the LTO tape library and drives attached to the system as shown in Figure 6-12. The device name, type and location are listed in the left pane. The device name will be in one of two formats. If the library and drives are controlled by the TSM device driver they will be listed as:

- lbx.x.x.x - library
- mtx.x.x.x - tape device.

The x‘s represent the SCSI id, LUN, bus and port numbers respectively. For instance, a device listed as lb0.1.0.3 corresponds to a Library at SCSI id 0, LUN1, bus0, port3.

If the library and drives are controlled by the native (IBM Ultrium) tape device driver for Windows 2000 they will be listed as:

- \\.\Changerx - library medium changer.
- \\.\Tapex - tape device.

Here, the x represents the numerical order in wich the devices are discovered by the operating system.

These are the alias names that TSM uses to communicate with the devices. For all LTO devices, the library should be controlled by the TSM device driver and the drives should be controlled by the Ultrium tape device drivers. This is shown in Figure 6-12, with devices lb0.1.0.3, \\.\Tape0 and \\.\Tape1.

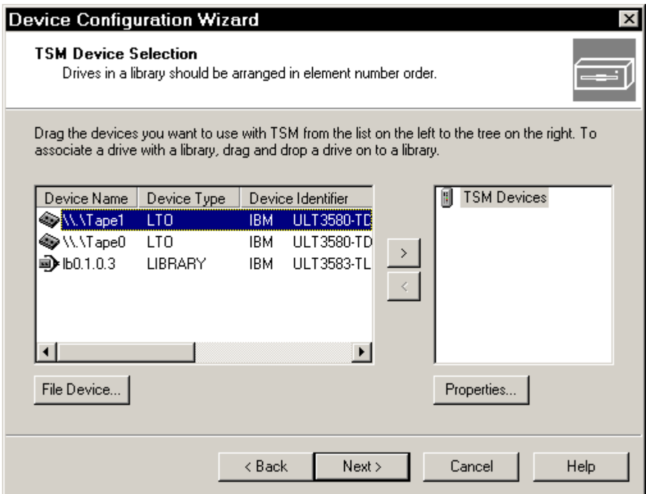


Figure 6-12 TSM device selection

The Ultrium device driver starts earlier in the boot sequence than the TSMSCSI driver (which runs as a service) and therefore assumes ownership of the tape devices.

If your display does not show up in this way, you can explicitly specify which driver takes ownership of which device by doing the following:

1. From the TSM Console, expand the tree to TSM Device Driver for the machine that you are configuring.
2. Expand TSM Device Driver and Reports.
3. Click Service Information in the TSM Console tree in the left panel. The Service Information window appears in the right panel.
4. Right click **TSM Device Driver** in the right pane. Select **Properties** from the pop-up menu.
5. In the **Device Driver Options** dialog, check the *Enable Windows 2000 and Optical Device Support* check box. The startup type is set to Boot as default.
6. To control a device with the TSM Device Driver:
   a. Use the move button to move a device from the *Devices Controlled by Native Device Drivers* pane to the *Devices Controlled |by the TSM Device Driver* pane.
   b. Click **OK**. A message appears stating that the TSM Device Driver must be restarted. Click **OK**.
   c. Right click the **TSM Device Driver** in the right pane. Select **Stop** from the pop-up menu.
   d. Right click the **TSM Device Driver** in the right pane. Select **Start** from the pop-up menu.
7. To control a device with the Windows Device Driver:
   a. Use the move button to move a device from the *Devices Controlled by the TSM Device Driver* pane to the *Devices Controlled by Native Device Drivers* pane.
8. Click **OK**

If you have RSM enabled then Windows 2000 will assume ownership of both medium changer and the tape devices, in which case the library medium changer will be viewed as \\.\Changer0 instead of lbx.x.x.x. However use of RSM is not recommended with TSM.

We want to make all the LTO devices available to TSM. Drag and drop the devices to the right hand side pane of Figure 6-12. First, select the library, followed by the tape drives. Drop them so that they land underneath the library definition. This is how you assign multiple drives to the library. Be careful of the way that you arrange the devices in the right hand pane. The configuration wizard will assume that the way the drives are listed corresponds to their SCSI element id number. The element address is a number indicating the physical location of a drive within an automatic library. Applications use the drive's element address to connect the physical location of the drive to the drive's SCSI address. The completed configuration is shown in Figure 6-13.

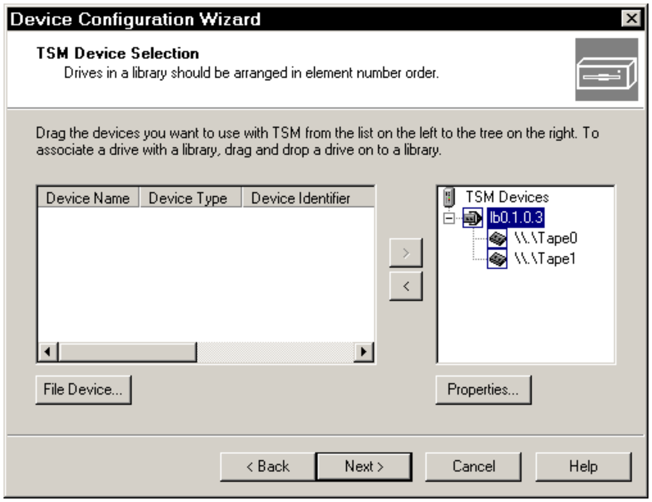


Figure 6-13 TSM devices selected

Click **Next** and you will be prompted to enter the Tape Drive SCSI Element Number as shown in Figure 6-19 and Figure 6-18 on page 230.

You can obtain the SCSI *element_number* of your drives from *3584 UltraScalable Tape Library Planning and Operator Guide,* GA32-0408 or *3583 Ultrium Scalable Tape Library Setup and Operator Guide*, GA32-0411. You can also obtain this information at these websites

`http://www.tivoli.com/support/storage_mgr/devices/atab104.htm`
`http://www.tivoli.com/support/storage_mgr/devices/atab101.htm`

for 3583 and 3584 element addresses respectively.

Figure 6-14 shows you the SCSI Element address for drives of the 3584 and Figure 6-15 shows you the SCSI Element address for drives of the 3583.

SCSI DTE Addresses for Tape Drives						
	Frame 1	Frame 2	Frame 3	Frame 4	Frame 5	Frame 6
Row 1	257(X'101')	269(X'10D')	281(X'119')	293(X'125')	305(X'131')	317(X'13D')
Row 2	258(X'102')	270(X'10E')	282(X'11A')	294(X'126')	306(X'132')	318(X'13E')
Row 3	259(X'103')	271(X'10F')	283(X'11B')	295(X'127')	307(X'133')	319(X'13F')
Row 4	260(X'104')	272(X'110')	284(X'11C')	296(X'128')	308(X'134')	320(X'140')
Row 5	261(X'105')	273(X'111')	285(X'11D')	297(X'129')	309(X'135')	321(X'141')
Row 6	262(X'106')	274(X'112')	286(X'11E')	298(X'12A')	310(X'136')	322(X'142')
Row 7	263(X'107')	275(X'113')	287(X'11F')	299(X'12B')	311(X'137')	323(X'143')
Row 8	264(X'108')	276(X'114')	288(X'120')	300(X'12C')	312(X'138')	324(X'144')
Row 9	265(X'109')	277(X'115')	289(X'121')	301(X'12D')	313(X'139')	325(X'145')
Row 10	266(X'110')	278(X'116')	290(X'122')	302(X'12E')	314(X'13A')	326(X'146')
Row 11	267(X'111')	279(X'117')	291(X'123')	303(X'12F')	315(X'13B')	327(X'147')
Row 12	268(X'10C')	280(X'118')	292(X'123')	304(X'130')	316(X'13C')	328(X'148')
Note: Addresses are given in decimal and hexadecimal format.						

Figure 6-14 SCSI Element number of tape drives in the 3584

Figure 6-15 SCSI Element number of tape drives in the 3583

Alternatively, if you had RSM running before setting up TSM, you could use it to check the element numbers that are associated with each drive. In the Computer Management window go to **Storage -> Removable Storage -> Physical Locations -> IBM ULT358x-TL -> Drives**. You will see the drive listed as Drivex where x is equivalent to the element number. Right-click the Drive and select 'Properties', shown in Figure 6-16.

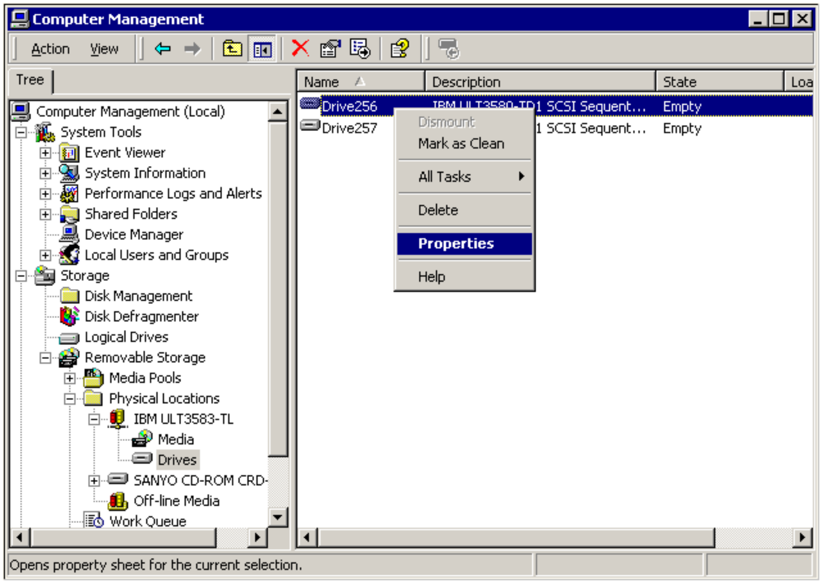


Figure 6-16 RSM drive listing

In the Properties box you can see the Device name which, in this case, is listed as \\.\Tape0. So now we know that the device \\.\Tape0 has element number 256 which we can use in the next step.

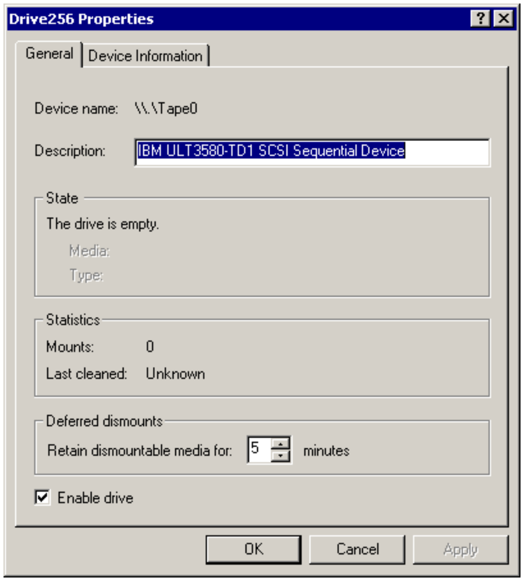


Figure 6-17 Drive properties

Enter the element number for the drive given (Figure 6-18) and click **OK**. .

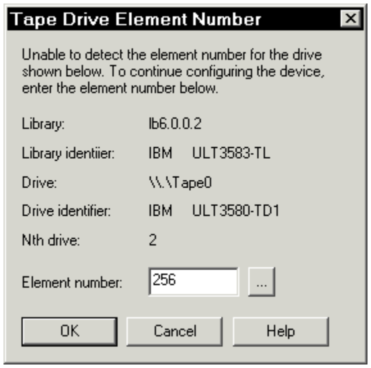


Figure 6-18 Tape Drive element number

Repeat for the other drive (Figure 6-18)

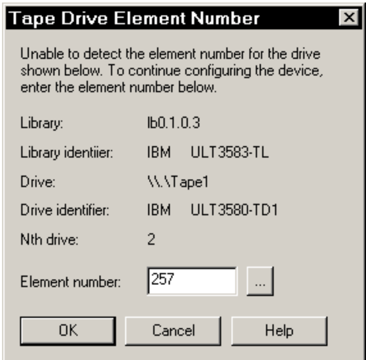


Figure 6-19 Tape Drive 2 element number

The wizard will proceed to define the library and drives to TSM server. To complete the device configuration wizard, click **Finish** on the final window. A pop up window will appear to show that the device definitions have completed successfully.

Now we have successfully configured the library and drives. The wizard has automatically defined a device class, as well as a storage pool with the device class assigned to it. We have taken a section of the TSM Server activity log (using the **`QUERY ACTLOG`** command) which shows configuration made by the wizard.

Example 6-3 TSM wizard generated configuration

```
11/01/2001 13:58:37   ANR2017I Administrator ADMIN issued command: DEFINE
                       LIBRARY lb0.1.0.3 libtype=scsi device=lb0.1.0.3
```

```
11/01/2001 13:58:44   ANR8400I Library LB0.1.0.3 defined.
11/01/2001 13:58:44   ANR2017I Administrator ADMIN issued command: DEFINE DRIVE
                       lb0.1.0.3 GENDRV_Tape0 device=\\.\Tape0 element=256
11/01/2001 13:58:44   ANR8404I Drive GENDRV_TAPE0 defined in library LB0.1.0.3.
11/01/2001 13:58:44   ANR2017I Administrator ADMIN issued command: DEFINE DRIVE
                       lb0.1.0.3 GENDRV_Tape1 device=\\.\Tape1 element=257
11/01/2001 13:58:44   ANR8404I Drive GENDRV_TAPE1 defined in library LB0.1.0.3.
11/01/2001 13:58:44   ANR2017I Administrator ADMIN issued command: DEFINE
                       DEVCLASS LTOCLASS1 devtype=LTO format=drive library=lb0-
                       .1.0.3
11/01/2001 13:58:44   ANR2203I Device class LTOCLASS1 defined.
11/01/2001 13:58:44   ANR2017I Administrator ADMIN issued command: DEFINE
                       STGPOOL LTOPOOL1 LTOCLASS1 maxscratch=500
11/01/2001 13:58:44   ANR2200I Storage pool LTOPOOL1 defined (device class
                       LTOCLASS1).
```

The wizard will automatically use the alias name (lb0.1.0.3 in our case) of the library device as the user name of the library. It will also give its own user name to the tape devices. For tape devices using an alias of the format \\.\Tapex, the wizard will create a name prefixed by GENDRV_TAPE. You can see that the wizard has also defined a storage pool and device class associated with tape library and drives using its own generic naming convention. We will discuss the device class and storage pool definitions in 6.2.4, “Defining the device class using the command line” on page 235 and 6.2.6, “Defining the storage pool using the command line” on page 237.

You can also modify the options for the TSM Device Driver service by accessing the TSM management console. Go to **Start -> Tivoli Storage Manager -> Servername (Windows - Local) -> TSM Device Driver -> Reports -> Service Information**. In the Service Information pane, right-click on the Device Driver service and select **Properties** as shown in Figure 6-20.

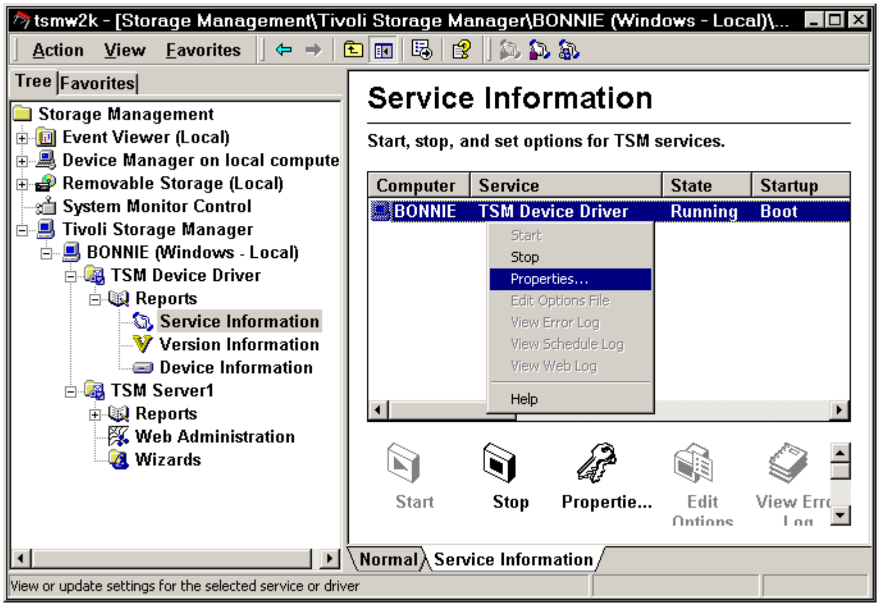


Figure 6-20 TSM Management Console service information

The Properties window lists the devices using the alias names as TSM would normally see them, as shown in Figure 6-21. By checking the *Enable Windows 2000 and Optical Device* option, we are effectively allowing TSM to access the tape devices by interfacing with the Ultrium device drivers. The TSM driver will assume the library device (lb0.1.0.3) using its own drivers upon boot, but the Ultrium device drivers will assume the tape devices (so that they are accessed as \\.\Tapex) and allow TSM to access them. This behaviour is evident if you access Device Manager and view the medium changer and tape devices. You will see that the Medium Changer is listed with a yellow question mark which means that the Ultrium driver has not been loaded for this device. Note that this is the expected behaviour.

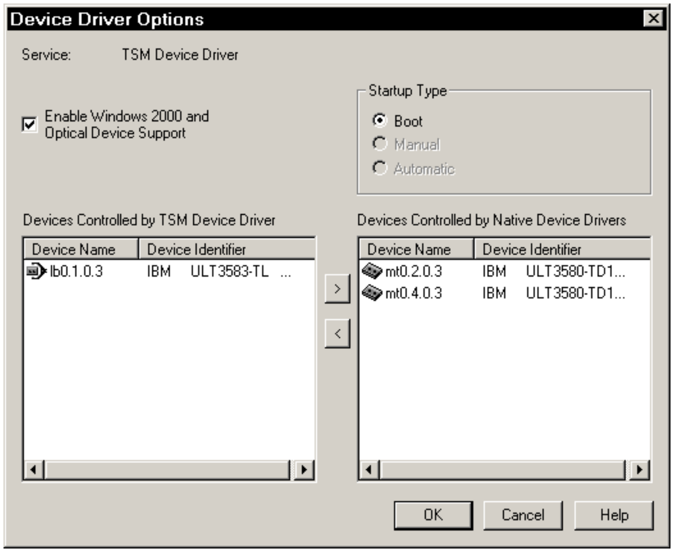


Figure 6-21 Device Driver options

Although the wizard has successfully configured the library, drive, device class and storage pool, it is less flexible than using the command line to perform these operations. The wizard uses its own naming conventions and will use default operating parameters. We will now show how to define the libraries and drives using the command line. For comparison purposes, we are using the same library, drive, device class and storage pool names as the wizard automatic definitions; however you can choose your own names according to individual preference or company standards.

6.2.2 Defining the library and drives using the command line

Manually defining the library via the command line or Web Administrative interface gives you extra control over the options associated with this action. Use the following command to define the library to Tivoli Storage Manager using the TSM administrative command line:

DEFINE LIBRARY *library_name* **LIBTYPE=SCSI DEVICE=***dev_name*

For *library_name* enter a user-specified name of the library to be defined. For *dev_name*, enter the full device name, in our case, lb0.1.0.3.

```
DEFINE LIBRARY lb0.1.0.3 libtype=scsi device=lb0.1.0.3 SHARED=YES
```

Next, define each of the library’s drives with

DEFINE DRIVE *library_name drive_name* **DEVICE=***dev_name*
ELEMENT=*element_number*
CLEANFREQUENCY=*Gigabytes/ASNEEDED/NONE* **ONLINE=yes**

For *library_name* enter the name of your already defined library (lb0.1.032 in our example). Use the operating system device name of the tape drive being defined for *device_name*. Enter the full device name for *dev_name*, like \\.\Tape0. The *element_address* is a number that indicates the physical location of a drive within an automated library. As discussed in 6.2.1, "Defining the library and drives using the Configuration Wizard" on page 223, TSM needs the element address to connect the physical location of the drive to the drive's SCSI address. We also showed how to get the element numbers in that section.

For *cleanerfrequency* we recommend specifying *NONE* for the 3584. This means the library has to take care of cleaning and cleaning must be enabled on the library (automatic cleaning). In this case TSM will not store any information about cleaning or the cleaner cartridge, but you can use the StorWatch Specialist for this purpose. If you want TSM to be in charge of cleaning the drive, then you should use option *ASNEEDED.* But then you have to disable the autocleaning function (host cleaning) on the library using the StorWatch Specialist. Also if you use a partitioned 3584, then every partion needs its own cleaner cartridge in the logical partion. In general, TSM-managed cleaning is intended for drives and libraries which do not have an automatic cleaning function.

Because the 3583 does not have autoclean capability, TSM has to take care of cleaning and you should specify cleanfrequency ASNEEDED. We configured our drives in the 3583 with:

```
DEFINE DRIVE lb0.1.0.3 GENDRV_Tape0 device=\\.\Tape0 element=256
CLEANFREQUENCY=asneeded
DEFINE DRIVE lb0.1.0.3 GENDRV_Tape1 device=\\.\Tape1 element=257
CLEANFREQUENCY=asneeded
```

Keep in mind as described in "Defining the library and drives using the Configuration Wizard" on page 223, that your drives are not necessarily configured by the operating system in the same order as they are installed physically in the library. Therefore check carefully that the element address maps to your drive configuration.

Attention: For LTO drives, cleaning the drive on a periodic basis (that is, after a set number of gigabytes has been processed by the drive) is not recommended.

Tip: Before defining the drives and libraries, make sure that your library is online and your drives are available. Also there should not be any cartridge loaded in the drive being defined.

6.2.3 Defining the device class using the Configuration Wizard

To allow the TSM Server to correctly use the LTO tape library and drives, we must define a device class. A device class is best thought of as the interface that allows TSM to effectively communicate with a device.

If we run the Configuration wizard to install the tape library and drives, the LTO device class and associated storage pool will be created automatically in the background as shown in Example 6-3 on page 230.

6.2.4 Defining the device class using the command line

To manually configure the device class:

DEFINE DEVCLASS *devclass_name* **LIBRARY=***library_name* **DEVTYPE=LTO**
FORMAT=*Drive/Ultrium/UltriumC* **MOUNTLIMIT=***mount_limit|DRIVES*

The *library_name* will match the name of the library you previously defined.

The FORMAT parameter has the following options valid:

- *drive*

  The server selects the highest format that can be supported by the drive on which a volume is mounted. This value will use the settings on the tape drive characteristics (device driver) for hardware compression. This is the default.

- *ultrium*

  Specifies that TSM writes data that uses the ULTRIUM recording format. This format results in a cartridge capacity of 100GB when using Ultrium 100GB data cartridge. This value over-rides the settings on the tape drive characteristics for hardware compression.

- *ultriumc*

Specifies that TSM writes data that uses the ULTRIUM recording format with compression. This format results in a cartridge capacity of approximately 200GB when using Ultrium 200GB data cartridge. This value over-rides the settings on the tape drive characteristics for hardware compression.

Compression in general improves backup performance. Therefore we recommend that you use compression either with *FORMAT=ultriumc,* or with recording *FORMAT= drive* if you have set hardware compression in the device driver. If you use recording *FORMAT=ultriumc*, then your LAN-free clients also use compression regardless of whether hardware compression is enabled. Therefore we suggest the easiest way is to use *FORMAT=ultriumc.*

Note that TSM also provides optional client compression. If this is enabled, then clients compress their data before sending it to the storage device. This is particularly useful where the network connection between the client and server is slow and traffic needs to be minimized. With client compression on, using tape drive compression has little effect and is not recommended. You should evaluate your environment and requirements (probably by performing some appropriate testing) to determine if client compression is of benefit. If so, then enable it, and use the uncompressed (FORMAT=ULTRIUM) flag when defining the device class. If not, then tape drive compression should be used.

The option *MOUNTLIMIT* specifies the maximum number of sequential access volumes that can simultaneously be mounted for the device class. This parameter is optional. The default is *drives*, which means it is set to the number of drives installed and available in the library. However, if you are going to share the library (for example, for LAN-free backup), Tivoli recommends not to use the default value, *drives*, but to specify instead the exact number of tape drives in the library.

To define the 3583 in our Windows 2000 environment, we called the device class *LTOCLASS1*, pointing to our previously defined library *lb0.1.0.3*. We specified *DRIVES* for the *FORMAT* parameter. We have two drives in the library the *MOUNTLIMIT* is set to 2.

```
DEFINE DEVCLASS LTOCLASS1 devtype=LTO format=drive library=lb0.1.0.3
```

Example 6-4 reflects our device class definition.

Example 6-4 query devclass ltoclass1 f=d

```
Device Class Name: LTOCLASS1
        Device Access Strategy: Sequential
            Storage Pool Count: 1
                   Device Type: LTO
                        Format: DRIVE
         Est/Max Capacity (MB):
```

```
                  Mount Limit: DRIVES
              Mount Wait (min): 60
         Mount Retention (min): 60
                  Label Prefix: ADSM
                 Drive Letter:
                       Library: LB0.1.0.3
                     Directory:
                   Server Name:
                  Retry Period:
                Retry Interval:
                     Twosided:
                        Shared:
Last Update by (administrator): ADMIN
         Last Update Date/Time: 11/01/2001
14:32:51
```

6.2.5 Defining the storage pool using the Configuration Wizard

If we run the Configuration wizard to install the tape library and drives, the LTO device class and associated storage pool will be created automatically in the background as shown in Example 6-3 on page 230.

6.2.6 Defining the storage pool using the command line

Define the storage pool with:

DEFINE STGPOOL *stgpool_name devclass_name* **MAXSCRATCH=100**

This storage pool should be assigned to the device class we just defined, so we specify the name, *LTOCLASS1*. We used *LTOPOOL1* as the stgpool_name:

```
DEFINE STGPOOL LTOPOOL1 LTOCLASS1 maxscratch=500
```

Example 6-5 shows you the query of the storage pool which we defined above.

Example 6-5 q stgpool ltopool1 f=d

```
Storage Pool Name: LTOPOOL1
               Storage Pool Type: Primary
               Device Class Name: LTOCLASS1
         Estimated Capacity (MB): 0.0
                        Pct Util: 0.0
                        Pct Migr: 0.0
                     Pct Logical: 100.0
                    High Mig Pct: 90
                     Low Mig Pct: 70
                 Migration Delay: 0
              Migration Continue: Yes
```

```
            Migration Processes:
              Next Storage Pool:
           Reclaim Storage Pool:
         Maximum Size Threshold: No Limit
                         Access: Read/Write
                    Description:
              Overflow Location:
          Cache Migrated Files?:
                       Collocate: No
          Reclamation Threshold: 60
 Maximum Scratch Volumes Allowed: 500
   Delay Period for Volume Reuse: 0 Day(s)
         Migration in Progress?: No
           Amount Migrated (MB): 0.00
Elapsed Migration Time (seconds): 0
       Reclamation in Progress?: No
 Volume Being Migrated/Reclaimed:
  Last Update by (administrator): ADMIN
          Last Update Date/Time: 11/01/2001 14:32:51
       Storage Pool Data Format: Native
```

Now you can use this storage pool in your management class copygroups so that the device will be used for backups or archives. For more information regarding the setup of management class copygroups refer to *Tivoli Storage Manager for Windows Adminitrator's Guide* GC35-0410-02 or *Tivoli Storage Manager for Windows: Quick Start* GC35-0409-01

6.2.7 Labelling tape media using the Configuration Wizard

Once we have set up our definitions, we need to identify the cartridges which TSM will use, either for storing data, or for cleaning the drives. You can find information on how to buy LTO cartridges from IBM, both data and cleaning, from the website:

http://www.storage.ibm.com/media/

LTO cartridges are also available from several other licensed manufacturers which vary from country to country. Check your local sources for details.

TSM requires each tape used to have a physical label written on it for identification. You can label volumes individually or process multiple volumes with variations on the label command. Here, we want to perform initial labelling of all the new tapes in our library. Since our 3583 model has a barcode reader and our tapes already have an external barcode label on them, this command will cause the matching label to be written onto the tape. We put the new tapes into the library then we can label them using the media labelling wizard or we can use the command line.

To access the Media Labelling wizard, open up the TSM Management Console by going to **Start -> Program Files -> Tivoli Storage Manager -> Management Console.** Scroll down to the Configuration wizard pane as shown in Figure 6-5 on page 219. Click on the Media Labelling Wizard and click **Start**. When the wizard appears, (Figure 6-22), click **Next**.

Figure 6-22 Media Labeling Wizard.

You will be prompted to make a drive selection. For our purposes we wish to label all tapes in the library so that they are initialized for TSM. We must make our selection at the Library level by placing a tick into the box next to the library name as shown in Figure 6-23. This will also automatically select the tape drives attached to it and ensure that every tape in the library is detected as a candidate for labelling.

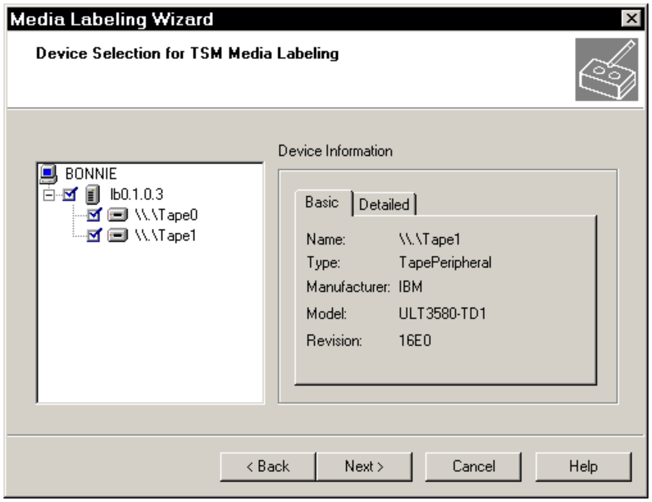


Figure 6-23 Device selection for labeling.

Click **Next** and all tape volumes residing in the library will be detected (Figure 6-24). Select the tapes that you wish to label. There are several available options for the TSM labelling. These include:

- Overwrite existing label - specify this if you wish to write a fresh label to the tape. The default is no, since it might lead to inadvertently overwriting a tape which contains valid data.
- Barcode reader - TSM will read the barcode label and use that to internally label the cartridge.
- Keep volumes in library - will retain the volumes inside the library and not check them out once each is labelled
- Prompt user to insert volumes - the user will be asked to insert cartridges to be labelled. To avoid this, insert the cartridges into the library via the Bulk I/O slot (for 3583 and 3584) beforehand.

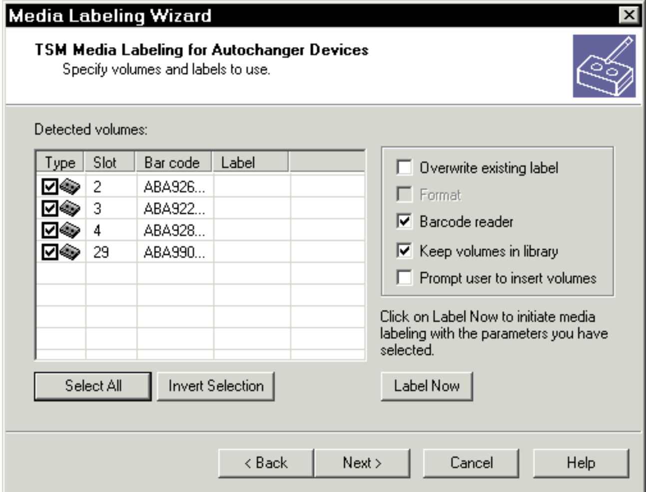


Figure 6-24 Volume selection for labeling.

Click **Next** and the media labelling process begins.The Media Labelling Monitor appears (Figure 6-25) showing the progress of the operation.

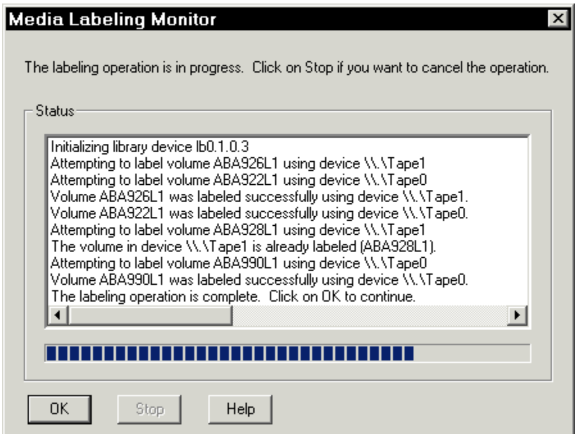


Figure 6-25 Media labeling monitor.

The Media Labelling wizard will ask if you would like to checkin the volumes that you have just labelled. You must checkin the tape volumes before they can be used. Specify Barcode reader as shown in Figure 6-26 to use the cartridge barcode label to checkin the cartridges (unless you have created labels different to the external barcode label or your tape device does not have a barcode reader). If you do not specify barcode reader you will be prompted to specify the volumes you wish to checkin.

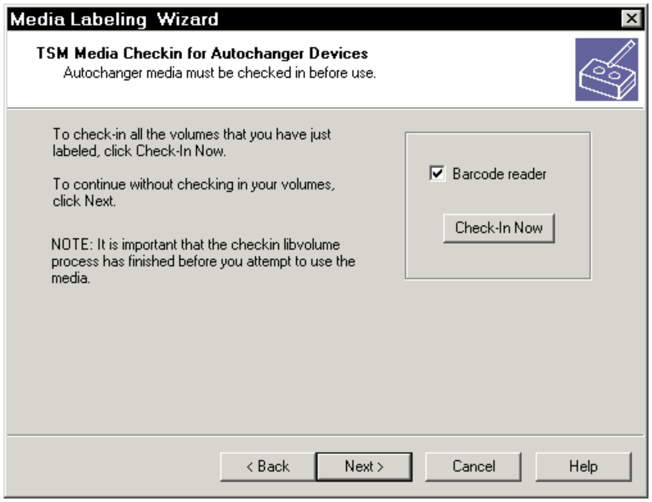


Figure 6-26 TSM Media Checkin

Click **Next** and the wizard will proceed to checkin the library tape volumes. A pop-up window will appear (Figure 6-27), indicating that this can take some time and you can monitor the progress through the Server console Monitor.

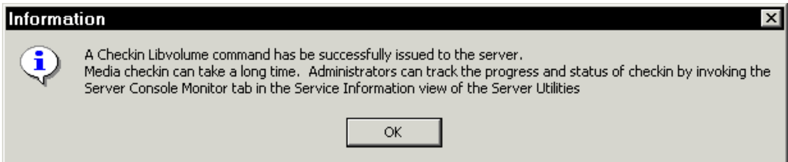


Figure 6-27 Media Checkin issued.

When the checkin is complete, another pop-up window will appear indicating the task was successful. It will also suggest you verify that the cartridges are able to be written to by performing a backup either on the local or on a network TSM client.

6.2.8 Labelling tape media using the command line

You can also use the TSM adminitrative command line to label and checkin tapes to the LTO tape library. To use the command line to label tapes in the library in the same way as described using the wizard we enter:

```
LABEL LIBVOLUME LB0.1.0.3 SEARCH=YES LABELSOURCE=BARCODE
CHECKIN=SCRATCH OVERWRITE=YES
```

The parameter *SEARCH=Yes* means that TSM searches inside the library for any unlabelled volume with a readable barcode. It then mounts each cartridge in turn and writes the label onto the tape.

After the above command, you can check on the status of the inserted volumes with the **q libvol** command. Example 6-6 shows all the labelled cartridges with scratch status. The element address is also displayed so that we can tell which physical location contains each volume.

Example 6-6 TSM query libvol

```
Library Name   Volume Name   Status       Owner        Last Use    Home Element
------------   -----------   ----------   ----------   ---------   ------------
LB0.1.0.3      ABA920L1      Scratch                               4,133
LB0.1.0.3      ABA922L1      Scratch                               4,127
LB0.1.0.3      ABA923L1      Scratch                               4,137
LB0.1.0.3      ABA925L1      Scratch                               4,097
LB0.1.0.3      ABA926L1      Scratch                               4,128
LB0.1.0.3      ABA928L1      Scratch                               4,099
LB0.1.0.3      ABA929L1      Scratch                               4,098
```

Inserting data cartridges using the I/O-Station

For inserting additional data cartridges to the library use the command

LABEL LIBVOLUME *lib_name* **SEARCH=bulk LABELSOURCE=barcode CHECKIN=scratch**

If you have only a few cartridges to insert, use the I/O - station and use the option *SEARCH=bulk*. You will be prompted to insert all the volumes to be labelled into the I/O port and to indicate when this has been done by issuing the REPLY command:

REPLY *request_name*

The server will then load and label the volumes it finds.

Example 6-8 shows you an output of the activity log when inserting one cartridge into the 3583. We used this command:

```
LABEL LIBVOLUME lb0.1.0.3 SEARCH=bulk LABELSOURCE=barcode
CHECKIN=scratch
```

followed by

```
REPLY 31
```

to continue the operation.

Example 6-7 Result of Label libvol command

```
11/02/01 09:49:11    ANR2017I Administrator ADMIN issued command: LABEL
                     LIBVOLUME lb0.1.0.3 SEARCH=BULK LABELSOURCE=BARCODE
                      CHECKIN=SCRATCH
11/02/01 09:49:11    ANR0984I Process 23 for LABEL LIBVOLUME started in the
                      BACKGROUND at 09:49:11.
11/02/01 09:49:11    ANR8799I LABEL LIBVOLUME: Operation for library lb0.1.0.3
                      started as process 31.
11/02/01 09:49:11    ANR0609I LABEL LIBVOLUME started as process 31.
11/02/01 09:49:12    ANR8373I 031: Fill the bulk entry/exit port of library
                     lb0.1.0.3 with all LTO volumes to be processed within 60
                      minute(s); issue 'REPLY' along with the request ID when
                      ready.
11/02/01 09:49:18    ANR8336I Verifying label of LTO volume ABA930 in drive
                      GENDRV_Tape0 (\\.\Tape0).
11/02/01 09:49:44    ANR2017I Administrator ADMIN issued command: REPLY 031
11/02/01 09:49:44    ANR8499I Command accepted.
11/02/01 09:49:48    ANR2017I Administrator ADMIN issued command: QUERY ACTLOG
11/02/01 09:51:00    ANR8810I Volum ABA930 has been labeled in library
                     lb0.1.0.3
11/02/01 09:51:42    ANR8427I CHECKIN LIBVOLUME for volume ABA930 in library
                      lb0.1.0.3 completed successfully.
11/02/01 09:52:40    ANR8810I Volume ABA930 has been labeled in library
                      lb0.1.0.3.
11/02/01 09:53:22    ANR8427I CHECKIN LIBVOLUME for volume ABA930 in library
                      lb0.1.0.3 completed successfully.
```

Inserting unlabeled data cartridges using the I/O-Station

If your library has a barcode reader (such as the 3583 Ultrium Scalable Tape Library or 3584 Ultrium UltraScalable Tape Library), you will almost certainly be using this reader to label the cartridges as shown in the previous section. However, if you have an LTO model (for example, the 3581) which is not equipped with a barcode reader you need to be able to manually specify a label. If the media already has a barcode label attached, we strongly recommend that you use this string to label the volume as this will make it much easier for your operators to process the volumes.

To insert an unlabeled cartridge, specify the volume name you want to use for the cartridge and put the cartridge in the I/O station.

LABEL LIBVOLUME *lib_name volume_name* **CHECKIN=scratch**

You will be prompted to insert the cartridge and to indicate when it is available by issuing the command (at an administrative command prompt):

REPLY *request_name*

You can insert only one cartridge at a time which will then be labelled by the server.

Example 6-8 shows you an output of the activity log for the inserting process of one unlabeled cartridge in a 3583. We used this command:

LABEL LIBVOLUME lb0.1.0.3 ABA925L1 CHECKIN=SCRATCH

followed by

REPLY *032*

to continue the operation.

Example 6-8

```
11/02/01 10:12:04     ANR2017I Administrator ADMIN issued command: LABEL
                      LIBVOLUME lb0.1.0.3 ABA925L1 CHECKIN=SCRATCHOVERWRITE=YES
11/02/01 10:12:04     ANR0984I Process 28 for LABEL LIBVOLUME started in the
                       BACKGROUND at 10:12:04.
11/02/01 10:12:04     ANR8799I LABEL LIBVOLUME: Operation for library lb0.1.0.3
                       started as process 32.
11/02/01 10:12:04     ANR0609I LABEL LIBVOLUME started as process 32.
11/02/01 10:12:04     ANR0405I Session 1368 ended for administrator ADMIN
                       (WebBrowser).
11/02/01 10:12:06     ANR8323I 002: Insert LTO volume ABA925L1 R/W into
                       entry/exit port of library lb0.1.0.3 within 60minute(s);
                       issue 'REPLY' along with the request ID when ready.
11/02/01 10:12:25     ANR2017I Administrator SERVER_CONSOLE issued command:
                       REPLY 002
11/02/01 10:12:25     ANR8499I Command accepted.
11/02/01 10:15:32     ANR8810I Volume ABA925L1 has been labeled in library
                       lb0.1.0.3.
11/02/01 10:16:15     ANR8427I CHECKIN LIBVOLUME for volume ABA925L1 in library
                       lb0.1.0.3 completed successfully.
11/02/01 10:16:16     ANR8800I LABEL LIBVOLUME for volume ABA925L1 in library
                       lb0.1.0.3 completed successfully.
11/02/01 10:16:16     ANR0985I Process 32 for LABEL LIBVOLUME running in the
                       BACKGROUND completed with completion state SUCCESS at
                       10:16:01.
```

Inserting cleaner cartridges

If you have chosen to have TSM manage library cleaning, you need to insert some cleaning cartridges. Use

CHECKIN LIBVOLUME *lb0.1.0.3* **STATUS=cleaner CHECKLABLE=barcode SEARCH=bulk CLEANINGS=50**

The parameter SEARCH=*bulk* means that TSM will search the library entry/Exit ports for usable volumes to checkin. You should set the *CLEANINGS* parameter to the number of uses specified for your cartridge. Insert one or more cleaner cartridges into the I/O station and reply to the request issued by the server as shown in Example 6-9

Example 6-9 Result of checkin libvol command

```
11/02/01 10:57:35     ANR2017I Administrator ADMIN issued command: CHECKIN
                      LIBVOLUME lb0.1.0.3 STATUS=CLEANER CHECKLABEL=BARCODE
                      MOUNTWAIT=60 SEARCH=BULK CLEANINGS=50
11/02/01 10:02:56     ANR0984I Process 4 for CHECKIN LIBVOLUME started in the
                       BACKGROUND at 20:02:56.
                      11/02/01 10:02:56     ANR8422I CHECKIN
                      LIBVOLUME:Operation for library lb0.1.0.3 started as
                      process 4.
11/02/01 10:03:07     ANR8373I 048: Fill the bulk entry/exit port of library
                      lb0.1.0.3 with all LTO volumes to be processed within 60
                       minute(s); issue 'REPLY' along with the request ID when
                       ready.
11/02/01 10:03:09     ANR2017I Administrator ADMIN issued command: QUERY ACTLOG
11/02/01 10:03:21     ANR2017I Administrator ADMIN issued command: REPLY 048
11/02/01 10:03:21     ANR8499I Command accepted.
11/02/01 10:03:26     ANR2017I Administrator ADMIN issued command: QUERY ACTLOG
11/02/01 10:03:40     ANR2017I Administrator ADMIN issued command: QUERY ACTLOG
11/02/01 10:03:46     ANR8430I Volume CLNI17 has been checked into library
                       LB0.1.0.3.
11/02/01 10:03:46     ANR1434W No files have been identified for automatically
                       storing device configuration information.
11/02/01 10:03:46     ANR8431I CHECKIN LIBVOLUME process completed for library
                       lb0.1.0.3; 1 volume(s) found.
11/02/01 10:03:46     ANR0985I Process 4 for CHECKIN LIBVOLUME running in the
                       BACKGROUND completed with completion state SUCCESS at
                       10:03:46.
```

6.2.9 Performance hints for TSM and LTO

Because TSM writes a record of each file backed up to its database for tracking, it will perform better with large file workloads than with small file workloads. This is because of the proportion of time spent doing database writes and updates as a fraction of the total backup time. Therefore to get the best performance with

TSM and LTO drives be sure to raise the parameter *TXNGroupmax* on the server to its maximum value, 256. This parameter controls how many files are transferred as a group between the client and server. On the client, also set the parameter *TXNBytelimit* to its maximum of 2097152. This parameter specifies the number of kilobytes the client program can buffer together in a transaction before it sends data to the server.

To set *TXNGroupmax*, edit the dsmserv.opt on the TSM server as shown in Example 6-10. If you are using the Storage Agent for LAN-free backup, (discussed in 6.4, “Configuring TSM for LAN free backup with LTO” on page 254) you should also set this parameter to the same value in the options file dsmsta.opt.

Example 6-10 TXNGroupmax entry in dsmserv.opt and dsmsta.opt

```
*==============================================================================
*
*  TXNGROUPMAX
*
*  Specifies the maximum number of files transferred as a group between
*  the client and storage agent.
*
*   Syntax
*   +------------------+----------------------------------------------+
*   | TXNGroupmax      | value                                        |
*   +------------------+----------------------------------------------+
*
*   Parameters
*      value             Specifies the maximum number of files that are
*                        transferred as a group between the client and
*                        storage agent.  The minimum value is 4 and the maximum
*                        value is 256.  The default value is 40.
*
*   Examples
    TXNGroupmax 256
*
*  ====================================================================
```

To set the client parameter *TXNBytelimit*, edit dsm.opt. The entry should look like:

Example 6-11 TXNBytelimit entry in dsm.opt

```
TXNByte              2097152
```

In general, small file workloads will backup faster if they are staged initially to a disk storage pool which then migrates to the LTO pool. More suggestions on storage pool configuration are in *Getting Started with Tivoli Storage Manager: Implementation Guide*, SG24-5416. We also recommend the use of compression on the LTO drives as discussed in 6.2.6, "Defining the storage pool using the command line" on page 237.

6.3 Sharing LTO tape libraries with TSM

Several TSM Servers can share the same library using the library sharing feature, as shown in Figure 6-2 on page 215. Tape library sharing is supported among any combination of Windows NT, Windows 2000, AIX, Solaris and HP-UX servers. Some operating system platforms were supported at the TSM Version 3.7 level, however others were introduced later. We recommend using the latest code level, which was Version 4.2.1 at the time of writing. You can download the latest code fixes from

`http://www.tivoli.com/support/storage_mgr/adsercli.htm`

All servers which will share the library need to have a FC/SAN connection to the tape drives in the library. One server will control the library robotics and is designated the *library manager* serverices from the library manager, rather than to the library itself as in non-shared library configurations. For instance, if a library client wants to write data to a tape, then the client has to ask the library manager to mount the tape volume into an available drive. After the tape is mounted by the library manager, then the library client can write the data directly over the physical SAN path to the tape drive.

In our lab environment, we had two SAN-attached Windows 2000 servers, BONNIE and DIOMEDE which access the 3583 Ultrium Scalable Tape Library via SAN Data Gateway and FC switch. This set up is shown in Figure 6-28. We will set up BONNIE as the library manager and DIOMEDE as a library client. Both systems have the basic Tivoli Storage Manager Version 4.2.1 code installed and configured. All library managers and library clients need to have the Library Sharing feature licensed.Do not run the Device Configuration Wizard on the library client as we will define the devices there manually.

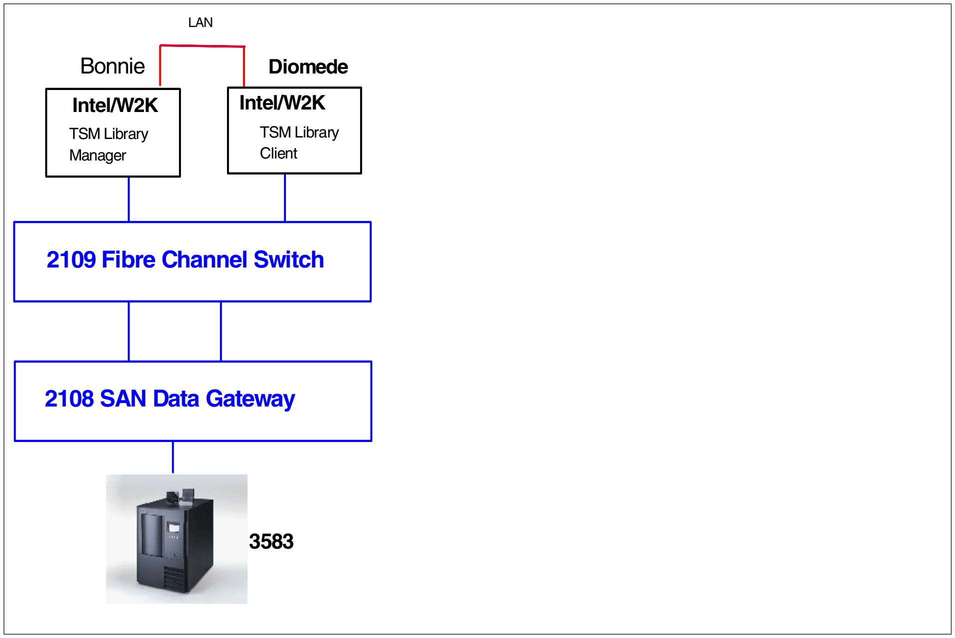


Figure 6-28 Our lab library sharing environment

6.3.1 Configuring the library manager to share libraries

First, install and configure the tape library and drives on the system which will be the Library Manager, as described in Section 6.2, “Configuring LTO tape libraries with TSM” on page 216. We will assume the same naming as was used in that section - that is, a library called lb0.1.0.3 with two drives GENDRV_Tape0 and GENDRV_Tape1.

Since library sharing uses server-to-server communication for sending and receiving requests, the next step is to set up server-to-server communications between the library manager and the library clients.

Set the following parameters on the Library Manager: servername, serverpassword, serverhladdress, serverlladdress and set crossdefine to on.

```
SET SERVERNAME server_name
SET SERVERPASSWORD server_password
SET CROSSDEFINE on
SET SERVERHLADDRESS server_ip_address
SET SERVERLLADDRESS server_ip_portaddress
```

We configured the Library Manager server BONNIE as follows:

```
tsm: BONNIE> SET SERVERNAME bonnie
```

```
tsm: BONNIE> SET SERVERPASSWORD ?***?
tsm: BONNIE> SET CROSSDEFINE on
tsm: BONNIE> SET SERVERHLADDRESS 9.1.38.150
tsm: BONNIE> SET SERVERNAME lladdress 1500
tsm: BONNIE> SET SERVERLLADDRESS 1500
```

Now, configure the library so that it can be shared with the Library Clients. Do this with the *shared=yes* parameter on the **UPDATE LIBRARY** command.

We used:

```
tsm: BONNIE> UPDATE LIBRARY lb0.1.0.3 SHARED=yes
```

6.3.2 Configuring the library client to access a shared library

Now we need to configure the library client, DIOMEDE with server-to-server communication. Set each of the following parameters: servername, serverhladdress, serverlladdress and set crossdefine to on.

SET SERVERNAME *server_name*
SET SERVERPASSWORD *server_password*
SET CROSSDEFINE on
SET SERVERHLADDRESS *server_ip_address*
SET SERVERLLADDRESS *server_ip_portaddress*

We configured the Library Client DIOMEDE as shown below:

```
tsm: DIOMEDE> SET SERVERNAME diomede
tsm: DIOMEDE> SET SERVERPASSWORD ?***?
tsm: DIOMEDE> SET CROSSDEFINE on
tsm: DIOMEDE> SET SERVERHLADDRESS 9.1.38.165
tsm: DIOMEDE> SET SERVERLLADDRESS 1500
```

Now, we must create a server definition for the library manager,so that the library client knows which system is managing the tape libraries. Use the **DEFINE SERVER** command.

DEFINE SERVER *library_manager_servername* **SERVERPASSWORD=***library_manager_password* **HLADDRESS=***library_manager_ip_address* **LLADDRESS=***library_manager_port_number* **COMM=tcpip**

Here we are defining the server BONNIE on the Library Client, DIOMEDE:

```
tsm: DIOMEDE> DEFINE SERVER bonnie serverpassword=?***?
hladdress=9.1.38.150 lladdress=1500 comm=tcpip
```

Define library on library client

You should have already performed basic tape drive installation, including the Ultrium device driver, on the library client system as described in Chapter 2, “Basic LTO setup for Windows 2000” on page 27. The installation of the SCSI Medium Changer (SMC) on the library llient is not needed as only the Library Manager interfaces directly with the SMC device driver.

On the library client machine, define the shared library and the shared drives.

First define the library with:

DEFINE LIBRARY *library_name* **LIBTYPE=shared PRIMARYLIBMANAGER=***lib_manager_name*

Note the use of the *LIBTYPE=shared* parameter. You must use the same *library_name* as was defined on the library server:

```
tsm: DIOMEDE> DEFINE LIBR lb0.1.0.3 libtype=shared
primarylibmanager=bonnie
```

Example 6-12 shows the defined shared library on the library client DIOMEDE.

Example 6-12 Shared library displayed with q library f=d

```
Library Name: lb0.1.0.3
                  Library Type: SHARED
                        Device:
              Private Category:
              Scratch Category:
              External Manager:
                        Shared: No
       Primary Library Manager: BONNIE
Last Update by (administrator): ADMIN
         Last Update Date/Time: 11/02/01 16:21:45
```

Define drives on the library client

Now, define each of the tape drives with

DEFINE DRIVE *library_name drive_name* **DEVICE=***dev_name* **ONLINE=YES**

For *library_name* enter the name of your already defined library (lb0.1.0.3). Specify the name of your to be defined tape drive for *device_name*. Enter the full device name for *dev_name*, like \\.\Tape0.

Get the tape device names from the TSM Management Console as shown in Figure 6-12, “TSM device selection” on page 225, but do not drag and drop any devices to perform automatic configuration.

You have to define each tape drive with this command. Use the same drive names as you defined on the library manager. We defined:

```
tsm: DIOMEDE> DEFINE DRIVE lb0.1.0.3 gendrv_tape0 device=\\.\Tape0
ONLINE=yes
tsm: DIOMEDE> DEFINE DRIVE lb0.1.0.3 gendrv_tape1 device=\\.\Tape1
ONLINE=yes
```

You can check the result with **Q DRIVE** as shown in Example 6-13.

Example 6-13 q drive on the DIOMEDE server

```
Library Name     Drive Name       Device Type     On-Line
------------     ------------     -----------     -------------------
3583LIB1         DRIVE1           LTO             Yes
3583LIB1         DRIVE2           LTO             Yes
LB0.1.0.3        GENDRV_TAPE0     LTO             Yes
LB0.1.0.3        GENDRV_TAPE1     LTO             Yes
```

Now you can define the device class and the storagepool using the library definitions as described in 6.2.4, “Defining the device class using the command line” on page 235 and 6.2.6, “Defining the storage pool using the command line” on page 237. Your devices are now ready for use on both the library manager and the library client.

6.3.3 Administering shared libraries

When using a shared LTO library, it is important to remember that the library clients cannot directly access the library robotics (medium changer) themselves. Any requests for tape movement must be directed through the library manager. While library clients do not directly access the library robotics, once a volume is mounted in a drive, the library clients can read or write data directly to the drive via the SAN data path. This means that certain commands give different output, or are not applicable.

QUERY LIBVOLUME

If you use the **QUERY LIBVOLUME** on the library manager the output is different to what it was before library sharing. The output now also displays which TSM server is the “owner” of each volume as shown in Example 6-14.

Example 6-14 Q LIBVOL on a Library Manager

```
Library Name   Volume Name   Status       Owner        Last Use    Home Element
------------   -----------   ----------   ----------   ---------   ------------
LB0.1.0.3      ABA920L1      Private      BONNIE       Data        4,133
LB0.1.0.3      ABA922L1      Private      BONNIE       Data        4,127
LB0.1.0.3      ABA923L1      Private      DIOMEDE      Data        4,137
LB0.1.0.3      ABA925L1      Scratch                               4,097
```

```
LB0.1.0.3     ABA926L1     Scratch                    4,128
LB0.1.0.3     ABA928L1     Scratch                    4,099
LB0.1.0.3     ABA929L1     Scratch                    4,098
```

QUERY VOLUME

Querying the volumes (**QUERY VOLUME**) on any attached server will report only those volumes that belong to that server.

AUDIT LIBRARY

Performing an **AUDIT LIBRARY** command from a library client does not actually perform a physical audit on the shared library; instead, the library client's database is checked and synchronized against the library manager's database. No tape mounts are performed.

Performing this command on the library manager mounts or inspects all the tapes in the library, just as it does in non-shared configurations.

CHECKIN and CHECKOUT LIBV

Checking in or out of a volume from a shared library must be done from the library manager. If you try to execute the **CHECKOUT LIBVOLUME** command from a library client the operation will fail with an error.

LABEL LIBVOLUME

When the LTO library is shared, tape labelling must be performed on the library manager. If you try to execute the **LABEL LIBVOLUME** command from a library client the operation will fail with an error.

You can share the scratch volumes between all the library clients. This is because the library manager serves as a central repository for information about all the volumes contained in the library. Since all media handling requests are processed by the library manager, it can keep track of which tape belongs to which TSM server and which tapes are unallocated and available for use by any server. There is no special configuration required to utilize this feature; simply make sure there is an adequate supply of labeled scratch tapes in the library and the library manager will allocate them as needed to the requesting library clients (and itself, as another TSM server). Once a particular volume is assigned to a library client, the library manager flags that volume as belonging to that client, and prevents any other client from accessing it.

Note: The library manager is itself a fully functional TSM server - that is, it typically supports its own backup client workload and can access and use the volumes just like a library client. However it also has the particular function of overall management of the devices and tape inventory.

6.4 Configuring TSM for LAN free backup with LTO

LAN-free client data transfer is based on the library sharing technology. It requires the clients which will send their data to have SAN access to the storage devices (LTO tape in our example). The TSM server also requires SAN tape library access. The function is provided by separating the actual application data (the client data written to or read from the storage pools) from the meta or control data (information contained in the TSM database). The metadata is transmitted over the LAN from the TSM client to the TSM server while the application data is moved over the SAN from the TSM client to the storage device. See Figure 6-3 on page 216 for an overview of the data flow. Our lab setup is shown in Figure 6-29.

A core component of LAN-free technology is the Storage Agent which is a piece of code installed on each LAN-free client. Essentially, the Storage Agent can be viewed as a lightweight TSM server that has no database or storage hierarchy of its own. It behaves like a Library Client which contacts the TSM server for volume access, and reads/writes data directly to SAN-attached devices.

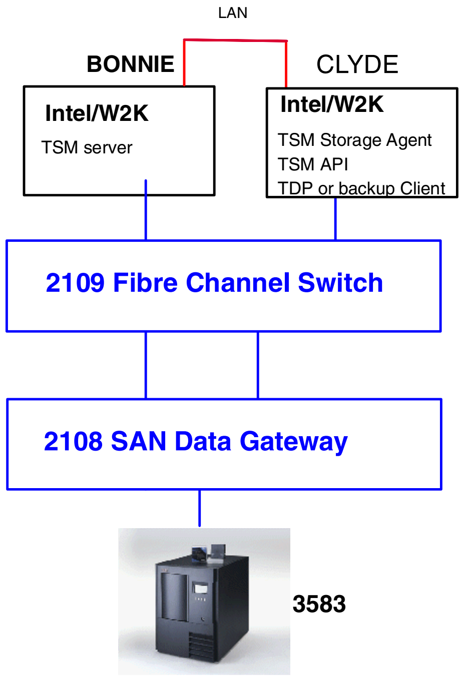


Figure 6-29 LAN free client setup

6.4.1 LAN-free setup summary

We tested LAN-free backup using the following configuration:

- Intel server, BONNIE, with Windows 2000 SP2 (build 2195) and QLogic QLA2200 FC adapter, TSM server Version 4.2.1
- Intel server, CLYDE,with Windows 2000 SP2 (build 2195) and QLogic QLA2200 FC apapter, TSM Storage Agent Version 4.2.1, TSM backup/archive client and API
- IBM 2109 FC switch
- IBM 2108-R03 SAN Data Gateway
- 3583 Ultrium Scalable Tape Library with two LVD drives

The setup used these steps:

1. **On the TSM server, BONNIE:**
   - Disable RSM
   - Install the Ultrium device drivers.
   - Install TSM and set up server-to-server communication.
   - Define the LTO Library using Shared=yes

– Define the LTO drives
– Define a device class associated with the server
– Define a storage pool and assign it to the above device class
– Create a policy domain with a management class for the SAN client that has a destination storage pool as the Library storage pool
– Define a LAN free client node and assign it to the above policy domain
– Define the Storage Agent Client as a server

2. **On the LAN-free client, CLYDE**
   – Disable RSM
   – Install the Ultrium device drivers
   – Install the TSM Client software
   – Create and modify dsm.opt
   – Install the DSMSTA agent
   – Install the TSM Device Driver
   – Customize the Storage Agent configuration files and the Service
3. **Define the Drivemappings on the server, BONNIE**
   – Define the drivemappings on the TSM server using the DEFINE DRIVEMAPPING command
4. **Verify the LAN-free configuration by:**
   – Running a backup from the client
   – Monitoring activity on the client network interfaces
   – Monitoring activity on the switch

6.4.2 Setting up the Server for LAN free

We performed the following the TSM server, BONNIE, to enable it to support LAN free clients.

1. Disable RSM as described in “Disabling RSM” on page 61. This is important since it ensures that requests made from the TSM server to access the library do not not pass to RSM.
2. Install the IBM Ultrium device drivers for Windows 2000 as detailed in 2.2.3, “Installing the LTO Medium Changer and tape device drivers” on page 36.
3. Install TSM, following the QuickStart Guide. Make sure Library sharing is licensed, as well as the correct number of Managed System for SAN items corresponding to the number of LAN free clients. Configure server-to-server

communication by using the appropriate SET SERVERxxx commands. We used the following:

```
tsm: BONNIE> SET SERVERNAME bonnie
tsm: BONNIE> SET SERVERPASSWORD ?***?
tsm: BONNIE> SET CROSSDEFINE on
tsm: BONNIE> SET SERVERHLADDRESS 9.1.38.150
tsm: BONNIE> SET SERVERNAME lladdress 1500
```

4. Define the LTO library with the option shared=yes. We used:

```
DEFINE LIBRARY lb0.1.0.3 libtype=scsi device=lb0.1.0.3 SHARED=YES
```

5. Define the LTO tape drives:

```
DEFINE DRIVE lb0.1.0.3 GENDRV_Tape0 device=\\.\Tape0 element=256
CLEANFREQUENCY=asneeded
DEFINE DRIVE lb0.1.0.3 GENDRV_Tape1 device=\\.\Tape1 element=257
CLEANFREQUENCY=asneeded
```

6. Define the device class

```
DEFINE DEVCLASS LTOCLASS1 devtype=LTO format=drive library=lb0.1.0.3
```

7. Define the storage pool

```
DEFINE STGPOOL LTOPOOL1 LTOCLASS1 maxscratch=500
```

8. Define the policy domain. This is optional; however, the client MUST use a management class that has copy groups using a destination storage pool that is associated with the LTO library on the SAN. You can specify a different management class in asn existing policy domain. If you do not set the management class as default you will have to specify the mangement class to use in the client option file on the storage agent.

   a. Define the policy domain

   ```
   DEFINE DOMAIN lanfree BACKRETENTION=30 ARCHRETENTION=365
   ```

   b. Define the policy set in the above domain

   ```
   DEFINE POLICYSET LANFREE standard
   ```

   c. Define the management class to the policy set.

   ```
   DEFINE MGMTCLASS LANFREE STANDARD lanfree SPACEMGTECHNIQUE=NONE
   AUTOMIGNONUSE=0 MIGREQUIRESBKUP=YES
   ```

   d. Set the management class as default for that policy domain

   ```
   ASSIGN DEFMGMTCLASS LANFREE STANDARD LANFREE
   ```

   e. Define the copygroup ensuring that the destination storage pool is that which you will use to define drivemappings for the client as discussed later in this section. Put simply, use the storage pool that will be the location for the storage agents' data. In this case it will be the LTO library storage pool.

```
DEFINE COPYGROUP LANFREE STANDARD LANFREE DESTINATION=LTOPOOL1
FREQUENCY=0 VEREXISTS=2 VERDELETED=1 RETEXTRA=30 RETONLY=60
MODE=MODIFIED SERIALIZATION=SHRSTATIC
```

f. Validate the policy set:

```
VALIDATE POLICYSET LANFREE STANDARD
```

g. Activate the policy set:

```
ACTIVATE POLICYSET LANFREE STANDARD
```

9. Register the LAN free client node. Use the option MAXNUMMP (maximum number of mount points) to limit the the number of drives available to the storage agent client. The default is to use all available drives in the library. Specify the DOMAIN as the LANFREE policy domain if you defined this previously in step 8. This will mean that the backup data will automatically by assigned to the default management class in this domain unless specified otherwise in the options file (dsm.opt) on the LAN free client.

```
tsm: BONNIE> REGISTER NODE clyde ?***? DOMAIN=LANFREE AUTOFSRENAME=NO
ARCHDELETE=YES BACKDELETE=NO FORCEPWRESET=NO TYPE=CLIENT KEEPMP=NO
MAXNUMMP=2 URL=http://clyde:1581 PASSEXP=9999
```

10. Define the LAN free client as a server.

```
tsm: BONNIE> DEFINE SERVER clyde COMMMETHOD=TCPIP SERVERPASSWORD=?***?
HLADDRESS=9.1.38.151 LLADDRESS=1500 URL=http://clyde:1580
```

6.4.3 Setting up the client for LAN free

To set up the TSM client for LAN free backup, do the following:

1. Disable RSM as described in "Disabling RSM" on page 61.
2. Install the IBM Ultrium device drivers for Windows 2000 as detailed in "Installing the LTO Medium Changer and tape device drivers" on page 36.
3. Install the TSM client software using *Tivoli Storage Manager: Installing the Clients* SH26-4119. The latest client code is available from

   ftp://service.boulder.ibm.com/storage/tivoli-storage-management/maintenance/client/

4. Create the client options files (dsm.opt) and include the following lines:

```
nodename nodename
tcpserveraddress servername
enablelanfree yes
```

5. Install the Storage Agent from the CD included with your media kit. Check the Tivoli website for any updates. Run **setup.exe** to invoke the TSM InstallShield wizard. The welcome screen will appear and you will then be prompted for a temporary save directory. Accept the default location or choose an alternative

location. The install process then extracts the files. The TSM Install GUI starts automatically: select **Install Products** then **TSM Storage Agent** (Figure 6-30).

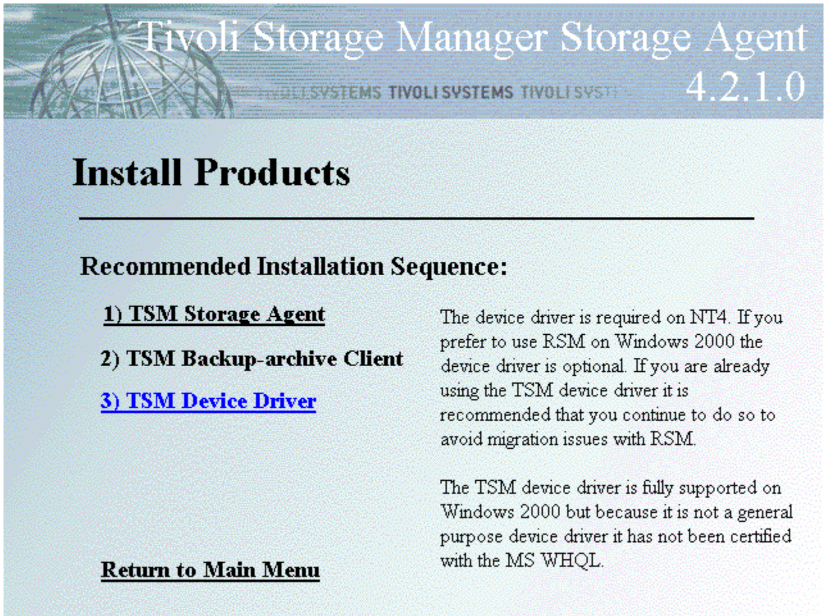


Figure 6-30 TSM Install GUI

Click past the welcome screen, then select the folder to install the Storage Agent files into. Next, select the setup type (Figure 6-31). We chose **Custom** for our installation.

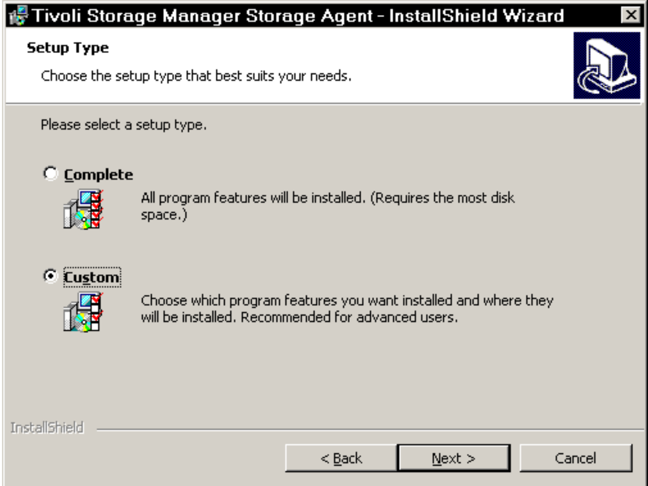


Figure 6-31 Storage Agent setup types.

The options for a cutsom setup appear (Figure 6-32). You may opt to not install Online Documention and/or install additional Language support.

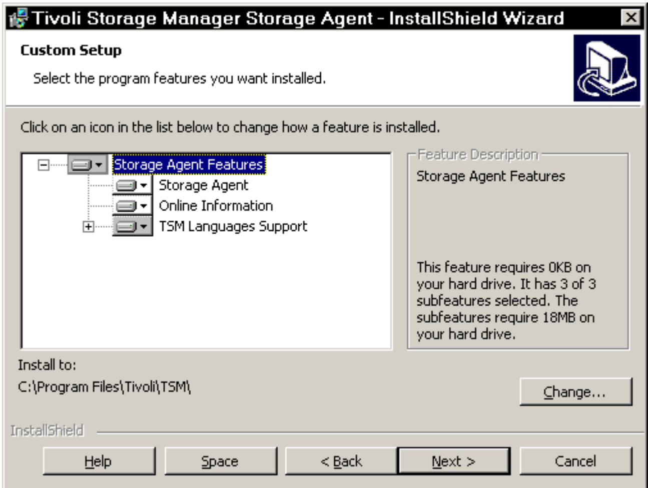


Figure 6-32 Storage Agent custom setup options

The wizard is now ready to install the storage agent by copying the files. When the install process completes, click **Finish**.

6. Next, install the TSM device driver by selecting option 3 on the install GUI (Figure 6-30 on page 259). The installation is straightforward. Ensure that the

device driver is set to start up at boot. Reboot the server once the device driver install is complete.

To enable (or verify) the device driver is enabled type **tsmscsi /enable** at a DOS prompt in the directory where the Storage Agent is installed:

The results of this command should look like this:

```
C:\Program Files\Tivoli\TSM\storageagent>tsmscsi /enable
TSM Windows 2000 / Optical support is enabled on CLYDE.
```

7. Initialize the Storage Agent server using the Initialization Wizard. The wizard should begin automatically after you complete the Storage Agent install. If it doesn't, you may start it by selecting **Start -> Programs -> Tivoli Storage Manager -> TSM Management Console**. The Initialization Wizard will appear (Figure 6-33).

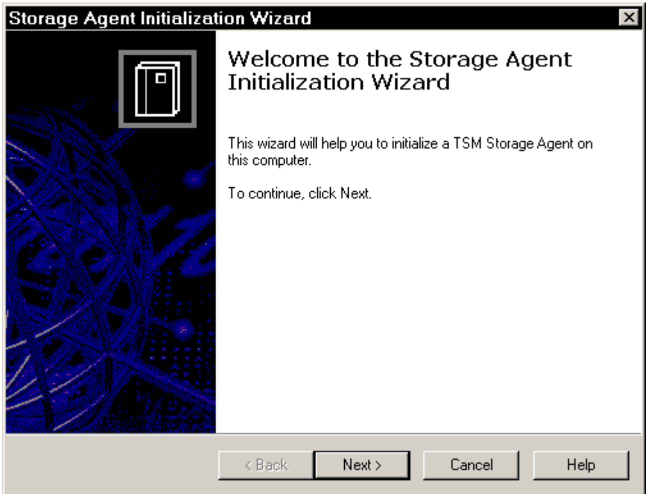


Figure 6-33 Storage Agent Initialization Wizard.

You will be prompted to enter server account information into the panel shown in Figure 6-34. This information will be used to build the dsmsta.opt files and the devconfig configuration files. Enter the following information:

Storage Agent name: This is the name for the Storage Agent. It must be the same as that which was used to define the Storage Agent to the TSM Server in 10. on page 258.

Storage Agent password: This is the password for the Storage Agent. It must be the same as that which was used to define the Storage Agent to the TSM Server in 10. on page 258.

Storage Agent TCP/IP address: The TCP/IP address of the server. It may be entered as either the hostname of the Storage Agent or the fully qualified domain name of the server, depending on what name resolution services are running on your network. If you are unsure, enter in the IP address.

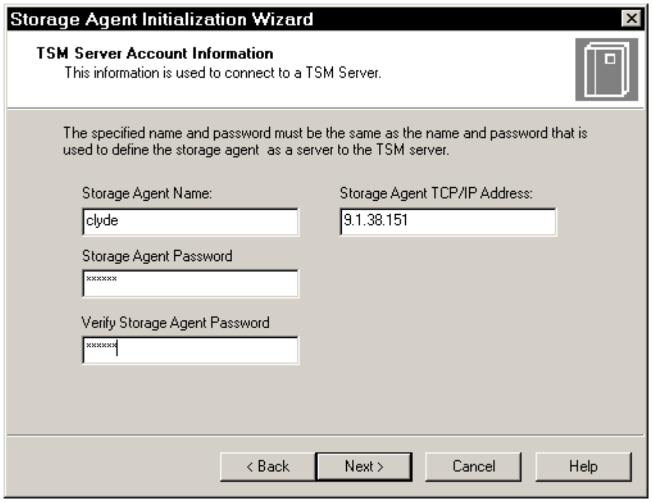


Figure 6-34 TSM Server Account Information

Now you must enter the details of the TSM server with which the Storage Agent will communicate in the panel shown in Figure 6-35. Your entries should match the server-to-server communication which was configured on the TSM server, BONNIE in 3. on page 256. Enter in the following:

Server Name: The TSM server name (BONNIE in our example).

Server Password: This is the TSM server password and must be entered as it was set on the server.

Server TCP/IP address: The TCP/IP address of the TSM server. It may be entered as either the name of the TSM Server or the fully qualified domain name of the server, depending on the name resolution services running on your network. If you are unsure, enter in the IP address.

Server Port Number: This is the equivalent of the Serverlladdress as set on the TSM server. By default it is 1500.

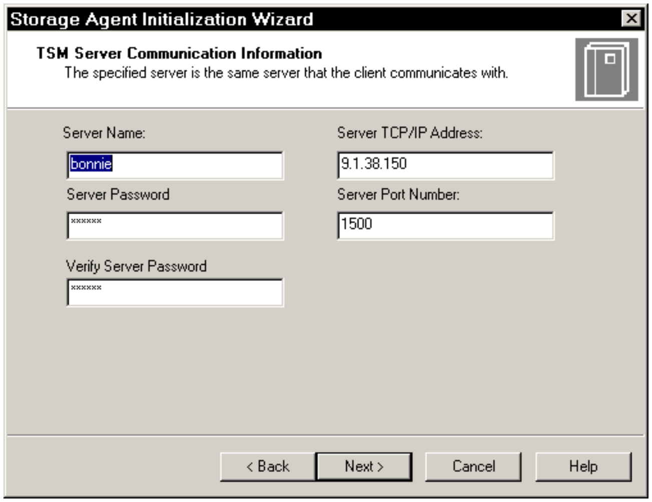


Figure 6-35 TSM Server Communication Information

The initialization wizard will prompt you for an account to use to start the Storage Agent with and whether to start the service automatically or manually. We selected to automatically start the service at boot time. This is shown in Figure 6-36.

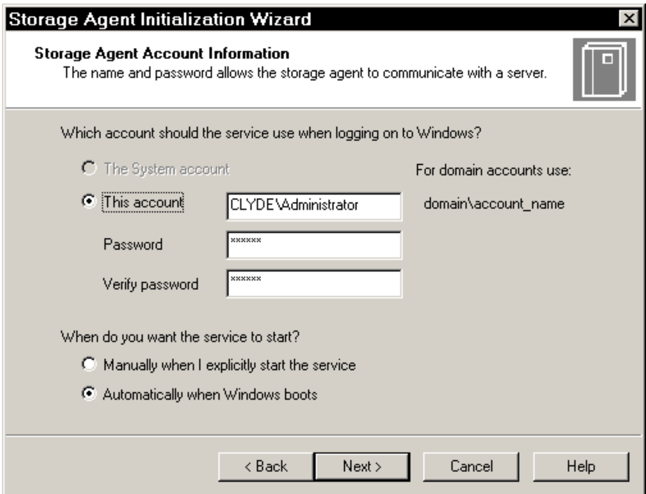


Figure 6-36 Storage Agent account information.

The Storage Agent will initialize when you click **Finish** on the final screen.

A pop-up window will appear indicating that the account you specified for starting up the Storage Agent service has been granted the *LogOnAsAService* right, which is required for correct operation. The Storage Agent is then initialized. You will now see two configuration files in the Storage Agent installation directory. The Storage Agent configuration file, dsmsta.opt, contains the lines:

Example 6-15 Storage Agent configuration file dsmsta.opt

```
COMMmethod TCPIP
COMMmethod NAMEDPIPE
DEVCONFIG devconfig.txt
SERVERNAME bonnie
```

The device configuration file, devconfig.txt has this:

Example 6-16 Storage Agent device configuration file devconfig.txt

```
SET STANAME clyde
SET STAPASSWORD ?...?
SET STAHLADDRESS 9.1.38.151
DEFINE SERVER bonnie HLADDRESS=9.1.38.150 LLADDRESS=1500 SERVERPA=?.....?
```

6.4.4 Defining the Storage Agent Drive Mappings

You must map all the TSM defined drives on the server using the device names as seen by the Storage Agent. The drive mappings allow the Storage Agent client to back up data to the drives that have been mapped, using its own device configuration. The backup operation will fail if you attempt to use a drive in the library that is not mapped. The device names can be obtained on the Storage Agent (CLYDE) via the TSM Management Console or by entering the command **tsmdlst** from a DOS command line. The TSM device names for the drives are listed as \\.\Tape0 and \\.\Tape1.

Example 6-17 tsmdlst command output

```
C:\Program Files\Tivoli\TSM\storageagent>tsmdlst
Computer Name:      CLYDE
TSM Device Driver:  Running
TSM Device Name  ID    LUN  Bus  Port   TSM Device Type  Device Identifier
-------------------------------------------------------------------------------
lb0.1.0.3        0     1    0    3      LIBRARY          IBM     ULT3583-TL
2.50
\\.\Tape0        0     2    0    3      LTO              IBM     ULT3580-TD1
16E0
\\.\Tape1        0     4    0    3      LTO              IBM     ULT3580-TD1
16E0
```

For a more detailed view, use **tsmdlst /Detail**. This gives the following output.

Example 6-18 tsmdlst command with detailed output

```
C:\Program Files\Tivoli\TSM\storageagent>tsmdlst /Detail
Computer Name:      CLYDE
TSM Device Driver:  Running

Device Type:        MediumChangerPeripheral
TSM Device Name:    lb0.1.0.3
TSM Device Type:    LIBRARY
ID:                 0
LUN:                1
Bus:                0
Port:               3
Device Identifier:  IBM     ULT3583-TL      2.50

Device Type:        TapePeripheral
TSM Device Name:    \\.\Tape0
TSM Device Type:    LTO
ID:                 0
LUN:                2
Bus:                0
Port:               3
Device Identifier:  IBM     ULT3580-TD1     16E0
Supported Generic Tape:  Yes
  Variable Blocks:       Yes
  Filemarks:             Yes
  Relative Blocks:       Yes
  Reverse Position:      Yes

Device Type:        TapePeripheral
TSM Device Name:    \\.\Tape1
TSM Device Type:    LTO
ID:                 0
LUN:                4
Bus:                0
Port:               3
Device Identifier:  IBM     ULT3580-TD1     16E0
Supported Generic Tape:  Yes
  Variable Blocks:       Yes
  Filemarks:             Yes
  Relative Blocks:       Yes
  Reverse Position:      Yes
C:\Program Files\Tivoli\TSM\storageagent>
```

To view the device names from the TSM Management Console, click on **Tivoli Storage Manager -> TSM Server Name -> TSM Device Driver -> Device Information** as shown in Figure 6-37 below.

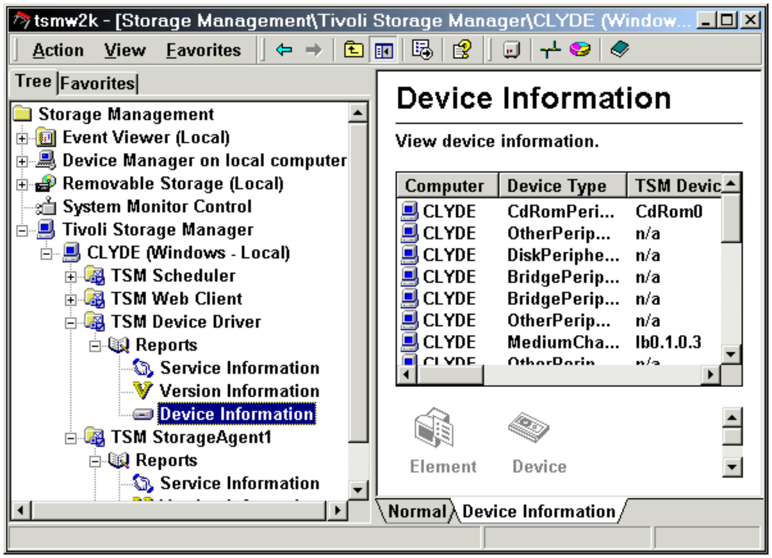
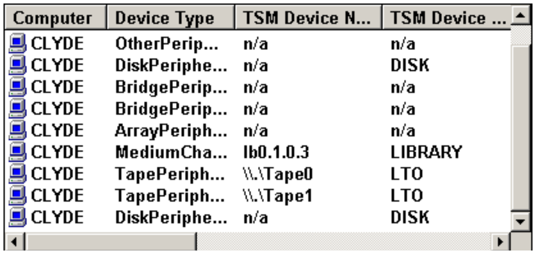


Figure 6-37 Device information

The devices will be listed in the right hand pane as in Figure 6-38.



Computer	Device Type	TSM Device N...	TSM Device ...
CLYDE	OtherPerip...	n/a	n/a
CLYDE	DiskPeriphe...	n/a	DISK
CLYDE	BridgePerip...	n/a	n/a
CLYDE	BridgePerip...	n/a	n/a
CLYDE	ArrayPeriph...	n/a	n/a
CLYDE	MediumCha...	lb0.1.0.3	LIBRARY
CLYDE	TapePeriph...	\\.\Tape0	LTO
CLYDE	TapePeriph...	\\.\Tape1	LTO
CLYDE	DiskPeriphe...	n/a	DISK

Figure 6-38 Storage Agent Device Listing

The drivemappings can now be defined on the TSM server (BONNIE) using the device names as seen by the Storage Agent:

```
tsm: BONNIE> DEFINE DRIVEMAP CLYDE LB0.1.0.3 GENDRV_TAPE0 DEVICE=\\.\tape0
ONLINE=YES
tsm: BONNIE> DEFINE DRIVEMAP CLYDE LB0.1.0.3 GENDRV_TAPE1 DEVICE=\\.\tape1
ONLINE=YES
```

6.4.5 Verifying the LAN-free configuration

You can verify the LAN free connection by:

- Running a backup from the client
- Monitoring activity on the switch
- Monitoring activity on the client network interfaces

The best way to verify your LAN-free setup is to run a backup on the client. If the configuration is successful then the backup should work the first time. Note that if it fails the first time then the client will attempt to move data over the LAN connection the second time you initiate a backup.

You can also check the activity log on the server to verify SAN data transfer using the QUERY ACTLOG command as shown in Figure 6-19. We can see there was a session for our defined LAN-free client (CLYDE), confirming that our configuration is correct.

Example 6-19 q actlog

```
11/01/2001 16:22:10   ANR0406I Session 685 started for node CLYDE (WinNT)
                       (Tcp/Ip 9.1.38.151(2064)).
11/01/2001 16:22:10   ANR0400I (Session: 684, Origin: CLYDE)  Session 16
started
                       for node CLYDE (WinNT) (Named Pipe).
11/01/2001 16:22:13   ANR0408I Session 686 started for server CLYDE (Windows
NT)
                       (Tcp/Ip) for library sharing.
11/01/2001 16:22:34   ANR8337I (Session: 684, Origin: CLYDE)  LTO volume
                       ABA920L1 mounted in drive GENDRV_TAPE0 (\\.\tape0).
11/01/2001 16:22:34   ANR0409I Session 686 ended for server CLYDE (Windows NT).
11/01/2001 16:23:21   ANR0408I Session 687 started for server CLYDE (Windows
NT)
                       (Tcp/Ip) for library sharing.
11/01/2001 16:23:21   ANR0409I Session 687 ended for server CLYDE (Windows NT).
11/01/2001 16:24:29   ANR0403I Session 685 ended for node CLYDE (WinNT).
11/01/2001 16:24:32   ANE4952I (Session: 642, Node: CLYDE)  Total number of
                       objects inspected:    8,364
11/01/2001 16:24:32   ANE4954I (Session: 642, Node: CLYDE)  Total number of
                       objects backed up:      121
11/01/2001 16:24:32   ANE4958I (Session: 642, Node: CLYDE)  Total number of
                       objects updated:          0
11/01/2001 16:24:32   ANE4960I (Session: 642, Node: CLYDE)  Total number of
                       objects rebound:          0
11/01/2001 16:24:32   ANE4957I (Session: 642, Node: CLYDE)  Total number of
                       objects deleted:          0
11/01/2001 16:24:32   ANE4970I (Session: 642, Node: CLYDE)  Total number of
                       objects expired:         19
11/01/2001 16:24:32   ANE4959I (Session: 642, Node: CLYDE)  Total number of
```

```
                          objects failed:          20
11/01/2001 16:24:32   ANE4961I (Session: 642, Node: CLYDE)  Total number of
                          bytes transferred:    19.80 MB
11/01/2001 16:24:32   ANE4963I (Session: 642, Node: CLYDE)  Data transfer time:
                                              8.43 sec
11/01/2001 16:24:32   ANE4966I (Session: 642, Node: CLYDE)  Network data
                          transfer rate:        2,404.53 KB/sec
11/01/2001 16:24:32   ANE4967I (Session: 642, Node: CLYDE)  Aggregate data
                          transfer rate:        134.93 KB/sec
11/01/2001 16:24:32   ANE4968I (Session: 642, Node: CLYDE)  Objects compressed
                          by:                    0%
11/01/2001 16:24:32   ANE4964I (Session: 642, Node: CLYDE)  Elapsed processing
                          time:             00:02:30
11/01/2001 16:24:34   ANR8336I (Session: 684, Origin: CLYDE)  Verifying label
of
                          LTO volume ABA920L1 in drive GENDRV_TAPE0 (\\.\tape0).
11/01/2001 16:25:06   ANR0408I Session 688 started for server CLYDE (Windows
NT)
                          (Tcp/Ip) for library sharing.
11/01/2001 16:25:17   ANR8468I (Session: 684, Origin: CLYDE)  LTO volume
                          ABA920L1 dismounted from drive GENDRV_TAPE0 (\\.\tape0)
                          in library LB0.1.0.3.
11/01/2001 16:25:17   ANR0409I Session 688 ended for server CLYDE (Windows NT).
11/01/2001 16:25:17   ANR0403I (Session: 684, Origin: CLYDE)  Session 16 ended
                          for node CLYDE (WinNT).
```

You can also monitor activity on the switch to ensure that data is actually being tranferred over the SAN. To demonstrate this we have include an example of the activity on the switch as depicted in the switch performance applet in Figure 6-39. You will notice activity on Ports 11 and 12. Port 11 corresponds to the connection between the switch and the node CLYDE which is the Storage Agent. Port 12 corresponds to the port that the Library is attached to via the SAN Data Gageway. The TSM Server is attached to Port 9 - notice that there is no activity on this port, indicating that the TSM Server is not involved in data transfer to the LTO library.

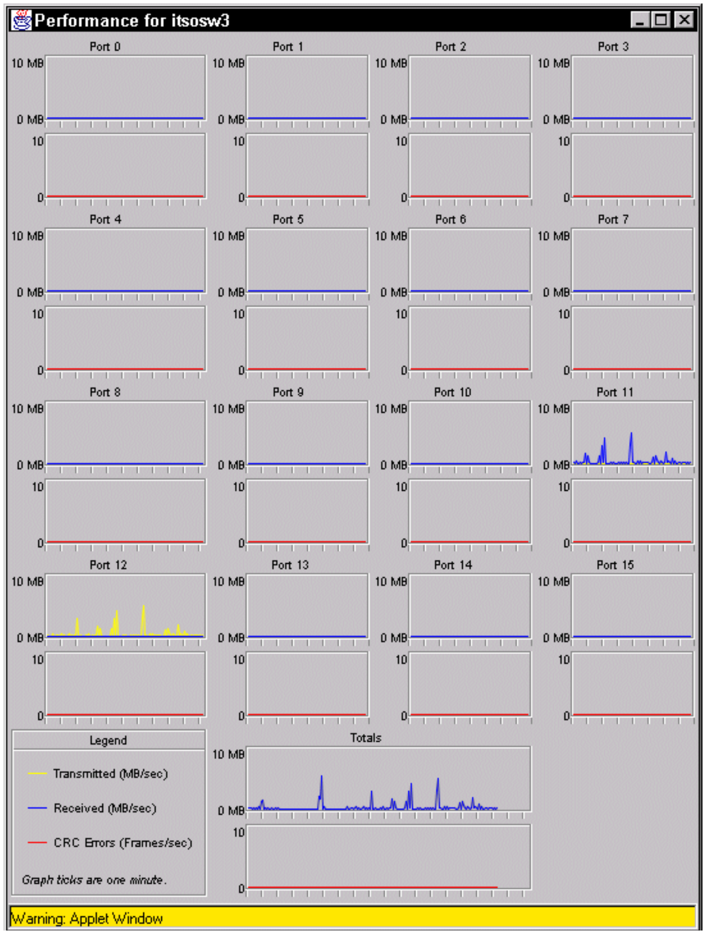


Figure 6-39 Switch performace applet

6.5 Tivoli Data Protection for NDMP

In this section we will discuss NDMP, provide an overview of Tivoli Data Protection for NDMP and show how to configure it using an LTO tape library.

6.5.1 What is NDMP?

NDMP (Network Data Management Protocol) is an open standard protocol developed to eliminate the issues centred around the decentralization of backup standards for file servers and dedicated NAS (Network Attached Storage) file servers.

Network Attached Storage

NAS stands for Network Attached Storage and is a way to make large amounts of disk storage available to many clients using standard file sharing protocols. A NAS box (sometimes also called a NAS appliance or file server) consists of a number of standard disks, one or more network adapters (NICs) and a controller which typically runs an embedded specialized operating system, used to configure and administer the box. The NAS appliance exists as an entity on the network, the disks are divided up into volumes, which can then be accessed by other servers or workstation, using standard file-sharing protocols like NFS and CIFS. NAS is therefore easy and relatively cheap to implement since standard file sharing methods and normal network adapters are used to access the data.

But the question arises, how to back up the data in the NAS box? One way is to back up the mounted file systems from a client which is accessing it. However this involves multiple network accesses and may or may not backup metadata like access control lists correctly. Or, you could write/modify a backup client to run directly on the NAS appliance itself. The issue here is that vendors use different operating systems (often specialized) for their appliances, which means multiple ports of the backup client would be necessary. A standard is really needed to make NAS backup easier.

The need for NDMP

NDMP provides a standard protocol for backup applications to use to backup NAS servers. NDMP was also borne out of the desire to have NAS systems ready for backup by eliminating the need to have backup software even installed on a NAS client. NDMP thus allows NAS and backup vendors to focus on core competencies and protects the customer from having to perform any backup configuration on their NAS system.

For the customer, NDMP provides a high performance backup solution by separating meta-data (control path) transfer over the LAN from raw backup data (data path) which can be transferred locally to a storage device. NDMP also solves the problem of interoperability of various NAS servers and backup software.

For more information on NDMP see Appendix A, “NDMP” on page 435.

6.5.2 Overview of Tivoli Data Protection for NDMP

Tivoli Data Protection for NDMP (TDP for NDMP), provides backup of NAS file servers using Tivoli Storage Manager. TSM controls the backup operation remotely, but the NAS file server transfers the backup data locally. Typically, this in a direct SCSI attached configuration between the NAS file server and a tape library. It is possible to configure NDMP operations with TSM using a SAN attached configuration. However, the library robotics must be logically but explicitly controlled by the TSM server, and the tape drives must be logically but explicitly controlled by the NAS file server.

TDP for NDMP backs up and restores complete NAS file systems without having to use file access protocols like CIFS (Common Internet File System) and NFS (Network File System). The first backup performed is a full backup with every backup thereafter being a differential backup by default (a differential backup will backup all file system changes since the last full backup). When a restore is initiated, TSM will restore the full backup first followed by the differential backup. TSM is unable to perform restores at the file or directory level using TDP for NDMP at this time.

6.5.3 Hardware and software requirements

Tivoli Data Protection for NDMP requires the following:

- TDP for NDMP - a separately priced and licensed feature on the TSM server.
- TSM Server for Windows v4.2.1 or higher, running on Windows NT 4.0 with Service Pack 6 or later, or, Windows 2000 with Service Pack 2 or later.
- Tivoli Storage Manager Version 4.2.1 client on Windows NT, Windows 2000, Sun Solaris (32-bit), AIX, and AIX 5L.
- A Network Appliance File Server running Data ONTAP 6.1.1 or higher. The combination of the file server model and operating system must be supported by Network Appliances (Netapp).
- A SCSI or Fibre Channel attached tape library with drive(s) that is supported by the TSM device driver. For a list of supported devices refer to:

  `http://www.tivoli.com/support/storage_mgr/devices/all.html`
- One or more tape devices in the tape library that are supported on the NetApp server. Refer to:

  `http://www.netapp.com/solutions/data_protection_devices.html`
- Libraries must be defined to the TSM server using libtype=SCSI (manual libraries are not supported, including the 3580).

For Fibre Channel-attached library environments customers should verify interoperability of specific NAS, tape, and SAN devices with the hardware vendors.

For updates on supported hardware software and operating system version (for NAS system and TSM server) for TDP for NDMP refer to:

`http://www.tivoli.com/support/storage_mgr/tdp_ndmp.html#ndmpWIN`

6.5.4 Supported TSM interfaces

You can use the following interfaces to interact with TDP for NDMP:

Client operations

- Backup Client command line
- Web Client

Server operations

- Administrative command line
- Web administrative GUI
- Server console

Unsupported operations

The following TSM operations are not supported for data that has been backed up using TDP for NDMP:

- Storage pool migration
- Storage pool backup and restore
- Reclamation
- Move data
- Import and export operations
- Backupset generation and archiving.

6.5.5 TDP for NDMP configurations

The fundamental physical requirement for TDP for NDMP is to have the tape devices connected to the NAS system. The library robotics may be controlled by either the NAS system or the TSM server. If the tape library does not have separate interfaces for the medium changer and tape devices or if there is a large distance separating the TSM server and the NAS system then the library must be directly connected to the NAS system. Here are the supported configurations:

Library connected to NAS system

In this configuration, the tape library and drives are directly connected to the NAS file server as shown in Figure 6-40. The TSM server sends commands to the library across the LAN to the NAS file server which passes the commands onto the tape library. Any generated responses are sent back to the TSM server via the NAS file server. In this configuration the NAS file server may be separated from the TSM server by a large distance, as TCP/IP connectivity is all that is required.

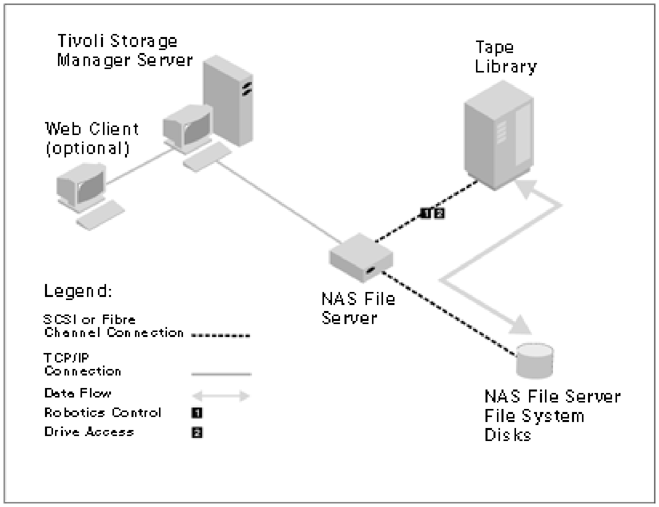


Figure 6-40 Library connected to NAS system

Library connected to TSM server

In this configuration the Tape library is directly connected to the TSM server and the tape drives within the library are directly connected to the NAS file server as shown in Figure 6-41. The TSM server passes commands directly to the tape library, and the NAS file server pushes data directly to the tape devices at the request of the TSM server. This configuration is only possible within the physical connectivity limitations of SCSI or fibre channel.

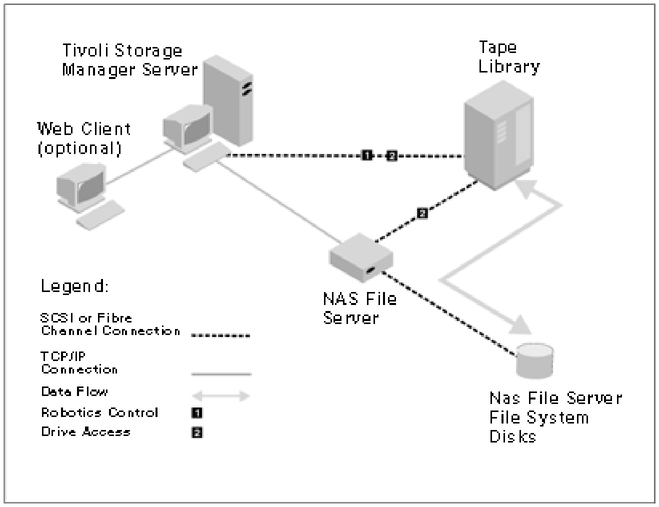


Figure 6-41 Library connected to TSM server, drives connected to NAS system.

Tape library and drive sharing

It is possible to share the tape library and drives between NDMP, LAN-free and TSM Server operations via a SAN configuration.

Following are minimal requirements for FC-attached tape libraries and drives:

- Tape libraries must be supported by TSM device drivers and must be defined to TSM using LIBTYPE=SCSI
- Tape drives must be supported by the file server hardware and operating system
- The library must support the tape drives
- Customers should verify interoperability of specific NAS, tape, and SAN devices with the hardware vendors. Tivoli cannot advise customers regarding the compatibility of specific combinations of devices.

For a list of supported SAN environments refer to:

http://www.netapp.com/osn/info/config.html

The following considerations apply to NDMP operations in conjunction with TSM library sharing:

- TSM library clients cannot perform NDMP operations
- A TSM library manager can perform NDMP operations, provided that the library is controlled directly by the library manager rather than by passing SCSI commands through a NAS system

The following considerations apply to tape drive configurations used for NDMP-controlled operations:

- Drives must be accessible (and supported by) the file server
- Drives can be shared by the TSM server and one or more NAS file servers
- Drives can be shared by one or more NAS file servers and one or more TSM storage agents, provided that the library is directly controlled by the TSM server and drives are accessible to the TSM server

Drives can be shared by one or more NAS file servers and one or more TSM library clients, provided that the library is directly controlled by the library manager

6.5.6 New Terms and Definitions for use with TDP for NDMP

Several new terms have been introduced with TDP for NDMP. These include:

Datamovers

A Datamover represents the NAS system. A datamover is similar to defining another server (via server-to-server communication) to the TSM server in that we define a high level (TCP/IP address) and low level address (port number), userid and password of the NAS system. However, we also define a type (NAS) and a dataformat (NETAPPDUMP).

Paths

If the library robotics are physically connected to the NAS file server, paths are defined on the TSM server. The path exists between the datamover and the drives and effectively allows the datamover to access the drives. The paths are defined using a device special name which is obtained via the autodiscovery feature on the NetApp system. A device special file name is used in conjunction with the path definition that determines whether the drive is using compression and how the tape library will handle tape media once a backup or restore operation has completed (i.e. rewind, rewind and dismount, rewind and eject etc.)

Data formats

The data format used for TSM operations is NETAPPDUMP. This is the format that is used by the NetApp system for tape backup. This format is used to define the destination storage pool and also used when defining the Datamover.

NAS device class

The device class is defined using type=NAS

NAS nodes

The node is defined using type=NAS

6.5.7 Configuring Tivoli Data Protection for NDMP

The configuration we used in our environment was a tape library directly connected to the NAS system via SCSI with the TSM server controlling the library by sending commands to the NAS file server.

We tested TDP for NDMP using the following:

- Intel server with Windows NT4 SP6a and TSM Server and Client at Version 4.2.1
- NetApp F720 Filer with NetApp Release 6.1.1R1
- LTO Ultrium 3581 Autoloader. This system has a medium changer device and one drive

The lab setup is shown in Figure 6-42 below.

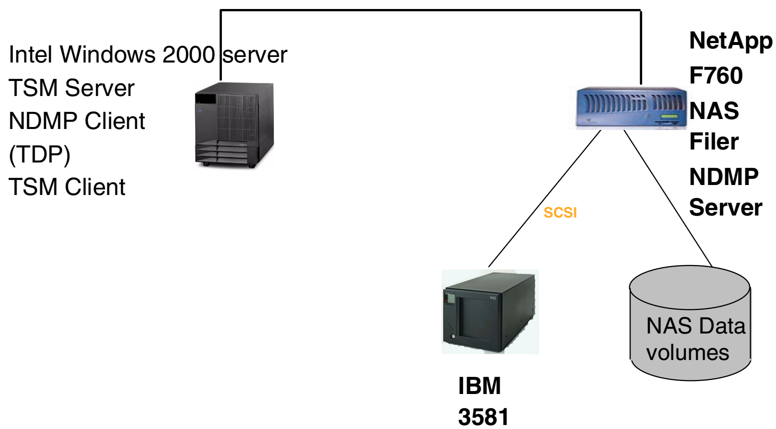


Figure 6-42 TSM NDMP lab setup

The TSM client is required to initiate the backup and restore operations. Any accessible TSM client (at the correct level) could be used, however in our setup we chose to install the client on the same system as the server. The NAS system is by default running the NDMP server. Enabling the NDMP license on the TSM server starts the NDMP client.

To set up TDP for NDMP we did the following:

- – Install TSM and the TSM device drivers
- – Shutdown TSM
- – Shutdown the server running TSM
- – Shutdown NAS file server
- – Attach library to NAS file server
- – Start NAS file server
- – Start TSM
- – Define environment on TSM for NDMP operations

Configuring the TSM environment for NDMP operations

Our TSM environment was configured as follows:

1. Determine the device alias names from the NetApp system. These names will be used when we define PATHS on the TSM server. The tape library and drive devices are detected by the autodiscovery feature on the NetApp system as shown in the NetApp syslog and illustrated in Example 6-20.

Example 6-20 Autodiscovery of the devices

```
Tue Nov  6 18:36:27 GMT [tape_mc_alias_admin:notice]: alias st2 automatically
added for tape/mc device 0b.3
Tue Nov  6 18:36:27 GMT [tape_mc_alias_admin:notice]: alias mc1 automatically
added for tape/mc device 0b.1
```

The alias names are available from the Netapp command line by running a telnet session to the system and issuing the commands:

`sysconfig -m`: this returns the alias name for the medium changer or library robotics. In this case it is mc1

`sysconfig -t`: this returns the alias names for the tape device.

The result of these commands as issued on the NetApp system is shown in Example 6-21. These names are used as the DEVICE parameter when defining Paths between the NAS system, the tape library and the tape drive.

The name you use for the tape device has several dependancies. The device names are of the format ***crstud*** where:

c: This portion of the name determines how you want the drive to handle your tape media at the end of an operation. The only type that is valid for TSM NDMP operations is the rewind device. If the character *r* is present, (for example, the alias rst2l), the drive is defined as a rewind device. This means that the drive will automatically rewind the tape when it has completed an operation. If you specify anything other than this it will still use a rewind device of the same LUN(u) and density(d). If the character *u* is present (for example, the alias ust2l), this means the drive will unload the tape when it has completed an operation. Either, both or neither of u and r could be present in the alias name on the NetApp system.

rst: This portion of the device name is always present and specifies that you are requesting a SCSI tape device

u: The logical unit number of the tape drive to use.

d: The density (or format) to use for tape write operations. This, in part, will determine whether or not you wish to use compression on your drive. For LTO Ultrium tape media format definition will relate to compression. The density types **l,m,h** all refer to a tape device using the same Ultrium format without compression. The density type **a** refers to a tape device using compression.

We use the name rst2l. Note that the alias rst2l will not use compression but instead will use the native (100Gb) format of the Ultrium tape.

Example 6-21 sysconfig command

```
netappsj1> sysconfig -m

    Medium changer (0b.1)  IBM      ULT3581-TA
    mc1 - medium changer device
netappsj1> sysconfig -t

    Tape drive (0b.3)  IBM     ULT3580-TD1
    rst2l  -  rewind device,        format is: LTO (100 GB)
    nrst2l -  no rewind device,     format is: LTO (100 GB)
    urst2l -  unload/reload device, format is: LTO (100 GB)
    rst2m  -  rewind device,        format is: LTO (100 GB)
    nrst2m -  no rewind device,     format is: LTO (100 GB)
    urst2m -  unload/reload device, format is: LTO (100 GB)
    rst2h  -  rewind device,        format is: LTO (100 GB)
    nrst2h -  no rewind device,     format is: LTO (100 GB)
    urst2h -  unload/reload device, format is: LTO (100 GB)
    rst2a  -  rewind device,        format is: LTO (200 GB w/comp)
    nrst2a -  no rewind device,     format is: LTO (200 GB w/comp)
    urst2a -  unload/reload device, format is: LTO (200 GB w/comp)
```

2. Register the NDMP license

   From the server console use the command:

   `REGISTER LICENSE ndmp.lic`

3. Define the Library

   Next we define the library using libtype=scsi.

```
DEFINE LIBRARY LIB1 libtype=scsi
```

No DEVICE parameter is required since the library will be controlled by the NAS system. If the library was connected to the TSM server we would need to specify a device name. (eg lbx.x.x.x).

The DEVICE parameter is actually specified when you define a PATH from the NAS system to the tape library and drive.

4. Define the NAS device class

   To do this we must specify the device class type as 'NAS' and we must specify mountretention=0 as follows:

```
DEFINE DEVCLASS NASC devtype=NAS mountretention=0 estcapacity=100G
library=LIB1
```

5. Define the NAS storage pool.

   Next we define a storage pool to use to store the data from NDMP backups. The main difference between this storage pool definition and other storage pool definitions is that we are using a format for the data that matches the format used on the NetApp system. This format is NETAPPDUMP. We defined the storage pool using the command:

```
DEFINE STGPOOL NASPOOL NASC maxscratch=10 dataformat=NETAPPDUMP
```

6. Register the node

   We register the NAS file server as a node to the TSM server. This is done using type=NAS.

```
REGISTER NODE NETAPPSJ1 ?***? type=NAS
```

7. Define the datamover

   We define the datamover using the nodename defined in the previous step, type (NAS), TCP/IP address or hostname (HLA), port number (LLA), , userid (administrative id of the NAS system), system password and dataformat (NETAPPDUMP). The LLA of the NetApp system is 10000 by default.

```
DEFINE DATAMOVER NETAPPSJ1 type=NAS HLA=NETAPPSJ1 LLA=10000
userid=root password=?***? dataformat=NETAPPDUMP
```

8. Define a path between the datamover and the library using the tape device name on the system

   Since the library is connected to the NAS file server we must define a path between the datamover (NAS system) and the tape library. We do this using the device special file name obtained from the NetApp system in step 1. on page 277 - 'mc1'.

```
DEFINE PATH NETAPPSJ1 LIB1 SRCTYPE=DATAMOVER DESTTYPE=LIBRARY
device=mc1
```

9. Define the drive

```
DEFINE DRIVE LIB1 DRIVE1
```

No DEVICE parameter is required since the drive will be controlled by the NAS system. If the drive were to be connected to the TSM server we would need to specify a device name. (eg mtx.x.x.x). You may also require an element number in your definition. Note that no element number is required for our drive in the 3581 autoloader.

10. Define a path between the datamover, drive and the library using the device name obtained in step . TSM will use the no-rewind device regardless of what you enter here, so we have used the device name rst21.

```
DEFINE PATH NETAPPSJ1 DRIVE1 SRCTYPE=DATAMOVER DESTTYPE=drive
LIBRARY=LIB1 device=rst21
```

11. Label and checkin the library volumes

You must label and checkin tapes as you would normally for other TSM tape library configurations:

```
LABEL LIBVOL LIB1 SEARCH=yes LABELSOURCE=barcode CHECKIN=scratch
overwrite=yes
```

We perfomed this command on the 3581 library containing a single tape volume. The output for this command is given below:

Example 6-22 Output of label libvol command

```
11/06/2001 11:02:56   ANR2017I Administrator SERVER_CONSOLE issued command:
                       LABEL libvol LIB1 search=yes labelsource=barcode
                       checkin=scratch overwrite=yes
11/06/2001 11:02:56   ANR0984I Process 4 for LABEL LIBVOLUME started in the
                       BACKGROUND at 11:02:56.
11/06/2001 11:02:56   ANR8799I LABEL LIBVOLUME: Operation for library LIB1
                       started as process 4.
11/06/2001 11:04:40   ANR8810I Volume ABA927L1 has been labeled in library
LIB1.
11/06/2001 11:05:31   ANR8427I CHECKIN LIBVOLUME for volume ABA927L1 in library
                       LIB1 completed successfully.
11/06/2001 11:05:31   ANR8801I LABEL LIBVOLUME process 4 for library LIB1
                       completed; 1 volume(s) labelled, 1 volume(s) checked-in.
11/06/2001 11:05:31   ANR0985I Process 4 for LABEL LIBVOLUME running in the
                       BACKGROUND completed with completion state SUCCESS at
                        11:05:31.
```

12. Define policy domain, policy set, management class and copy groups

We now want to setup our data management policies for the NAS image backup data. In our configuration we created a separate domain for NAS data management. This allows us to bind the NAS system's data to to this domain so that all backup operations will be assigned to it by default. If we were to specify a separarate management class in the same domain as other data of a different format, we would have to specify the management class to backup to using the client options file or the command line.

```
DEFINE DOMAIN nasdomain description="Policy domain for NAS"
DEFINE POLICYSET nasdomain naspolicy description="Policy set for NAS"
DEFINE MGMTCLASS nasdomain naspolicy nasmgmtc description="Management
class for NAS"
DEFINE COPYGROUP nasdomain naspolicy nasmgmtc standard type=backup
destination=NASPOOL frequency=0 verexists=3 mode=absolute
serialization=shrstatic
```

Notice that we have given the desination storage pool as NASPOOL (which we defined in step 5. on page 279). If we do not specify the destination storage pool correctly then backup operations will fail.

Note that we do not define an archive copygroup since the archive function is not supported.

13. Specify NASMGMTC as the default management class for policy set.

    We must now specify a default management class to use in the policy set. This is a mandatory step if you have defined a new policy set.

    ```
    ASSIGN DEFMGMTCLASS nasdomain naspolicy nasmgmtc
    ```

14. Specify NASPOLICY as the active policy set for policy domain.

    First, we validate the policy set to ensure the information we have provided is correct to the TSM server. Then we activate the policy set.

    ```
    VALIDATE POLICYSET nasdomain naspolicy
    ACTIVATE POLICYSET nasdomain naspolicy
    ```

15. Associate the policy domain NASDOMAIN with the client node.

    Since we have created a new policy domain for the sole purpose of managing NAS data we can update the node we registered in Step 5 so that its backup data is automatically managed by the policies defined in this domain. We used the command:

    ```
    UPDATE NODE netappsj1 ?***? domain=nasdomain
    ```

TSM has now been configured for NDMP operations. Now we will describe how to back up and restore NAS system data using TDP for NDMP.

6.5.8 Backing up and Restoring using TDP for NDMP

NDMP backup and restore can be performed using the following interfaces:

- Backup Client command line
- Web client GUI
- Admin command line.

We will give examples using all three interfaces.

Backup and restore with the backup client command line

You can use any appropriate level TSM backup/archive client to perform backup and restore operations (as described in 6.5.3, "Hardware and software requirements" on page 271). To backup NAS volumes, use the command:

```
BACKUP NAS options filespec
```

The keyword NAS is required and will ensure that a NAS backup is performed as opposed to the actual local backup/archive client (which is called CLIENT).

When using an interactive command line session with a non-administrative ID, Tivoli Storage Manager prompts for an administrator ID. The administrator ID must have at least client owner authority for the NAS node.

Options: Some options that you may specify include:

nasnodename: this option specifies the node name for the NAS file server when processing NAS file systems. If it is not specified, the value for nasnodename in the client options file, dsm.opt will be used. You cannot specify more than one nasnodename at a time

mode: This is the type of backup you want to perform. The two possibilities are full or differential. The default is differential unless otherwise specified. If this is the first ever backup then it will be full.

Filespec specifies one or more NAS volumes to backup on the system. You can specify *domain.nas* in dsm.opt, and list the explicit filesystems for backup. For example:

```
domain.nas filesystem1 filesystem2.
```

The default is domain.nas=all. To perform a full backup of /vol/vol0 we use the command:

```
BACKUP NAS-mode=full -nasnodename=netappsj1 {/vol/vol0}
```

Note that we enclose the filesystem volume name(s) in braces {}.

Use the *include.fs.nas* option in dsm.opt to bind a management class to Network Attached Storage (NAS) file systems for backup processing, thereby over-riding the default class. For example:

```
include.fs.nas netappsj/vol/vol1 nasMgmtClass
```

No wildcards can be used in this include statement. The volume directory structure must use forward slashes.You can override the default value in the dsm.opt file by entering a different value on the command line.

The command we used for the backup operation on the client command line was:

```
BACKUP NAS -nasnodename=netappsj1
```

This command will backup all filesystems on the NAS node called NETAPPSJ1 and bind the data to the default management class in the policy domain to which the client is defined. This system had three filesystems available, /vol/vol0, /vol/vol and /vol/vol2. The result of this operation is shown in Example 6-23.

Note that you are prompted to authenticate yourself. You will need to enter a TSM id which has client *owner* privilage for both the node which is running the backup/archive client and the NAS node. In this way, TSM restricts who can backup NAS nodes. In our example, we have used the default admin id, however you could authorize the client administrator node to backup the NAS node by using the GRANT AUTHORITY command (for example, **GRANT AUTHORITY client CLASSES=NODE AUTH=owner NODE=netappsj1**).

Example 6-23 backup output from backup client command line

```
tsm> backup nas -nasnodename=netappsj1

Please enter a user id with administrative authority over
both the nas node: 'NETAPPSJ1' & the client node: 'CLIENT'
<CLIENT>: admin

Please enter password for user id "ADMIN": *****

Session established with server ADSMAGENT_SERVER1: Windows NT
  Server Version 4, Release 2, Level 1.0
  Server date/time: 11/06/2001 13:29:10  Last access: 11/06/2001 13:18:52

NAS Differential Backup Function Invoked.

Process initiated on TSM server.
              ProcessId: 5
        Start date/time: 11/06/2001 13:29:27
  Administrative UserId: ADMIN
              Operation: Remote Differential Backup
                   Node: NETAPPSJ1
                 Source: /vol/vol0
    Bytes in operation : 413.14 MB

ANS1114I Waiting for mount of offline media.
      1,376,256 /vol/vol0 [Sent]
```

```
<    1.31 MB> [ - ]

Process initiated on TSM server.
              ProcessId: 6
        Start date/time: 11/06/2001 13:32:00
  Administrative UserId: ADMIN
              Operation: Remote Differential Backup
                   Node: NETAPPSJ1
                 Source: /vol/vol1
    Bytes in operation : 153.42 MB

ANS1114I Waiting for mount of offline media.
        589,824 /vol/vol1 [Sent]
<    1.87 MB> [  -]

Process initiated on TSM server.
              ProcessId: 7
        Start date/time: 11/06/2001 13:35:57
  Administrative UserId: ADMIN
              Operation: Remote Differential Backup
                   Node: NETAPPSJ1
                 Source: /vol/vol2
    Bytes in operation : 222.79 MB

ANS1114I Waiting for mount of offline media.
        655,360 /vol/vol2 [Sent]

Total number of objects backed up:        3
Total number of objects failed:           0
tsm>
```

We can show the sessions on the server by issuing **QUERY SESSION** from the administrative command line (Example 6-24). Notice that there are three sessions running in parallel for the client NETAPPSJ1, with platform TSMNAS - one for each of the three filesystem backups.

Example 6-24 q sess output

```
Sess Comm.  Sess     Wait   Bytes   Bytes Sess  Platform Client Name
Number Method State    Time    Sent   Recvd Type
------ ------ ------ ------ ------- ------- ----- -------- --------------------
   145 Tcp/Ip IdleW    3 S    2.2 K   1.5 K Node  WinNT    CLIENT
   149 Tcp/Ip IdleW  1.3 M    6.6 K     729 Node  TSMNAS   NETAPPSJ1
   150 Tcp/Ip IdleW  1.4 M      924     278 Node  TSMNAS   NETAPPSJ1
   151 Tcp/Ip IdleW  1.4 M      353     203 Node  WinNT    CLIENT
   152 Tcp/Ip IdleW  1.3 M      924     278 Node  TSMNAS   NETAPPSJ1
   153 HTTP   Run      0 S        0       0 Admin WebBro-  ADMIN
```

```
wser
```

You can perform restore operations using the backup client command line with the command:

```
RESTORE NAS options sourcefilespec destinationfilespec
```

When using an interactive command line session with a non-administrative ID, Tivoli Storage Manager prompts for an appropriately authorized administrator ID.

Options: Some options that you may specify include:

nasnodename: This option specifies the NAS system that you wish to restore. If not specified, the value for nasnodename in dsm.opt will be used. You cannot specify more than one nasnodename at a time.

monitor: This option is used to view processing during the restore. The default is to have monitor on.

pick: This will display the filesystem candidates for restore. If you select multiple volumes for restore do not use the *monitor* option because it will serialize the restores (i.e. process them one at a time) rather than restore them in parallel.

Sourcefilespec is the name of the NAS filesystem image that you want to restore.

Destinationfilespec is the location where you want to restore the image to. The default is the oringinal location.

You can also specify a point in time restore for NAS objects. For more information on backup command line options refer to *Tivoli Storage Manager for Windows Using the Backup Archive Client,* SH26-4117.

To restore a filesystem image onto the NAS client we used the command:

```
RESTORE NAS -nasnodename=netappsj1 {/vol/vol0}
```

Note that we must enclose the filesystem volume name(s) in braces {}.

The output of this command is shown in Example 6-25. Note that we are not prompted for password since we have authenticated already in this session.

Example 6-25 CLI NAS restore

```
tsm> restore nas -nasnodename=netappsj1 {/vol/vol0}

NAS Restore Function Invoked.

**************************** WARNING ********************************
```

```
You are about to restore a file system to a destination that may already
contain data. The final contents of this destination after the restore
is completed will be dependent on the NAS appliance.
Are you sure you want to replace
    File System/Volume: '/vol/vol0'?  (Yes (Y)/No (N)) y


Process initiated on TSM server.

              ProcessId: 14
        Start date/time: 11/06/2001 15:18:21
  Administrative UserId: ADMIN
              Operation: Remote Full Restore
                   Node: NETAPPSJ1
                 Source: /vol/vol0
    Bytes in operation : 427.93 MB

 ** Interrupted **]
ANS1114I Waiting for mount of offline media.
Restoring     471,195,648 /vol/vol0 [Done]

Restore processing finished.

Total number of objects restored:         1
Total number of objects failed:           0
```

Note that we are asked if we wish to overwrite any target volumes since we did not specify a *destinationfilespec* other than the original location.

Backing up and restoring using the admin command line

You can perform backup and restore operations from the administrative command line.

Use the following command to backup a NAS system from the administrative command line:

```
BACKUP NODE <nasnodename> <filesystemname> MGmtclass=mcname MODE=backup
mode WAIT=yes/no
```

To issue this command, you must have system privilege, policy privilege for the domain to which the node is assigned, or client owner authority over the node.

Valid arguments for this command are:

Filesystem: You can specify the filesystem you wish to backup You can specify multiple filesystem names using commas with no intervening spaces between them.

MGmtclass - Specify the management class to back up to. If this is not specified the data will be assigned to the default management class of the policy domain to which the NAS node is defined.

MODE - full or differential for the filesystem backup. DIFFERENTIAL is the default unless a backup has not yet been performed on the volume in which case it is FULL.

WAIT - specifies whether the command is executed in foreground or background. If you specify wait=yes, then the command prompt will not return until the command has completed. If you specify wait=no, the command prompt will return immediately.

You cannot specify more than one nasnodename at a time

We performed the operation using the following command

```
BACKUP node netappsj1
```

The result of this command is detailed in the activity log output as shown below inExample 6-26.

Example 6-26 q actlog

```
11/06/2001 12:59:13   ANR2017I Administrator ADMIN issued command: BACKUP NODE
                       netappsj1
11/06/2001 12:59:18   ANR0984I Process 2 for BACKUP NAS (FULL) started in the
                       BACKGROUND at 12:59:18.
11/06/2001 12:59:18   ANR1063I Full backup of NAS node NETAPPSJ1, file system
                       /vol/vol0, started as process 2 by administrator ADMIN.
11/06/2001 12:59:20   ANR0984I Process 3 for BACKUP NAS (FULL) started in the
                       BACKGROUND at 12:59:20.
11/06/2001 12:59:20   ANR1063I Full backup of NAS node NETAPPSJ1, file system
                       /vol/vol1, started as process 3 by administrator ADMIN.
11/06/2001 12:59:23   ANR0984I Process 4 for BACKUP NAS (FULL) started in the
                       BACKGROUND at 12:59:23.
11/06/2001 12:59:23   ANR1063I Full backup of NAS node NETAPPSJ1, file system
                       /vol/vol2, started as process 4 by administrator ADMIN.
11/06/2001 13:00:21   ANR8337I NAS volume ABA927L1 mounted in drive DRIVE1
                       (rst2l).
11/06/2001 13:00:31   ANR1340I Scratch volume ABA927L1 is now defined in
storage

                       pool NASPOOL.
11/06/2001 13:01:50   ANR1067I NAS Backup process 2 completed.
11/06/2001 13:01:50   ANR0988I Process 2 for BACKUP NAS (FULL) running in the
                       BACKGROUND processed 416,350,208 bytes with a completion
                       state of SUCCESS at 13:01:50.
11/06/2001 13:01:50   ANR8336I Verifying label of NAS volume ABA927L1 in drive
                       DRIVE1 (rst2l).
11/06/2001 13:03:05   ANR8468I NAS volume ABA927L1 dismounted from drive DRIVE1
```

```
                        (rst21) in library LIB1.
11/06/2001 13:04:05   ANR8337I NAS volume ABA927L1 mounted in drive DRIVE1
                        (rst21).
11/06/2001 13:05:21   ANR1067I NAS Backup process 3 completed.
11/06/2001 13:05:21   ANR0988I Process 3 for BACKUP NAS (FULL) running in the
                       BACKGROUND processed 155,123,712 bytes with a completion
                       state of SUCCESS at 13:05:21.
11/06/2001 13:05:21   ANR8336I Verifying label of NAS volume ABA927L1 in drive
                       DRIVE1 (rst21).
11/06/2001 13:06:14   ANR0407I Session 110 started for administrator ADMIN
                       (WebBrowser) (HTTP 9.113.21.66(1423)).
11/06/2001 13:06:41   ANR8468I NAS volume ABA927L1 dismounted from drive DRIVE1
                        (rst21) in library LIB1.
11/06/2001 13:07:46   ANR8337I NAS volume ABA927L1 mounted in drive DRIVE1
                        (rst21).
11/06/2001 13:09:15   ANR1067I NAS Backup process 4 completed.
11/06/2001 13:09:15   ANR0988I Process 4 for BACKUP NAS (FULL) running in the
                       BACKGROUND processed 226,099,200 bytes with a completion
                       state of SUCCESS at 13:09:15.
11/06/2001 13:09:15   ANR8336I Verifying label of NAS volume ABA927L1 in drive
                       DRIVE1 (rst21).
11/06/2001 13:10:45   ANR8468I NAS volume ABA927L1 dismounted from drive DRIVE1
                        (rst21) in library LIB1.
```

If we query the processes on the TSM server during execution (QUERY PROCESS command) we receive the output below. Note that the command we issued backs up all the file systems on the NAS node by default since we did not specify an individual file system. Since our library had only one drive, we could backup only one filesystem at a time. As it is the first backup for this NAS client, a FULL backup is automatically performed.

Example 6-27 QUERY PROCESS output

```
Process Process Description  Status
  Number
-------- -------------------- -------------------------------------------------
       2 Backup NAS (full)     NAS Node NETAPPSJ1, Source /vol/vol0, Bytes Moved
                                152,829,952, Estimated Percent Completed 34%,
                                Elapsed Time 113 seconds.
                               Current output volume: ABA927L1.

       3 Backup NAS (full)     NAS Node NETAPPSJ1, Source /vol/vol1, Bytes Moved
                                0, Estimated Percent Completed 0%, Elapsed Time
                                111 seconds.
                               Waiting for mount point in device class NASC (109
                               seconds).

       4 Backup NAS (full)     NAS Node NETAPPSJ1, Source /vol/vol2, Bytes Moved
                                0, Estimated Percent Completed 0%, Elapsed Time
```

```
 108 seconds.
Waiting for mount point in device class NASC (106
seconds).
```

To perform a restore using the administrative command line use the command:

```
RESTORE NODE nasnodename source_file_system destination_file_system
```

The destination is the original location by default. You can specify a destination file system. You can also specify a point in time - refer to *Tivoli Storage Manager for Windows Administrator's Reference*, GC35-0411.

Note that you cannot specify more than one nasnodename or filesystem to restore at a time.

To issue this command, you must have system privilege, policy privilege for the domain to which the node is assigned, or client owner authority over the node.

Backing up and restoring using the Web GUI

You can backup and restore NAS systems using the TSM client Web GUI. To enable this function you must install the *Client Acceptor Service* on the TSM server. For more details regarding this refer to the dsmcutil.hlp file which is located in the backup client directory on the TSM server or *Tivoli Storage Manager for Windows: Using the Backup Archive Client,* SH26-4117.

Our client options file (dsm.opt) residing on the TSM Server for using the Web GUI included the following parameters:

```
tcpserveraddress adsmagent
nodename adsmagent
nasnodename netappsj1
commmethod tcpip
```

To access the Web client, open a web browser and enter in the client URL, for example, http://tsmservername:1581.

The GUI opens as shown in Figure 6-43.

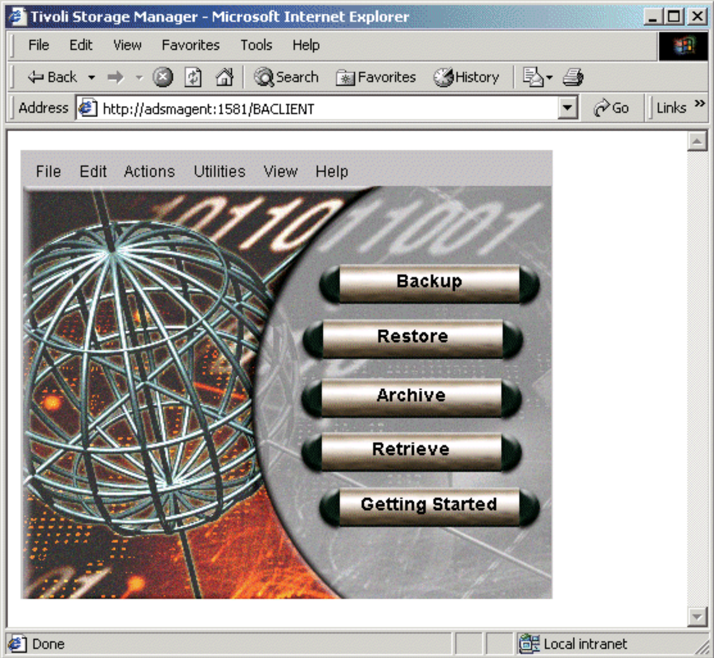


Figure 6-43 The TSM client web GUI

Click on the **Backup** tab. You will be prompted (Figure 6-44) to enter in a userid and password of an administrator on the TSM server. As we stated before in "Backup and restore with the backup client command line" on page 282, a TSM id which has client *owner* privilage for both the node which is running the backup/archive client and the NAS node. The main screen (Figure 6-45) will display only the NAS nodes for which our login id has the owner privilege.

When you have entered your id and password, click **Login**.

Figure 6-44 TSM Login

You will see the normal listing of potential backup objects for the local server in Figure 6-45. In addition to this there is a listing for the NAS system (called NETAPPSJ1 as configured in the dsm.opt file) which shows the filesystem volumes that may be backed up. You will see only the NAS nodes displayed which you have appropriate authority for (which is client OWNER) - therefore the nodes displayed are predetermined when you sign into the browser interface. Select the volume(s) you wish to backup. In the drop down box next to the **Help** button you may select the type of backup you wish to perform - Full or Differential. The default is differential unless you specify otherwise. If this is the first backup, it will be a full backup. When you have made your selections click **Backup**.

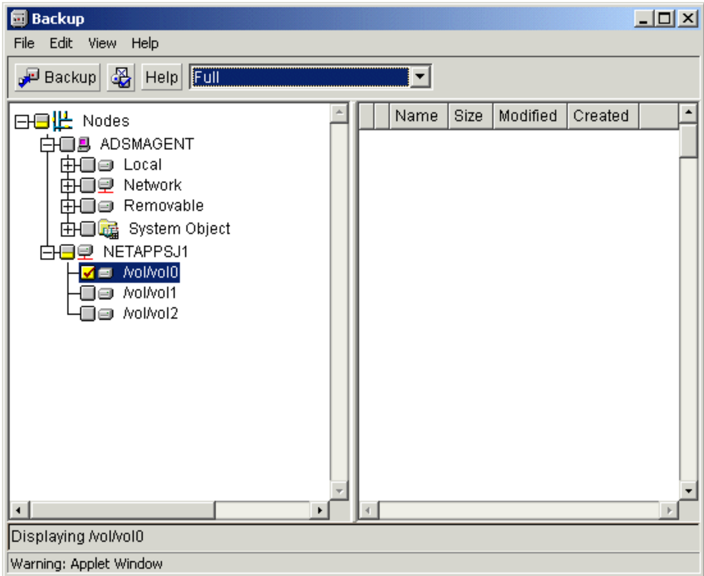


Figure 6-45 TSM web GUI backup window

The backup will proceed as shown below in Figure 6-46.

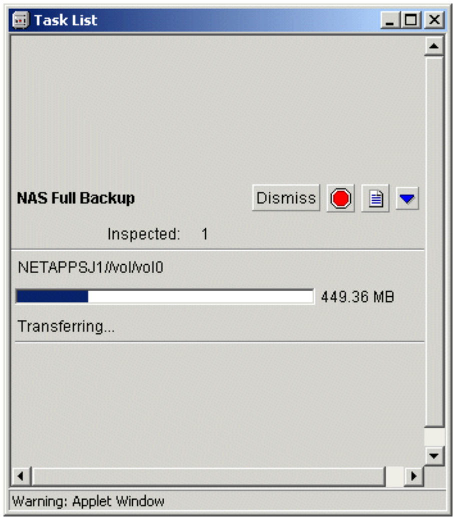


Figure 6-46 Task List window

If you click on the report button (second from the right) you will see a detailed status report for the operations as shown in Figure 6-47.

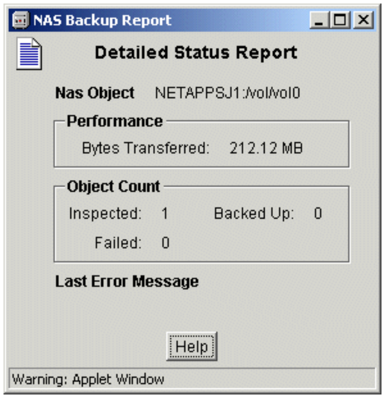


Figure 6-47 Detailed status report

To restore a filesystem image of a NAS system, close the current backup window and return to the original web GUI window (Figure 6-45). Click on **Restore**. You will be presented with the Web restore GUI. From here you may select the volume that you wish to restore. Click on the volume and select **Restore** as shown in Figure 6-48 below.

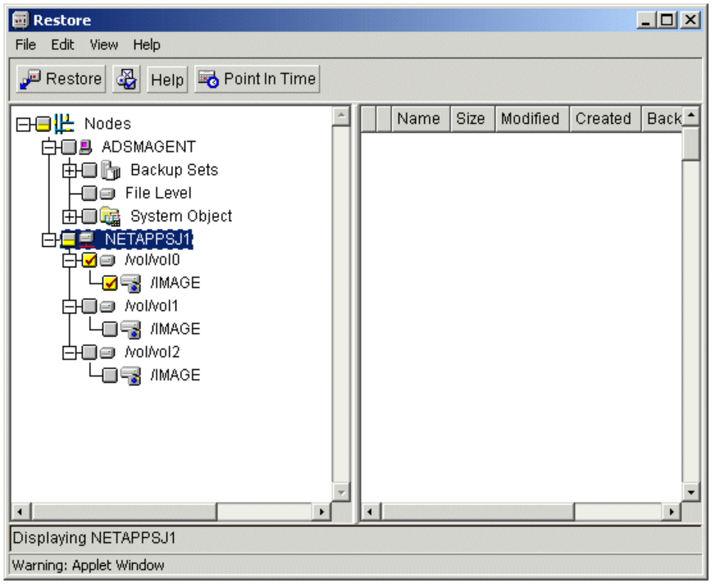


Figure 6-48 Web restore GUI

Next, select the desination that you wish to restore to. The default is the original location but you can over-ride this with an alternative if required.

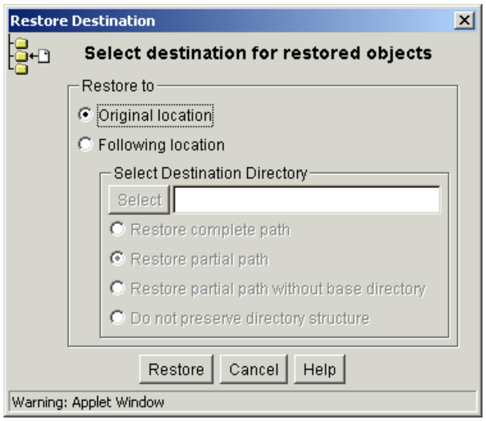


Figure 6-49 Restore destination

A warning will appear (as in Figure 6-50) stating that the destination you specified may contain an existing volume that will get overwritten if we proceed, and that the final contents of the destination is dependant on the NAS system. Click **Yes** to continue.

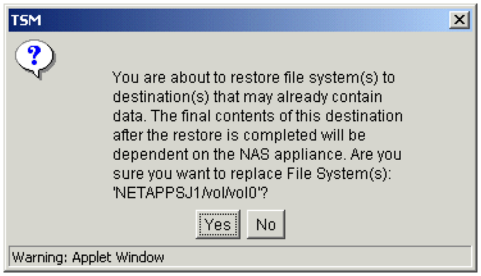


Figure 6-50 Data overwrite warning

The restore will proceed as shown in Figure 6-51.

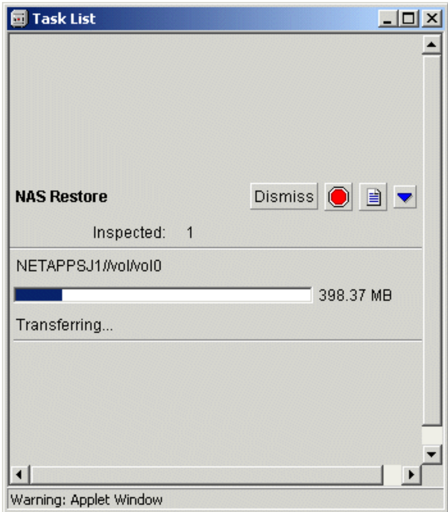


Figure 6-51 Restore progress

If you click on the report button (second from the right) you will see a detailed status report for the operations as shown in Figure 6-52 below.

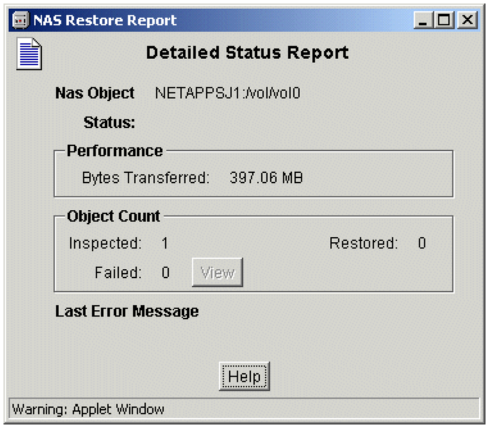


Figure 6-52 Detailed status report

You may also opt to restore inactive filesystem volumes from the web GUI by selecting **View->Display active/inactive files** as in Figure 6-53.

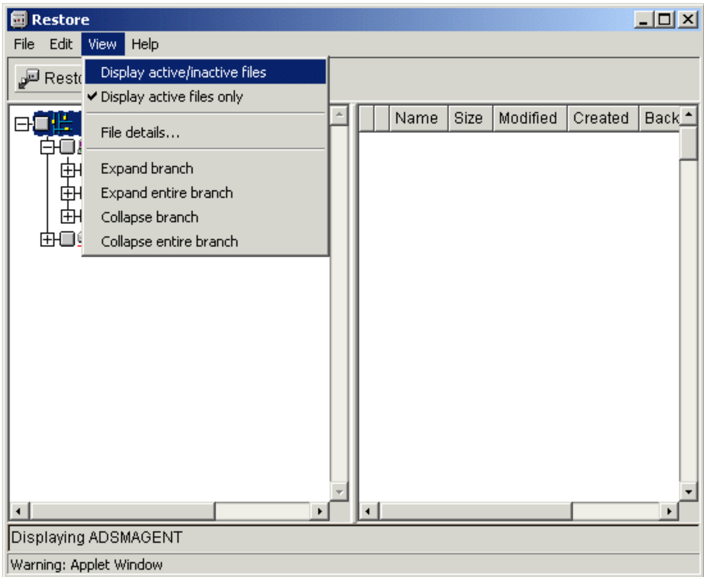


Figure 6-53 Display inactive files

You may then select the inactive volume you wish to restore (Figure 6-54). Inactive volumes are indicated by a small green diamond next to it. Click **Restore** and the operation will proceed as described previously.

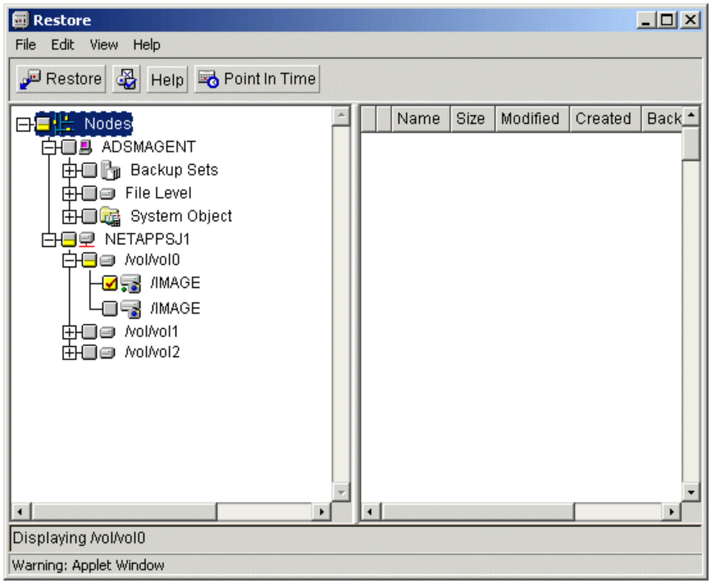


Figure 6-54 Inactive volumes

You may also select a point in time restore by clicking on the **Point in Time** button. Click **Use a Point in Time during restore** and enter in the details (Figure 6-55). Click **OK**.

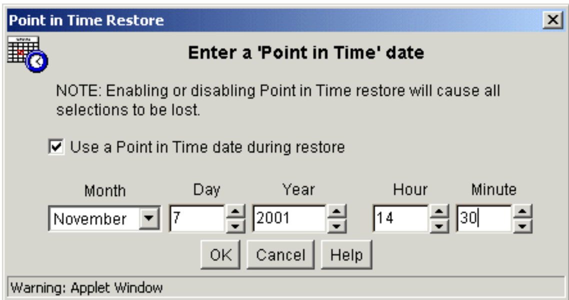


Figure 6-55 Point in time restore

The volumes will be displayed as of the point in time date (Figure 6-56).

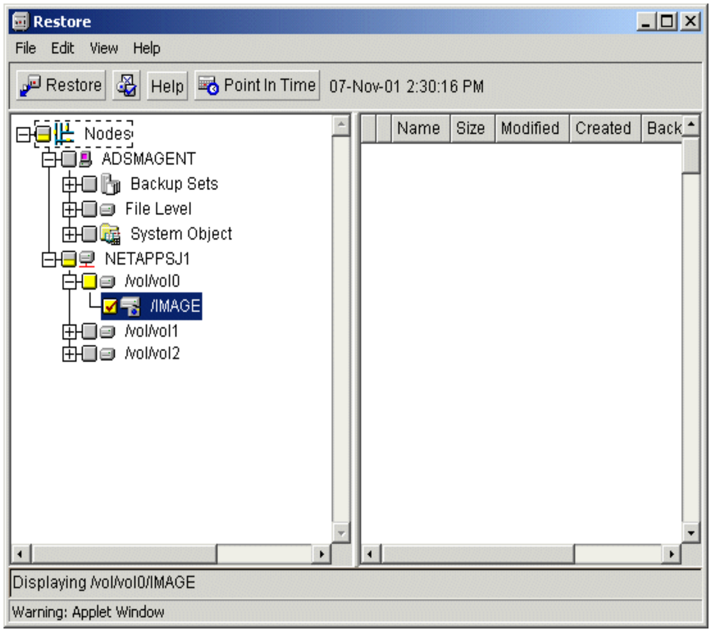


Figure 6-56 Point in time volume selection

You can view more information about the file volume by selecting **View>File details**. The screen in Figure 6-57 displays.

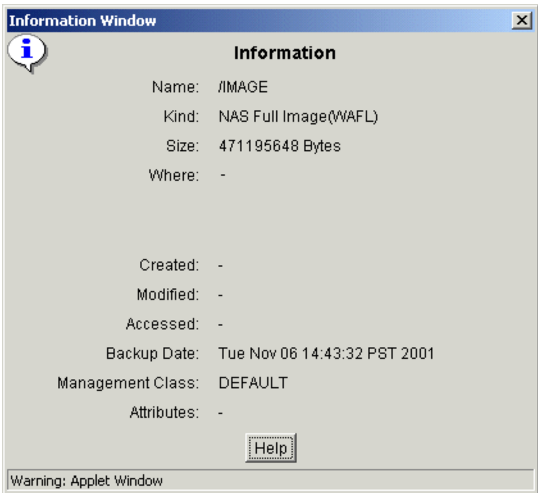


Figure 6-57 File details

Expiration and retention policies

When a backup is performed the TSM server checks to see if an eligible full image backup exists. If it doesn't, a full image backup is performed. The TSM server will also identify any previous backup versions that exceed the allowed number of versions according to the policies set in the management class. This is done from oldest to most recent without regard to whether the versions represent full or differential images. Any excess versions are marked for expiration. During expiration processing, if the server detects a full backup that is marked for expiration, it checks to see if that version has any dependent differentials. If so, the full backup version is not deleted even though it has been marked for expiration. An example should make this process clearer.

Let's say we set VEREXISTS in the backup copy group to 3 and we run a series of backups as follows:

- Day 1: full backup
- Day 2: differential backup
- Day 3: full backup
- Day 4: differential backup
- Day 5: differential backup

Each backup operation creates a version in the TSM database. After day 4's differential backup, therefore, we have a total of 4 versions, but the policy settings allow us only 3. Therefore the day 1 backup, being the oldest, will be marked for expiration. However, the first backup cannot be physically expired because the day 2 differential backups depends on it. This is because in order to restore the day 2 backup, we would have to restore the day 1 full and then the day 2 differential. A full backup will never be expired as long as it has dependent differentials. However, after day 4 it is no longer possible to restore JUST the day 1 backup. In this case, day 4 represents the ACTIVE backup, with day 2 and day 3 being INACTIVE backup versions. On day 5 when another differential backup is made, both the Day 1 and Day 2 backups will be marked for expiration. At this stage, shown in (Figure 6-58), the day 5 backup represents the ACTIVE backup, day 3 and day 4 backups are INACTIVE and the day 1 and day 2 backups are deleted.

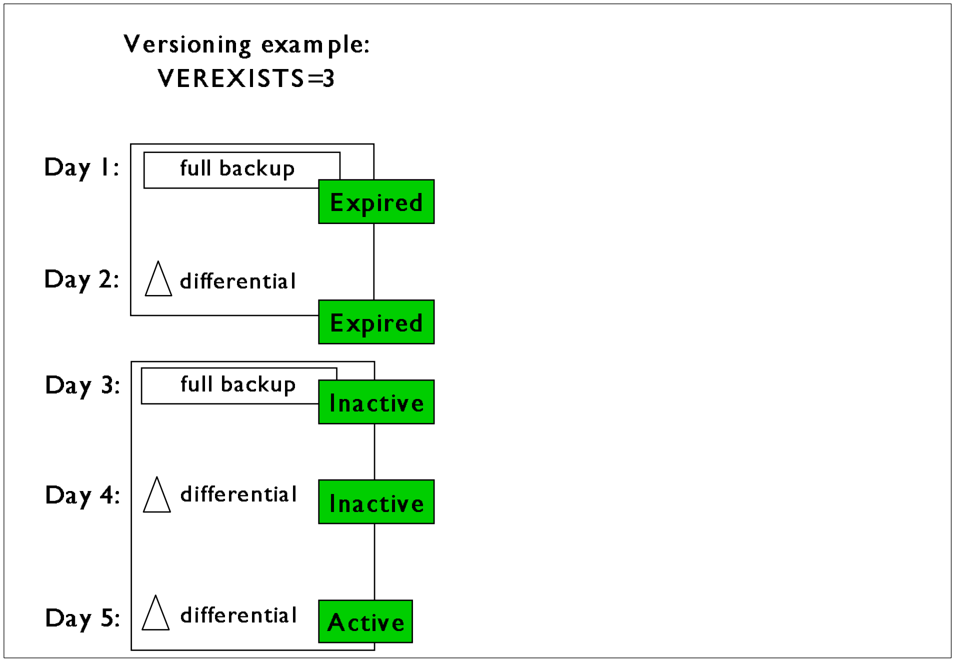


Figure 6-58 How version control works for NDMP backups

6.5.9 Managing NAS data using TDP for NDMP

A TSM administrator can manage TDP for NDMP operations. These operations may be performed on:

- Datamovers
- Paths
- NAS nodes
- NAS device classes
- NAS filespaces
- NAS storage pools

Using the administrative command line you can update, query and delete datamovers. The example below show the result of a query datamover command performed on our TSM server.

Example 6-28 q datamover netappsj1 f=d

```
Data Mover Name: NETAPPSJ1
               Data Mover Type: NAS
                    IP Address: NETAPPSJ1
```

```
         TCP/IP Port Number: 10000
                  User Name: root
   Storage Pool Data Format: NetApp Dump
                    On-Line: Yes
Last Update by (administrator): SERVER_CONSOLE
      Last Update Date/Time: 11/06/2001 10:56:09
```

You can update, query and delete paths between data movers and tape libraries and drives as your configuration changes. You can take the path offline if you need to shutdown the system by updating it (UPDATE PATH), specifying online=no. Shown below is the result of a query on the path that we defined for the datamover.

Example 6-29 q path f=d

```
Source Name: NETAPPSJ1
                Source Type: DATAMOVER
           Destination Name: LIB1
           Destination Type: LIBRARY
                    Library:
                     Device: mc1
                  Directory:
                    On-Line: Yes
Last Update by (administrator): SERVER_CONSOLE
      Last Update Date/Time: 11/06/2001 10:56:30
                Source Name: NETAPPSJ1
                Source Type: DATAMOVER
           Destination Name: DRIVE1
           Destination Type: DRIVE
                    Library: LIB1
                     Device: rst2l
                  Directory:
                    On-Line: Yes
Last Update by (administrator): SERVER_CONSOLE
      Last Update Date/Time: 11/06/2001 10:57:10
```

You can update, query, rename and remove NAS nodes. You should specify type=NAS so that only NAS nodes are displayed. The example below shows the output of a query performed on the NAS node registered to our TSM server.

Example 6-30 q node type=nas f=d

```
                  Node Name: NETAPPSJ1
                   Platform: (?)
            Client OS Level: (?)
             Client Version:
         Policy Domain Name: NASDOMAIN
      Last Access Date/Time: 11/06/2001 12:37:56
```

```
           Days Since Last Access: <1
           Password Set Date/Time: 11/06/2001 11:08:03
          Days Since Password Set: <1
            Invalid Sign-on Count: 0
                          Locked?: No
                          Contact:
                      Compression:
          Archive Delete Allowed?: Yes
           Backup Delete Allowed?: No
           Registration Date/Time: 11/06/2001 10:55:54
        Registering Administrator: SERVER_CONSOLE
     Last Communication Method Used:
        Bytes Received Last Session:
            Bytes Sent Last Session:
           Duration of Last Session:
        Pct. Idle Wait Last Session:
       Pct. Comm. Wait Last Session:
       Pct. Media Wait Last Session:
                          Optionset:
                                URL:
                          Node Type: NAS
          Password Expiration Period:
                 Keep Mount Point?: No
       Maximum Mount Points Allowed: 1
             Auto Filespace Rename : No
```

A query performed on the filespaces of our NAS node netappsj1 shows the type of NAS system platform and the length of time since the last full NAS image backup.

Example 6-31 q filespace netappsj1 f=d

```
Node Name: NETAPPSJ1
                                 Filespace Name: /vol/vol0
                     Hexadecimal Filespace Name:
                                           FSID: 1
                                       Platform: NetApp
                                 Filespace Type: WAFL
                          Is Filespace Unicode?: No
                                  Capacity (MB): 24,825.2
                                       Pct Util: 1.7
                     Last Backup Start Date/Time: 11/06/2001 15:35:27
                  Days Since Last Backup Started: <1
                Last Backup Completion Date/Time: 11/06/2001 15:39:14
                Days Since Last Backup Completed: <1
Last Full NAS Image Backup Completion Date/Time: 11/06/2001 14:46:42
Days Since Last Full NAS Image Backup Completed: <1

                                      Node Name: NETAPPSJ1
```

```
                           Filespace Name: /vol/vol1
               Hexadecimal Filespace Name:
                                     FSID: 2
                                 Platform: NetApp
                           Filespace Type: WAFL
                     Is Filespace Unicode?: No
                            Capacity (MB): 24,825.2
                                 Pct Util: 0.6
             Last Backup Start Date/Time: 11/06/2001 13:32:00
          Days Since Last Backup Started: <1
        Last Backup Completion Date/Time: 11/06/2001 13:35:49
        Days Since Last Backup Completed: <1
Last Full NAS Image Backup Completion Date/Time: 11/06/2001 13:05:20
Days Since Last Full NAS Image Backup Completed: <1

                                Node Name: NETAPPSJ1
                           Filespace Name: /vol/vol2
               Hexadecimal Filespace Name:
                                     FSID: 3
                                 Platform: NetApp
                           Filespace Type: WAFL
                     Is Filespace Unicode?: No
                            Capacity (MB): 24,825.2
                                 Pct Util: 0.9
             Last Backup Start Date/Time: 11/06/2001 13:35:57
          Days Since Last Backup Started: <1
        Last Backup Completion Date/Time: 11/06/2001 13:39:40
        Days Since Last Backup Completed: <1
Last Full NAS Image Backup Completion Date/Time: 11/06/2001 13:09:14
Days Since Last Full NAS Image Backup Completed: <1
```

Shown below is the result of a QUERY DEVICECLASS. Notice that the device type is listed as NAS.

Example 6-32 q devc nasc f=d

```
         Device Class Name: NASC
    Device Access Strategy: Sequential
        Storage Pool Count: 1
               Device Type: NAS
                    Format: DRIVE
     Est/Max Capacity (MB): 204,800.0
               Mount Limit: DRIVES
          Mount Wait (min): 60
     Mount Retention (min): 0
              Label Prefix: ADSM
              Drive Letter:
```

```
                  Library: LIB1
                Directory:
              Server Name:
             Retry Period:
           Retry Interval:
                Twosided:
                  Shared:
Last Update by (administrator): SERVER_CONSOLE
        Last Update Date/Time: 11/06/2001 10:55:17
```

The example below list the details of a QUERY STORAGEPOOL performed on our NAS storage pool. Notice the storage pool format is listed as NETAPPDUMP which is the distinguishing feature of this storage pool as compared to other storage pools.

Example 6-33 q stg naspool f=d

```
               Storage Pool Name: NASPOOL
               Storage Pool Type: Primary
               Device Class Name: NASC
         Estimated Capacity (MB): 2,048,000.0
                        Pct Util: 0.0
                        Pct Migr:
                     Pct Logical: 100.0
                    High Mig Pct:
                     Low Mig Pct:
                 Migration Delay:
              Migration Continue:
             Migration Processes:
               Next Storage Pool:
            Reclaim Storage Pool:
          Maximum Size Threshold:
                          Access: Read/Write
                     Description:
               Overflow Location:
           Cache Migrated Files?:
                       Collocate: No
           Reclamation Threshold:
 Maximum Scratch Volumes Allowed: 10
   Delay Period for Volume Reuse: 0 Day(s)
          Migration in Progress?:
            Amount Migrated (MB):
Elapsed Migration Time (seconds):
        Reclamation in Progress?:
 Volume Being Migrated/Reclaimed:
  Last Update by (administrator): SERVER_CONSOLE
           Last Update Date/Time: 11/06/2001 10:55:38
        Storage Pool Data Format: NetApp Dump
```

Unsupported stgpool parameters

The following DEFINE and UPDATE storage pool parameters are not supported for NAS storage pools.

- MAXSIZE
- NEXTSTGPOOL
- LOWMIG
- HIGHMIG
- MIGDELAY
- MIGCONTINUE
- RECLAIMSTGPOOL
- OVFLOLOCATION

You cannot backup a storage pool of the format NETAPPDUMP using the COPY STORAGEPOOL command.

7

Configuring VERITAS Backup Exec on Windows 2000

This chapter describes how to configure Backup Exec from VERITAS on Windows 2000 using an LTO library.

7.1 VERITAS Backup Exec

VERITAS Backup Exec for Windows NT and Windows 2000 is a comprehensive, reliable backup system with scalability and storage management options to fulfill the requirements of any network or enterprise. Advanced device and media management capabilities simplify tape device and library configuration and management for maximum, efficient access to stored information. The SAN Shared Storage Option improves backup and recovery performance through tape virtualization that moves data without affecting LAN traffic and lowers overall hardware costs. The powerful features of Backup Exec are accessed through wizards and an intuitive graphical interface, allowing full functionality to users of all levels. Central administration and policy management of multiple Backup Exec Servers reduces legwork and assures continuity. Built-in virus scanning and elimination increases security by ensuring that only virus free files are backed up. Disaster recovery features restore servers to the most recent backup, increasing availability. Microsoft Certification, ability to read and write to the Microsoft utility, and support for Microsoft SharePoint server ensure efficient integration with Windows systems and applications.

For more information on VERITAS Backup Exec, see their website:

`http://www.veritas.com/products/category/ProductDetail.jhtml?productId=bent2000`

7.2 Installing VERITAS Backup Exec for Windows 2000

We tested two environments with VERITAS Backup Exec. The first used SCSI direct access connection, with the following hardware, shown in Figure 7-1:

- Intel server with Windows 2000 Advanced Server (build 2195).
- Adaptec 29160 LVD SCSI card
- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives
- VERITAS Backup Exec version 8.6. revision 3808.

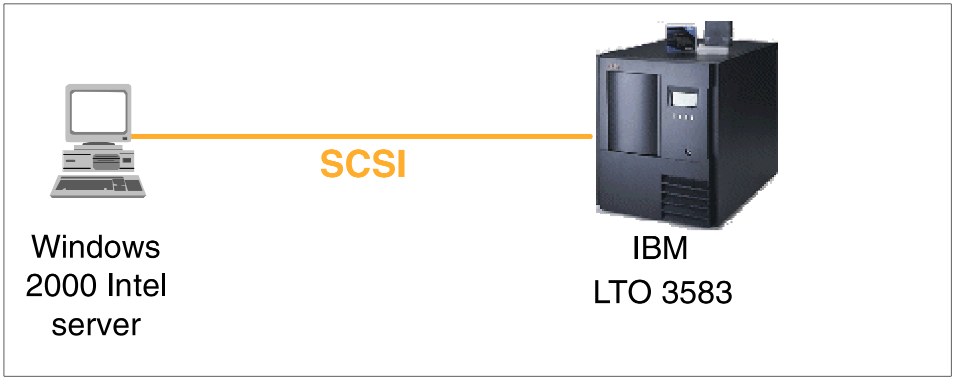


Figure 7-1 SCSI attach configuration

The second configuration is shown in Figure 7-2:

- Intel server with Windows 2000 Advanced Server (build 2195).
- Emulex LP8000 FC HBA
- IBM 2109 Fibre Channel switch
- IBM 2108 SAN Data Gateway (SDG)
- IBM 3583 library attached via SCSI port to the SAN Data Gateway. A single SCSI bus supported both the library controller and the two 3580 tape drives
- VERITAS Backup Exec version 8.6. revision 3808.

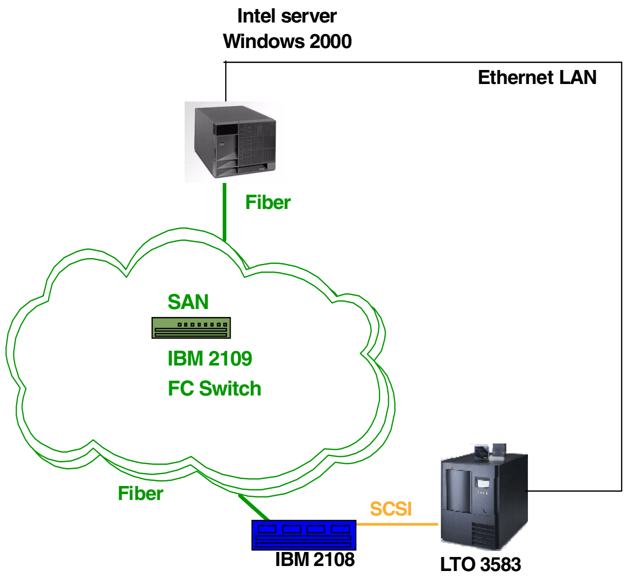


Figure 7-2 SAN attach configuration

The installation and configuration process for VERITAS Backup Exec with both direct-SCSI and SAN attached LTO tape library configurations was identical.

Product patches and updates for Backup Exec for Windows NT and 2000 Server, Advanced server, Datacenter and Small Business server may be found at the following site

http://support.veritas.com/menu_ddProduct_BEWNT.htm

For information on the list of supported LTO tape libraries refer to:

http://support.veritas.com/dsl/lists/device_ddProduct_BEWNT_media_half_inch_prod1_NT86.htm

7.2.1 Installation preparation

The preparation for installing VERITAS Backup Exec depends on whether your tape library is already installed.

Existing LTO installation

If your LTO drive was already installed on your server, check to see if the IBM drivers are being used. We do not need to use the IBM Ultrium drivers for the BackupExec software. If you have already installed these, disable them by following the description in 2.2.6, “Deleting LTO devices” on page 60.

New LTO installation

If this is a brand new installation, first install the adapter card to Windows 2000 and load the drivers. This procedure is given in 2.2.2, “Installing the SCSI adapter” on page 30 for the SCSI card, and 2.3, “Windows 2000 Fibre channel HBA driver installation” on page 63 for the FC card. Disable the RSM service if required as described in “Disabling RSM” on page 61. Shutdown the server, physically cable the tape library, and reboot the system.

All LTO installations

Your drive and libraries should now show up as unknown devices using the native Windows driver. Check in Windows Device Manager. The drives should appear similar to Figure 2-26 on page 44 and the changer, if present, as in Figure 2-18 on page 40.

7.2.2 Installing VERITAS Backup Exec

To start the installation, run `setup` from the product CD. Select **Backup Exec Installation** from the initial menu (Figure 7-3.

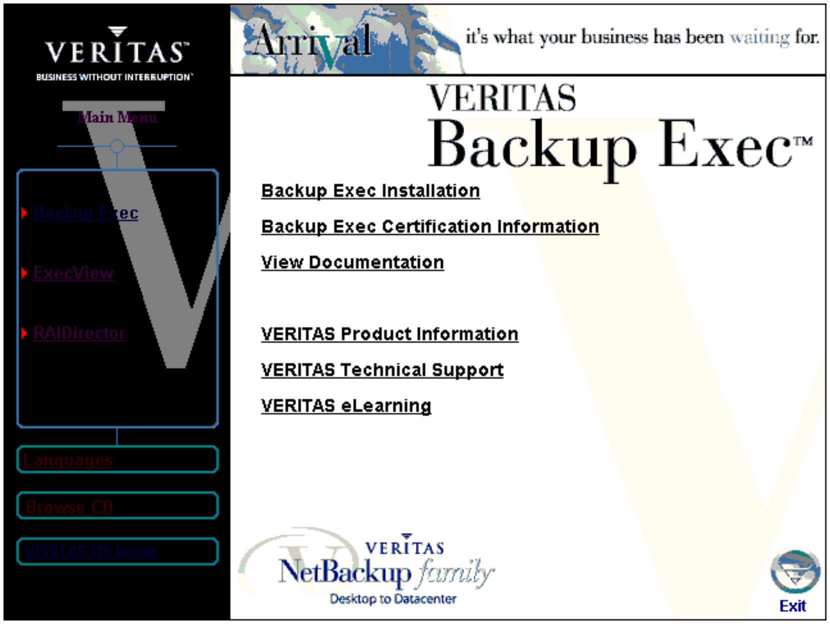


Figure 7-3 VERITAS Backup Exec main install menu

From the next screen (Figure 7-4), click on **Start Backup Exec Installation**.

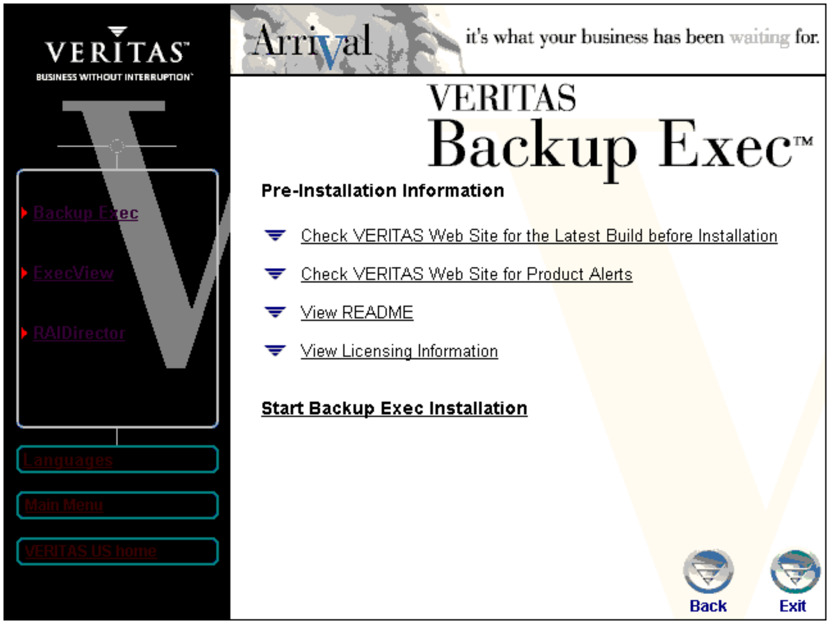


Figure 7-4 VERITAS Backup Exec install menu

The installation welcome screen will appear. Click **Next** to continue. On the Software License Agreement screen, click **Yes** to accept the license agreement.

An information screen will appear (Figure 7-5) detailing the operating system and hardware requirements for your system to run VERITAS Backup Exec. Check that you have a valid configuration and click **Next** to continue

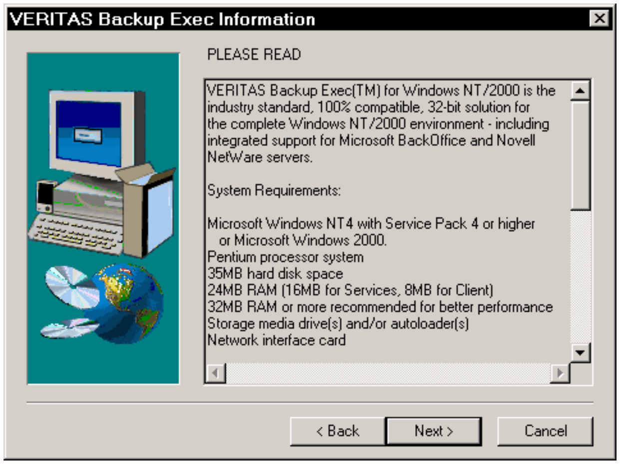


Figure 7-5 Backup Exec information

Select the component you wish to install on the screen shown in Figure 7-6. You can either install VERITAS Backup Exec and options on the local computer or select the Remote Administrator which allows you to remotely manage another server running VERITAS Backup Exec. For our purposes, we will install VERITAS Backup Exec locally.

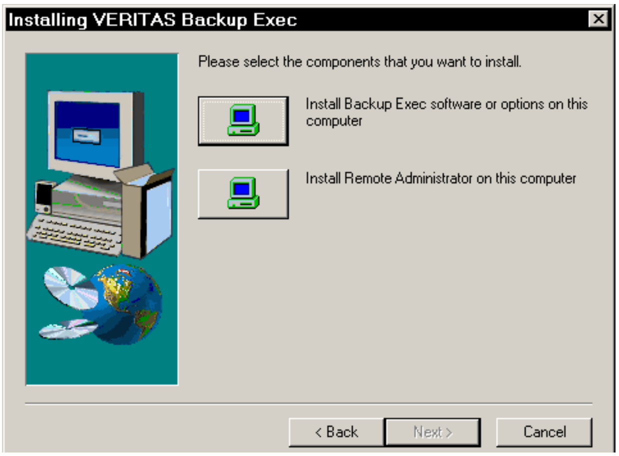


Figure 7-6 Select install option

You will be prompted to enter in your VERITAS Backup Exec serial number (Figure 7-7).If you click **Next** without entering a serial number a 60 day trial evaluation version of the software will be installed.

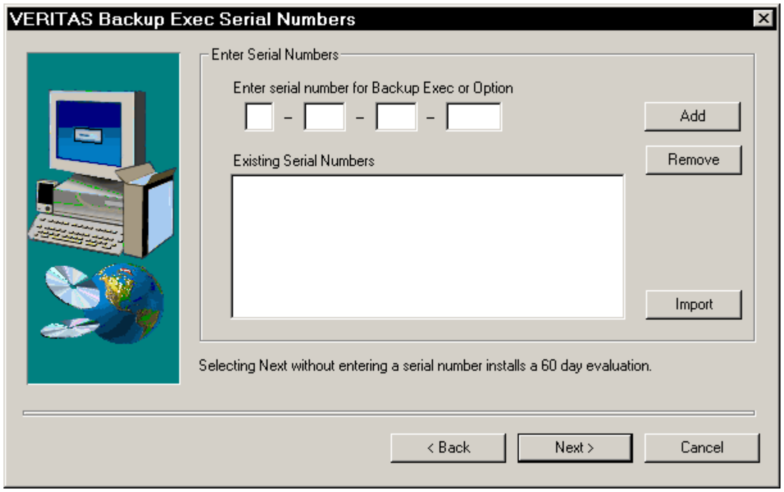


Figure 7-7 Serial number registration

The list of VERITAS Backup Exec install options appears, as shown in Figure 7-8. The only options we require for our installation are the Backup Exec software, Tape Device drivers and Robotic Library support. The basic Robotic Library support option may only provide support for a single drive robotic library or support for the first drive in a multi drive robotic library. In some instances you may need to purchase the Library Expansion Option. For the 3583 LTO tape library with two 3580 tape drives the standard robotic library support installation was sufficient. Note that if you do not select an option during the initial installation, you can install it later without affecting the VERITAS Backup Exec application. Other options of interest include:

SAN shared storage option - this option allows you to share secondary storage devices amongst multiple VERITAS Backup Exec servers in a SAN.

IBM ADSM Option - this option allows a Tivoli Storage Manager server's storage devices to appear as a tape robotic library in list of target devices on the VERITAS Backup Exec server, and allows it to be used as a backup and restore destination.

When you have selected the options you wish to install, click **Next**.

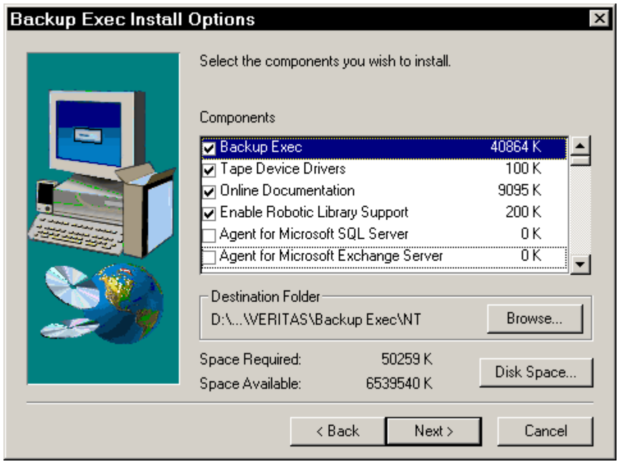


Figure 7-8 Backup Exec install options

Next, specify the destination folder for installing VERITAS Backup Exec.

The Device and Media Manager window will appear as in Figure 7-9. You need to decide whether or not you wish VERITAS Backup Exec to take ownership of any newly discovered tape libraries and drives. If VERITAS Backup Exec does not take ownership, RSM will take control of the devices and all management of the library will be performed in conjunction with RSM. Use this option if you wish to share the library with other RSM-compliant applications and use only the LTO Ultrium device drivers for both the LTO tape library and drives. If you have already disabled RSM as we recommended, then this option will fail. We have selected to allow VERITAS Backup Exec control the devices. Click **Next** to continue.

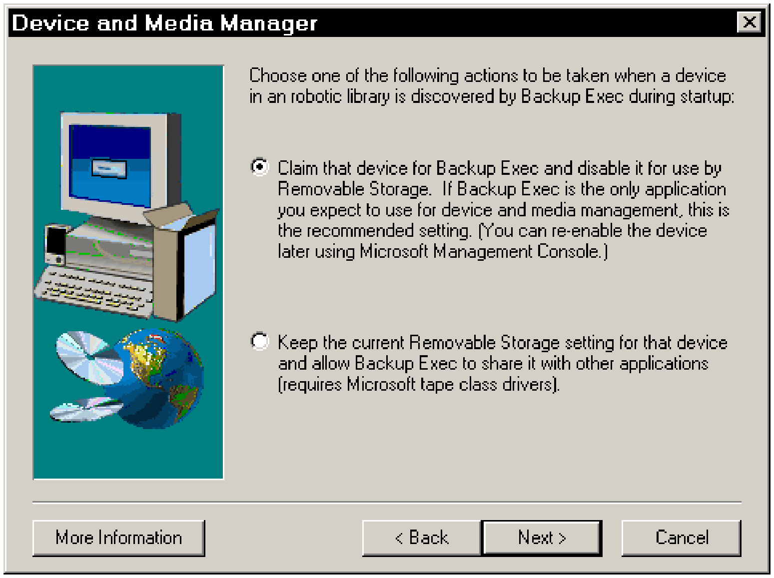


Figure 7-9 Device and Media Manager options

The Setup program is now ready to install. Click **Next** to confirm the parameters specified and the installation proceeds.

When prompted, as in Figure 7-10, enter the name and password of the account that you wish to use to start the VERITAS Backup Exec services.

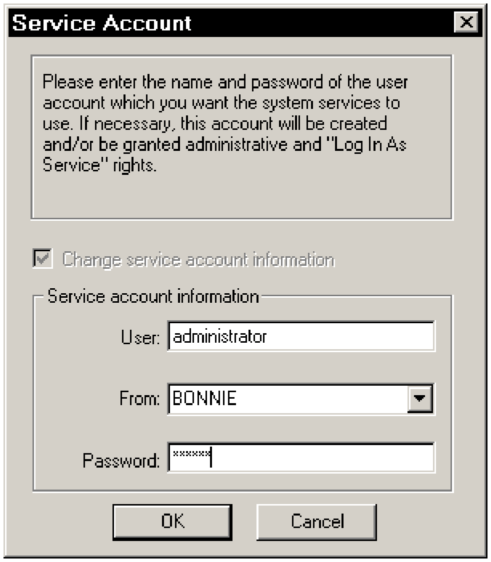


Figure 7-10 Service account

You will be asked (in Figure 7-11) to enter in the name of any other VERITAS Backup Exec servers (v8.5 or higher) that exist on the network. Leave the field blank and click '**OK**' if this is the first installation instance.

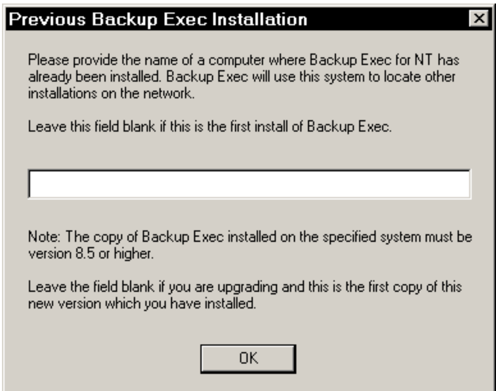


Figure 7-11 Previous Backup Exec installation

The Device Driver Install wizard will begin. As shown in Figure 7-12, the drivers included for VERITAS Backup Exec are not digitally certified by Microsoft. Click **Next** to continue.

Figure 7-12 Device driver installer

Choose which driver you wish to use for your tape devices. We have chosen to use VERITAS drivers for our installation, as shown in Figure 7-13. Alternatively, you can use the LTO Ultrium device drivers for Windows 2000 if you have them installed by selecting **Use VERITAS tape drivers for tape devices that do not already have drivers loaded**. Make your selection and click **Next** to continue.

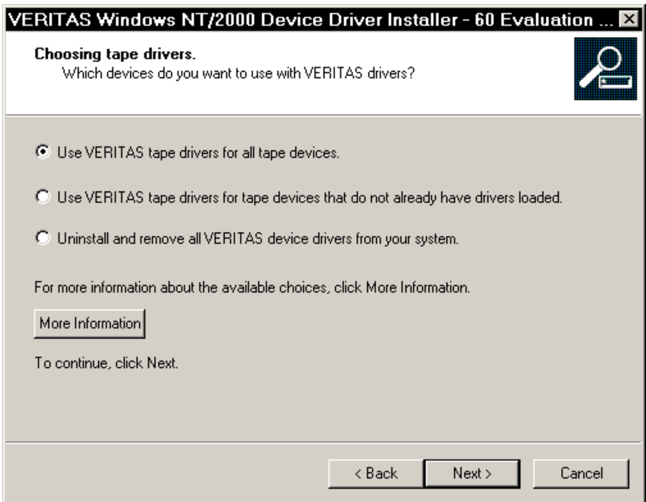


Figure 7-13 Choosing tape drivers

The installer will scan the bus for your attached hardware.It has detected the LTO 3580 tape devices as shown in Figure 7-14.

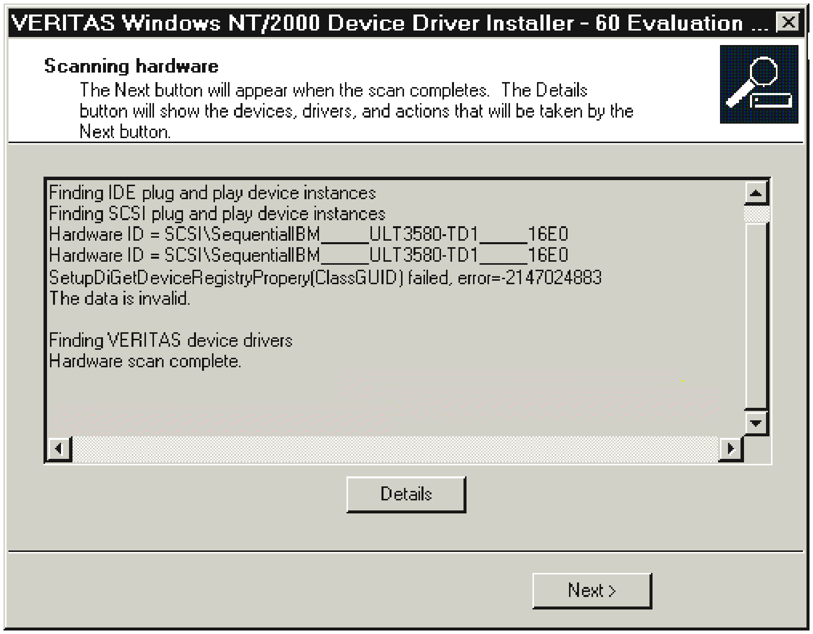


Figure 7-14 Scanning hardware

Clicking on the **Details** button displays information about the devices detected by the scan process (Figure 7-15). Notice that it has detected that the Ultrium tape devices are currently using the Ultrium device drivers (*ibmtape.sys*). The **Change** column indicates that it will replace this driver with its own as we chose in Figure 7-13. Click **OK** to return to the hardware scan window, then click **Next**.

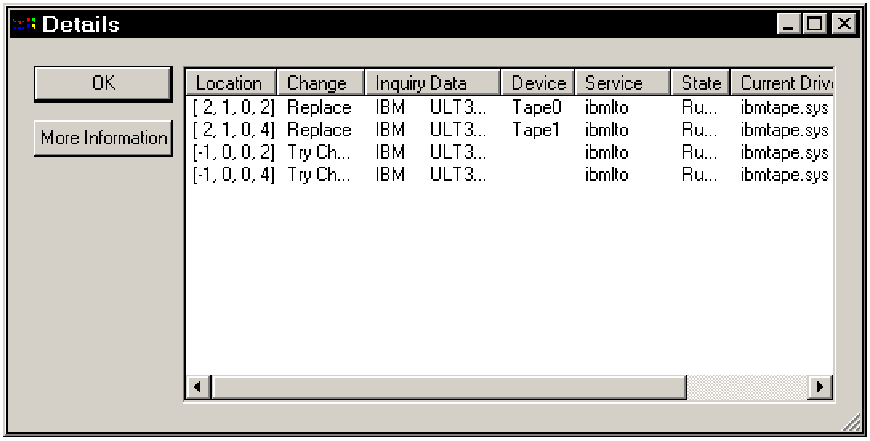


Figure 7-15 Detected hardware details

The wizard will proceed to install the most compatible driver in its listing for the Ultrium tape devices. In this case it is the *halfinch.sys* driver file (as shown in Figure 7-16).This driver has been used as a best fit driver for the IBM tape device, because there is no driver provided by VERITAS specifically for IBM LTO. When the installation is complete click **Next** and the driver installation will begin.

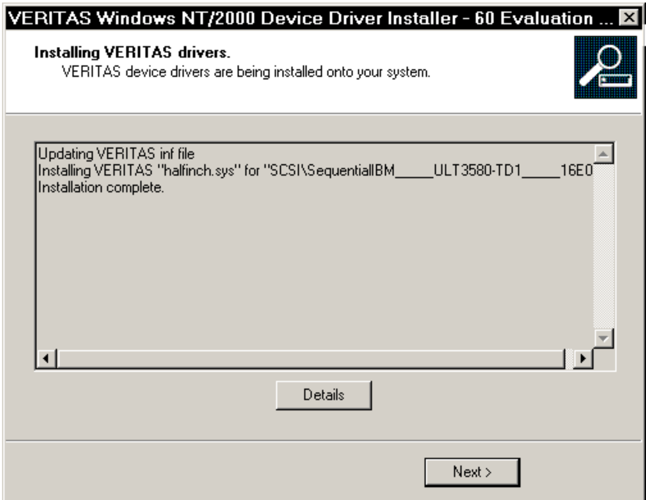


Figure 7-16 Installing VERITAS drivers

When the installation is complete, click on the **Details** button again. You will see in Figure 7-17 that the current driver has changed from *ibmtape.sys* to *halfinch.sys*. Click **OK** to return to the installation program, then click **Next**.

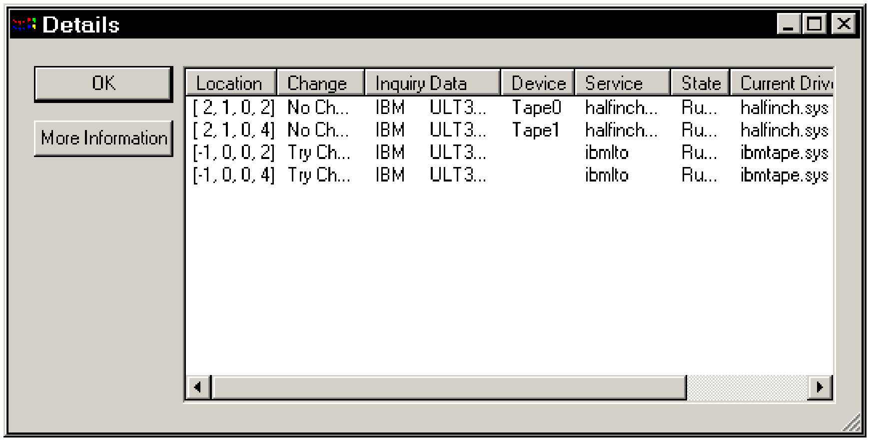


Figure 7-17 Installed hardware details

The Device Driver install wizard is now complete. Click **Finish**.

A window will appear (Figure 7-18) indicating that the wizard is installing robotic library support. The result of this will be that Backup Exec will use the Windows 2000 Ultrium device drivers to control the LTO tape library.

Figure 7-18 Installing robotic library support

If you display the device properties at this stage you will see that the library is still using the Ultrium device drivers, and the tape devices are using the VERITAS device drivers. If you select the properties of the device in Windows 2000 device manager you will notice that the driver is indeed provided by VERITAS. This is shown in Figure 7-19.

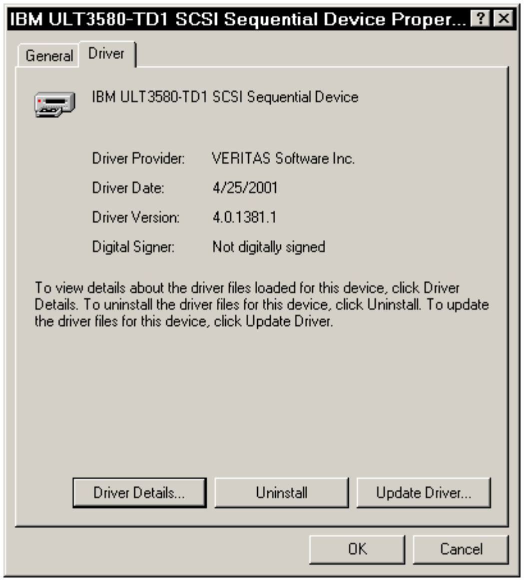


Figure 7-19 Driver details

You can double-check this by clicking on **Driver Details**, which confirms that the driver file *halfinch.sys* for the tape drives (Figure 7-20).

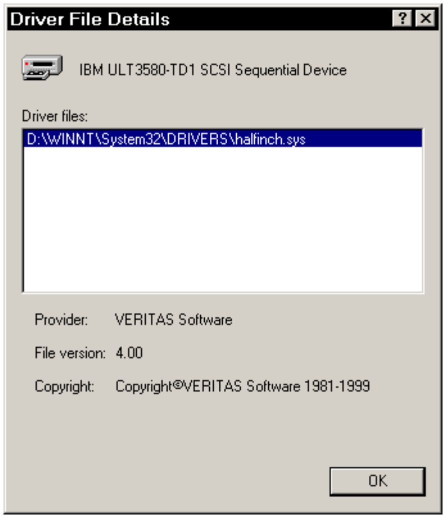


Figure 7-20 Driver file details

Returning to the install process in progress, select the program group you wish to use to run VERITAS Backup Exec, as in Figure 7-21. To restrict access to the VERITAS Backup Exec administration account, choose **Private Program Group**. The use of **Common Program Group** will allow any account on the local computer to use VERITAS Backup Exec. Click **Next** to continue.

Figure 7-21 Select program group

You will be asked if you wish to install the Remote Agent or other options at this time. Select **No** if you wish to finish the installation now, as we do not require these. The setup has now completed. Select **Yes** when prompted to restart the computer, then click **Finish**.

7.2.3 Configuring VERITAS Backup Exec

When the computer reboots, access VERITAS Backup Exec by going to **Start ->Programs -> Backup Exec**. The Online Registration wizard will start. Complete and submit your registration or you can opt to complete registration later. Click **Next** to continue.

The First Time Startup wizard will initiate which will help configure VERITAS Backup Exec for use. Click **Next** to begin (Figure 7-22).

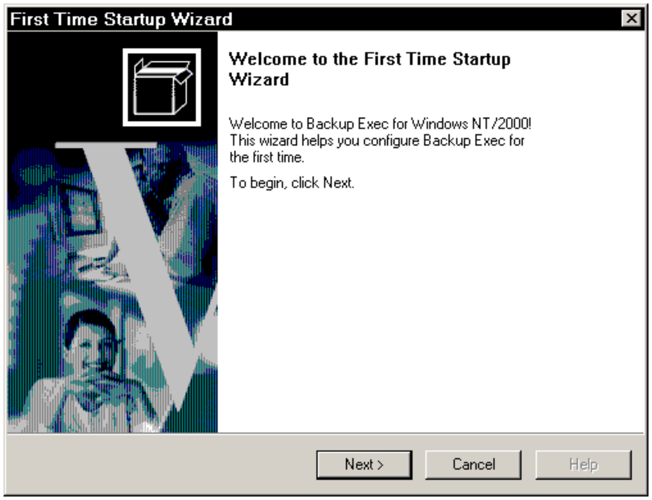


Figure 7-22 First time startup wizard

You are now invited to select the level of overwrite protection you wish to use on media with VERITAS Backup Exec as in Figure 7-23. Click on **Select Overwrite Protection Level**.

Figure 7-23 Media overwrite introduction

Select the level of protection that you require from the choices in Figure 7-24. If you select **Full** then any imported media or media belonging to other applications cannot get overwritten until either the data expires, the media gets moved to or from a scratch media status, or until you label or erase the media. If you select

Partial then you can reuse media from an older version of VERITAS Backup Exec or imported media from another application with a prompt before overwriting media. If you select **None** then you will be responsible for ensuring that media does not get accidentally overwritten. Make your selection and click **Next**. We chose **Partial**.

Figure 7-24 Overwrite protection level

Select the type of media you wish to overwrite first as in Figure 7-25. By selecting the option to overwrite scratch media first you can preserve recyclable media for a longer period of time in case it is needed for recovery. Make your selection and click **Next** to continue.

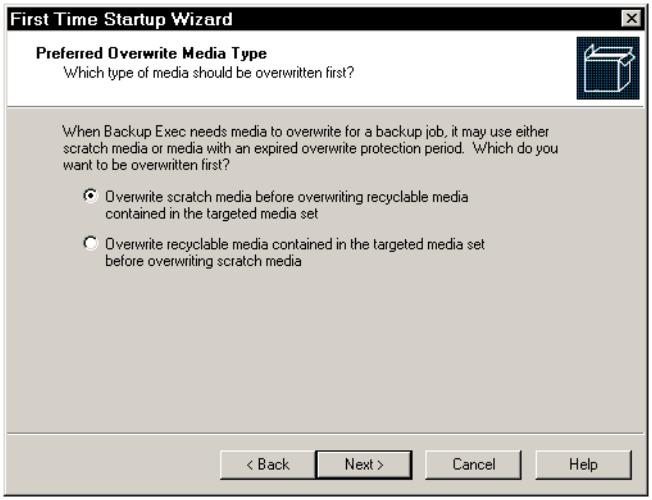


Figure 7-25 Preferred overwrite media type

The wizard will ask if you want VERITAS Backup Exec to scan for viruses prior to a backup operation (Figure 7-26). Click **Next** to continue.

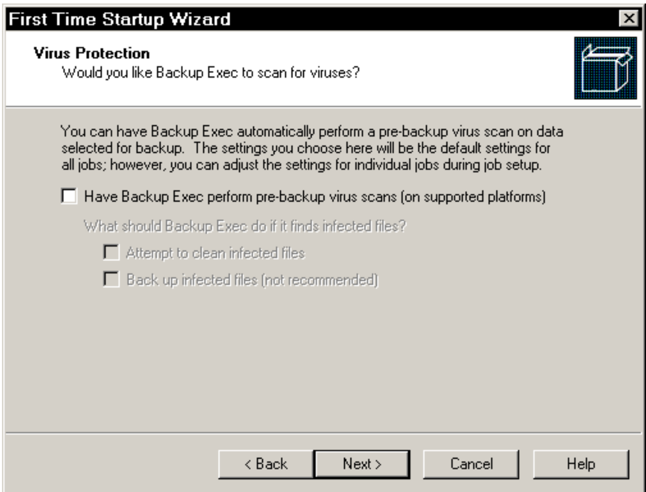


Figure 7-26 Virus protection

You can now elect to customize Windows Explorer (as in Figure 7-27) so that a backup can be started simply by right-clicking on a file or directory and selecting **Backup with Backup Exec**. Click **Finish**.

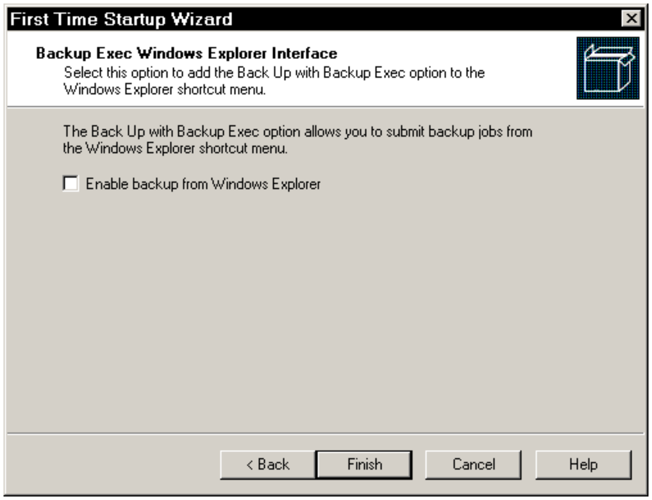


Figure 7-27 Windows explorer interface option

The Device Configuration Wizard will now begin. Click **Next** to continue.

The wizard will list the devices that may be used for backup as in Figure 7-28. Notice that it has detected our two drives and the library robot. Click **Next** to continue.

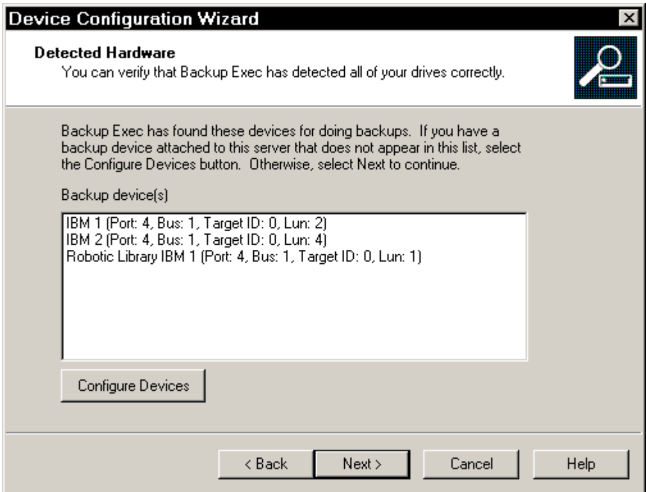


Figure 7-28 Detected hardware

You may at this stage want to configure **Backup to Disk Folders** as shown in Figure 7-29. These will be added to VERITAS Backup Exec's All Drives media pool which is the default destination for backup jobs. For more information regarding Backup to Disk folders refer to the VERITAS Backup Exec documentation**.** We will not be using this option in our installation as we are interested in backing up only to our tape device. Click **Next** to continue.

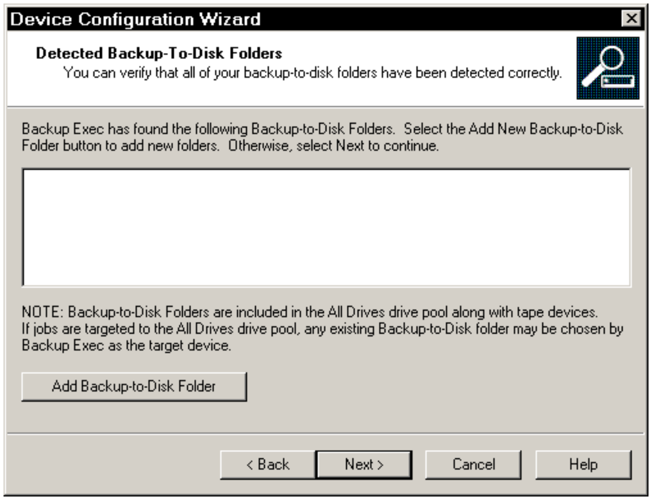


Figure 7-29 Detected backup-to-disk folders

The drive configuration window will appear as in Figure 7-30. Ensure the drives are situated directly below the entry for the LTO tape library in their correct element address order. For more information regarding element address for LTO tape libraries refer to:

http://www.tivoli.com/support/storage_mgr/devices/atab104.htm

for IBM LTO ultrium 3583 tape libraries or,

http://www.tivoli.com/support/storage_mgr/devices/atab101.htm

for IBM LTO Ultrium 3584 tape libraries.

Click **Next** when you have verified the configuration.

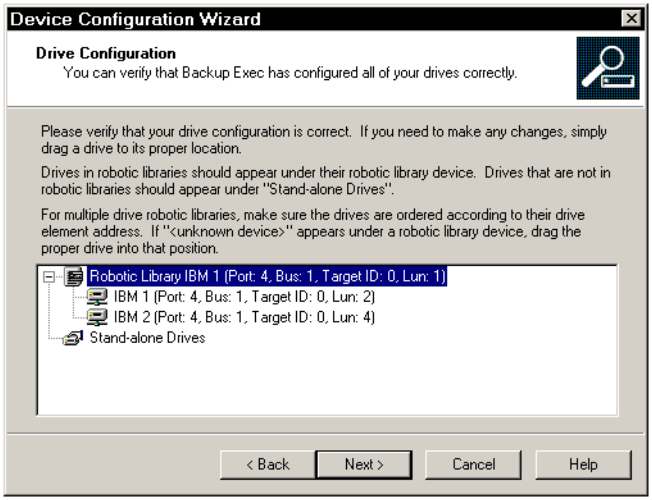


Figure 7-30 Device configuration

The Device Configuration Wizard is now complete. Click **Finish**. The Backup Wizard will now begin. You may cancel out at this stage as we will perform a backup manually to test the configuration.

When you cancel out of the wizard the Backup Exec Assistant will appear (as shown in Figure 7-31). From this window you can access the Backup Exec wizards for future execution.

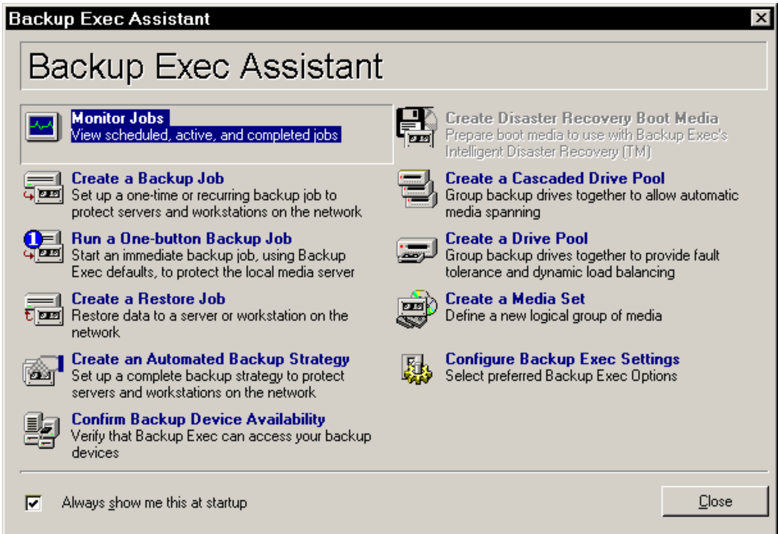


Figure 7-31 Backup Exec Assistant

We will close this screen and move to the Backup Exec main window, Figure 7-32. To execute the Backup Exec assistant later, select **Tools -> Backup Exec Assistant**.

Before we begin backing up data, we need to inventory and label the tapes in the library. From the main console window in Backup Exec, click on the Devices tab at the bottom. Underneath the listing for **All Devices** in the left hand window you will see a listing for drive pools as well as the servername (BONNIE in our case) which, with the default installation contains the server's locally attached tape library and drives. We have renamed the IBM1 entry for the library to read LTOLIB to distinguish it from the tape drives (Backup Exec will name the first attached IBM LTO library 'IBM1' by default). Click on **Slots** underneath LTOLIB. You will see the list of slots in the library and the tapes present. At this stage, most of the tape media is listed as Unknown Media. We need to inventory the library to scan and catalogue all of the tape volumes present. To do this right-click on **Slots** and select **Inventory** as shown in Figure 7-32.

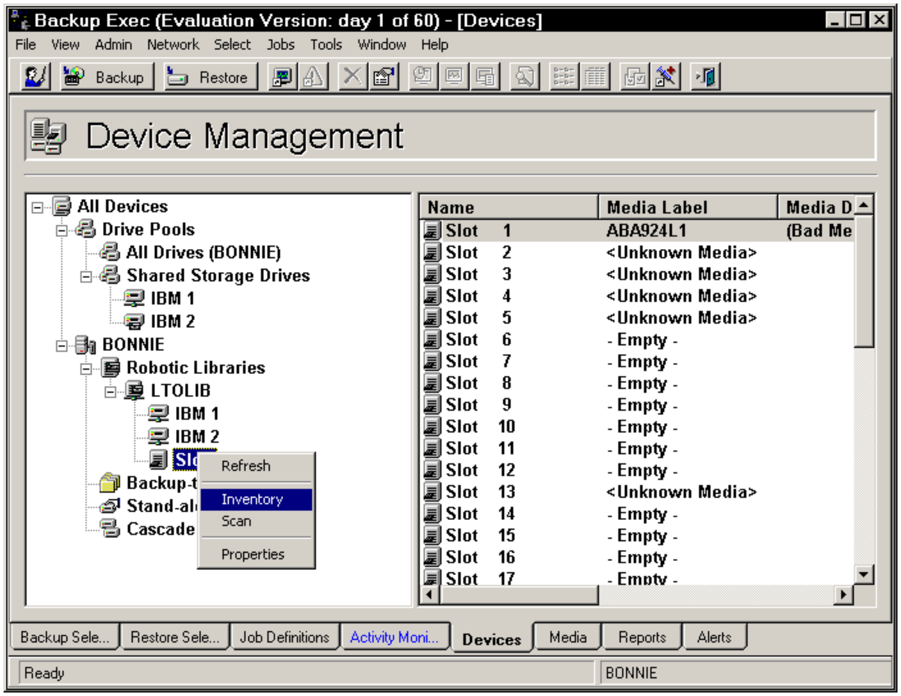


Figure 7-32 Device Management

After the inventory is complete, the tape media now appear with the names that have been taken from their barcode label (Figure 7-33). These volumes are already labelled, but are not necessarily in a scratch state. A backup operation may use these volumes, since we are using 'partial' media protection (as selected in Figure 7-24 on page 323). You will however be prompted to verify that you do indeed want to overwrite the media with a backup operation. We can give these volumes a scratch status by selecting to erase them by right-clicking on them and selecting **Erase**. We can also label, or in our case relabel the tapes using the barcode label. This operation will effectively erase any data existing on the tape. To label an individual volume we select **Slots**, then click on the volumes to label in the right hand pane. We then right-click and select **Label Media** as shown in the figure.

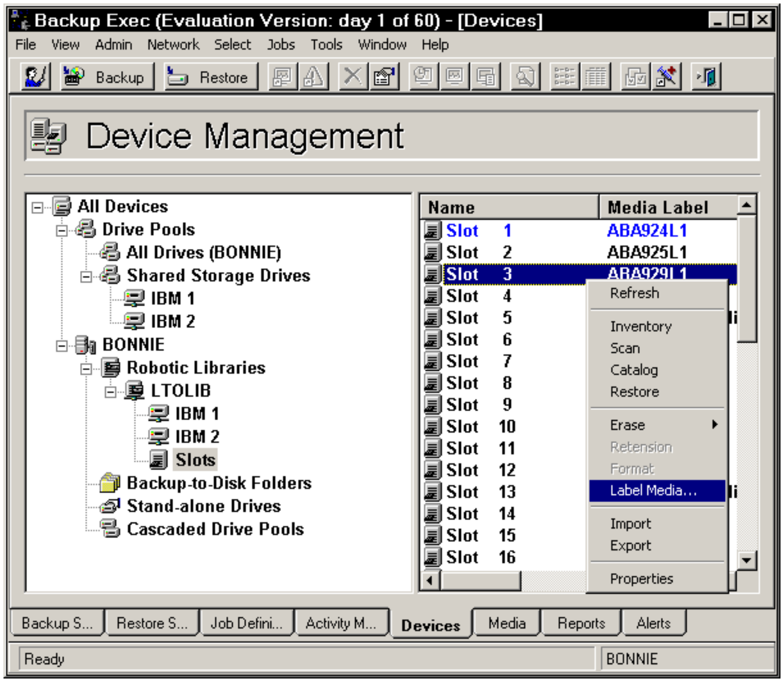


Figure 7-33 Label Media

A warning message will appear as in Figure 7-34 indicating that the labelling operation to be performed will be done on the current media in that slot. If the media has moved or changed since the last inventory then the operation may be performed on the wrong tape and cause erroneous labelling. To ensure this doesn't happen be sure to inventory the library or individual slot before labelling tapes. Click **OK** to continue.

Figure 7-34 Label media warning

A window will appear (Figure 7-35) showing the media label as detected by the barcode reader. If you want to change this label then you have to physically remove the barcode label from the tape cartridge. We do not recommend this. Click **OK** to continue

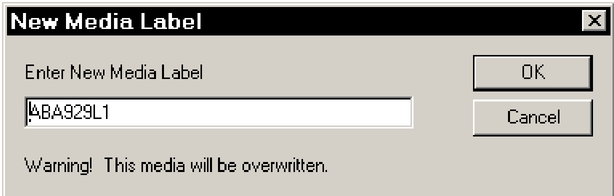


Figure 7-35 New media label

Another warning window will appear (Figure 7-36) indicating that relabelling the tape will cause all of the data residing on that tape to be erased. Click **OK** to start the labelling operation.

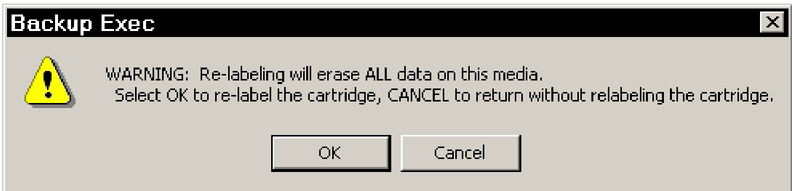


Figure 7-36 Relabelling warning

If we now select the **Activity** tab at the bottom of the main Backup Exec window view, we can view the status of the labelling job. The job has been completed as shown in Figure 7-37.

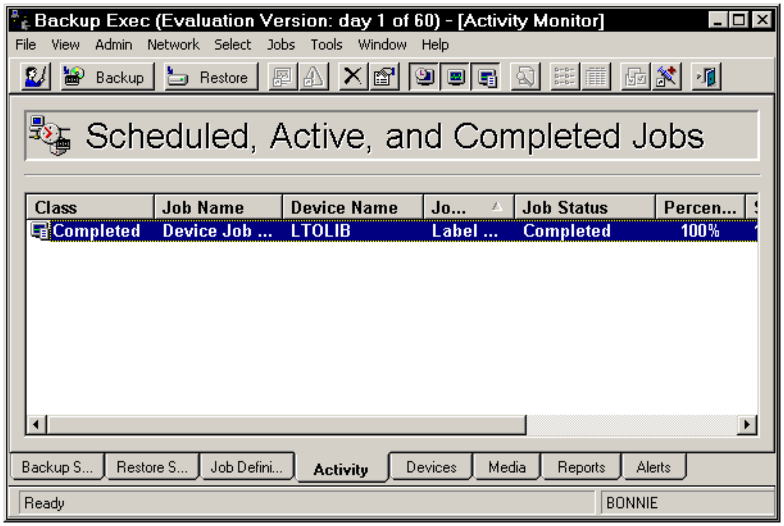


Figure 7-37 Activity tab

Now if we go to the **Media** tab (Figure 7-38), we can see the volume we just labelled (ABA929L1) listed as Scratch Media.

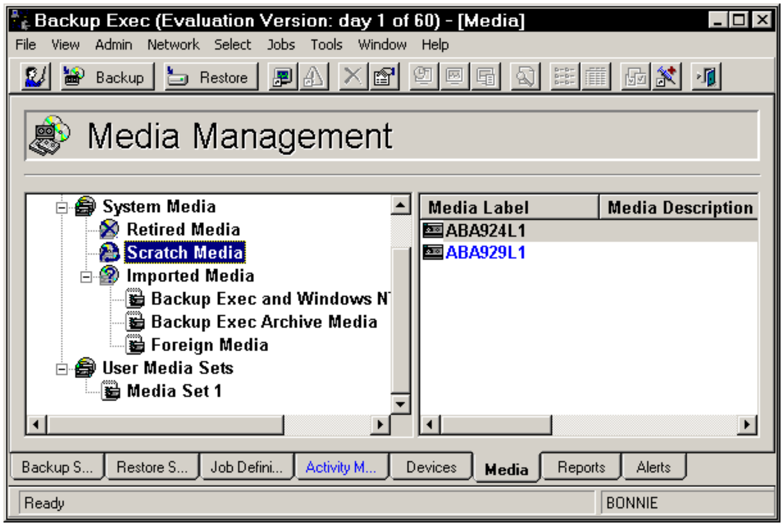


Figure 7-38 Media Management

We are now ready to backup data. Click on the **Backup** tab at the bottom of the main window. From here you may select the data that you want to backup simply by clicking on the checkbox next to the data volume(s) in the left or right hand pane. Selecting items puts a blue tick in the box as shown in Figure 7-39.

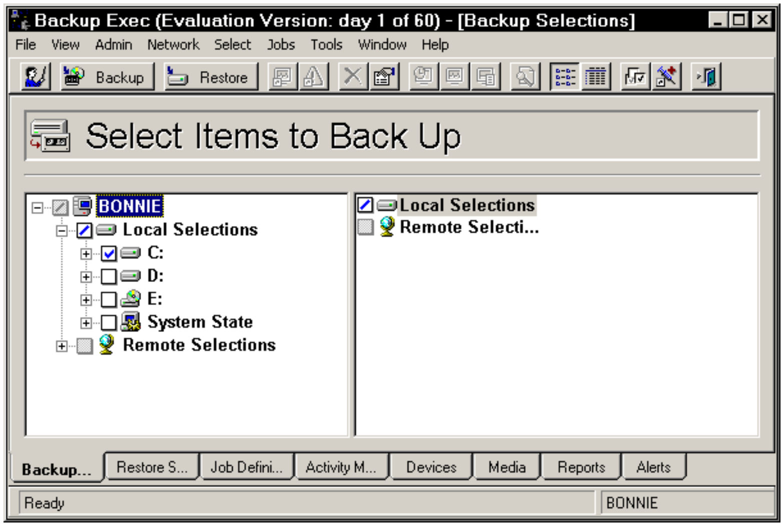


Figure 7-39 Items to backup

Now select the **Backup** button on the toolbar near the top of the screen. The backup job properties box will appear (Figure 7-40). The main tabs we are interested in are **General** and **Advanced**. From the **General** tab you may select:

- The job name
- The action to take at the commencement of the job.
- The media name
- The backupset description
- The backup method
- Destination device (LTOLIB in our example)
- Destination media set

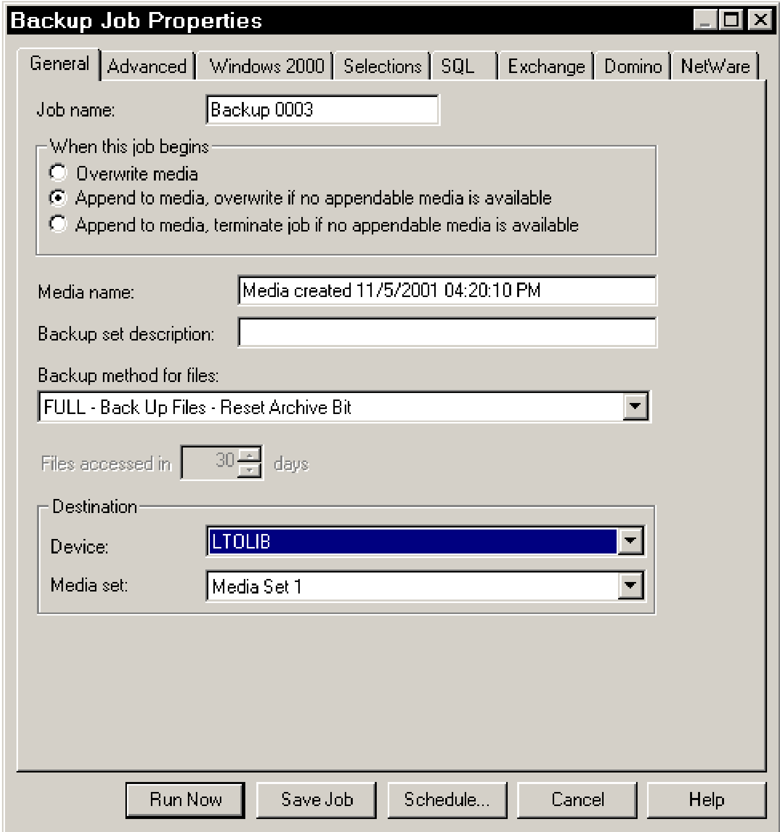


Figure 7-40 General job properties tab

Next, select the **Advanced** tab as in Figure 7-41. From this tab you may select various media handling options such as verify and eject media following backup. The selection we are most interested in here is the compression type. Notice that we have selected to use hardware compression for the operation. Once you have made your selection click **Run now**.

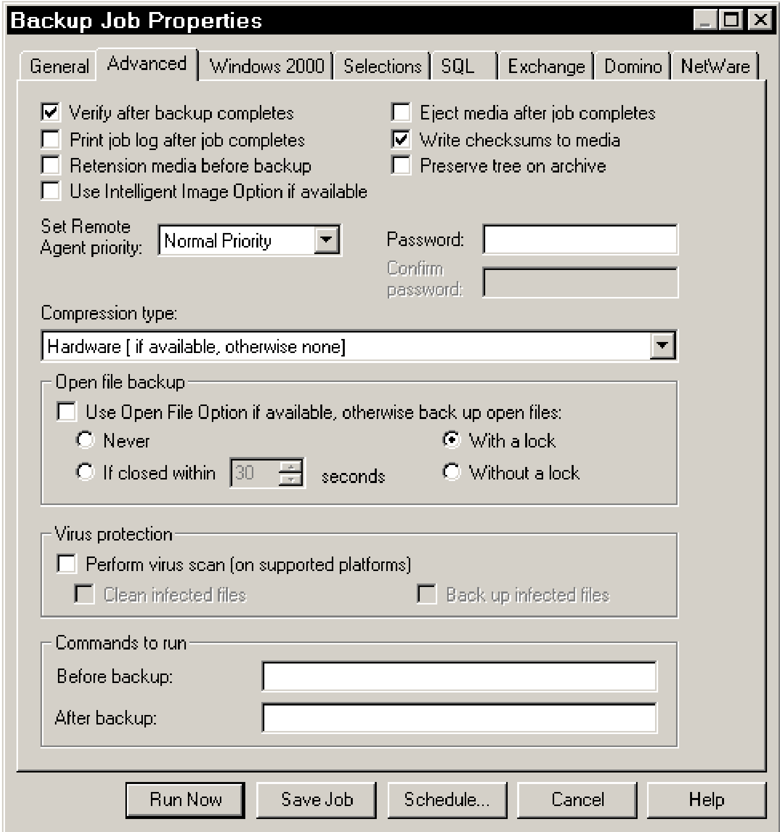


Figure 7-41 Advanced job properties tab

Return to the activity log (**Activity** tab on the main screen as shown in Figure 7-42) and you will notice that the job has just started and is now loading media.

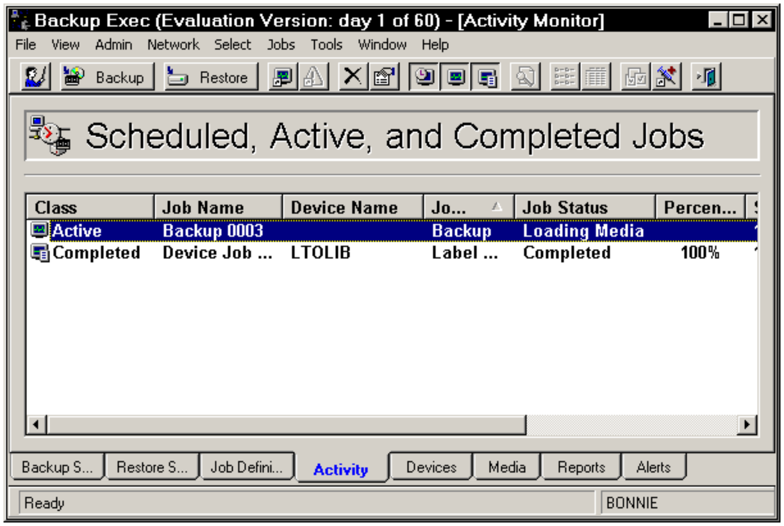


Figure 7-42 Backup job activity

When the backup operation is complete you will see a Job Status of Successful in the Activity window as shown in Figure 7-43.

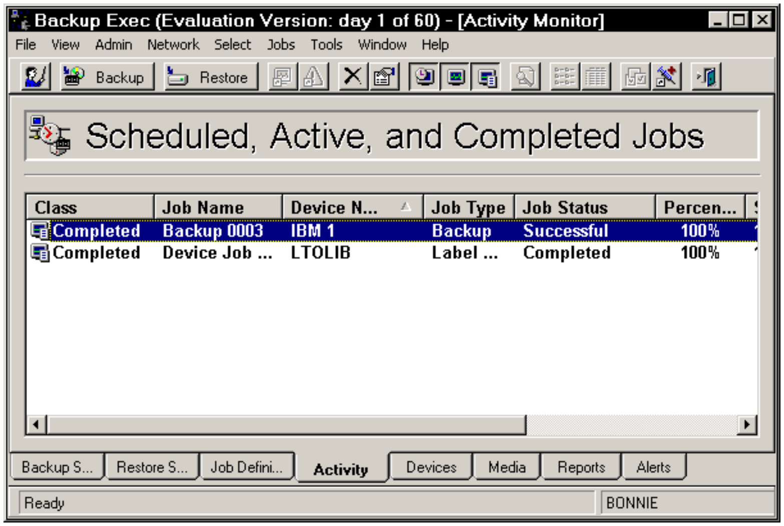


Figure 7-43 Backup activity status

Double click on the entry for the job (Backup0003) to view more details. The job log tab (Figure 7-44) shows details that have been logged during the progress of the backup. The completed job tab displays various completion information and statistics such as bytes transferred, number of directories and files backed up and elapsed time.

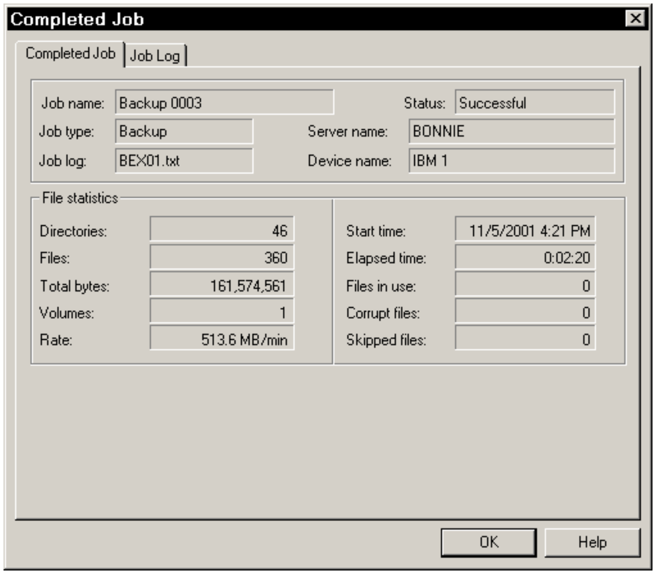


Figure 7-44 Completed job details

If you go to the **Media** tab on the main Backup Exec window as shown in Figure 7-45 you will notice that the volume we used for our backup has now been placed in Media Set 1.

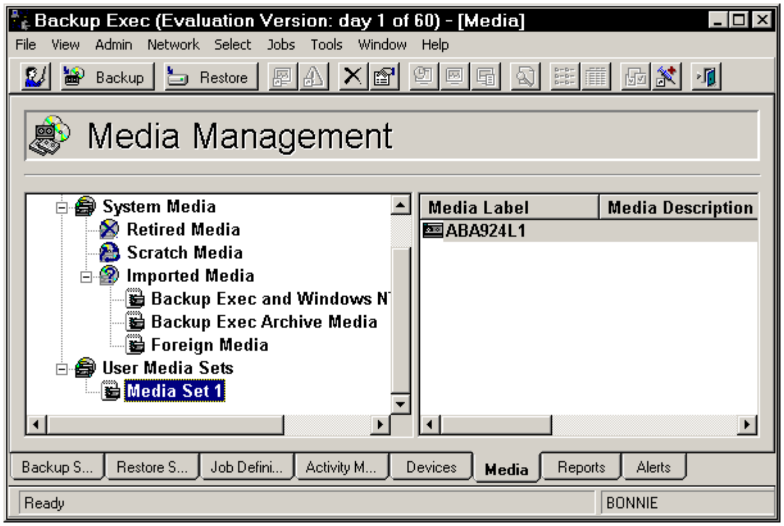


Figure 7-45 Media set

To restore data, go to the **Restore** tab, shown in Figure 7-46. The media candidates for restore will be listed under all volumes in the left hand pane. The backup set for the machine BONNIE will be visible under the server name. Select the file(s) you wish to restore and click **Restore**.

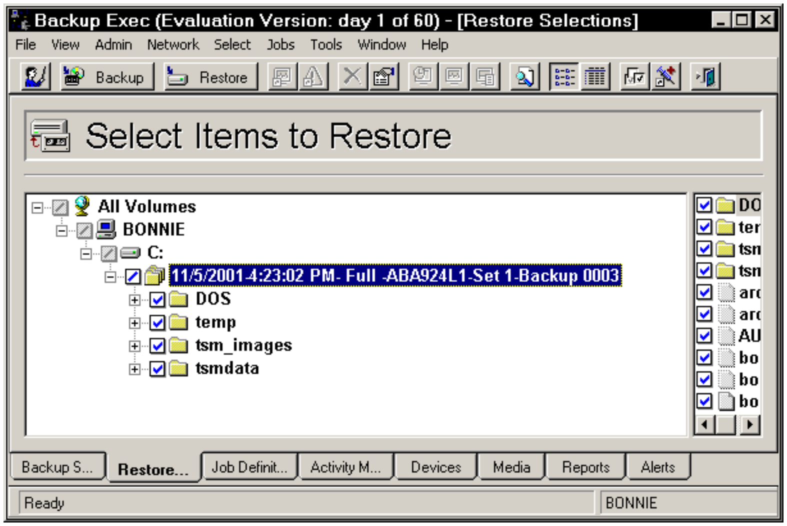


Figure 7-46 Restore tab

The Restore Job Properties window appears (Figure 7-47). Here you may select:

- Job name
- Restore security permissions
- Preserve directory structure

Select the device to restore from, which, in our example is from the tape media we just backed up to in the LTO library, LTOLIB.

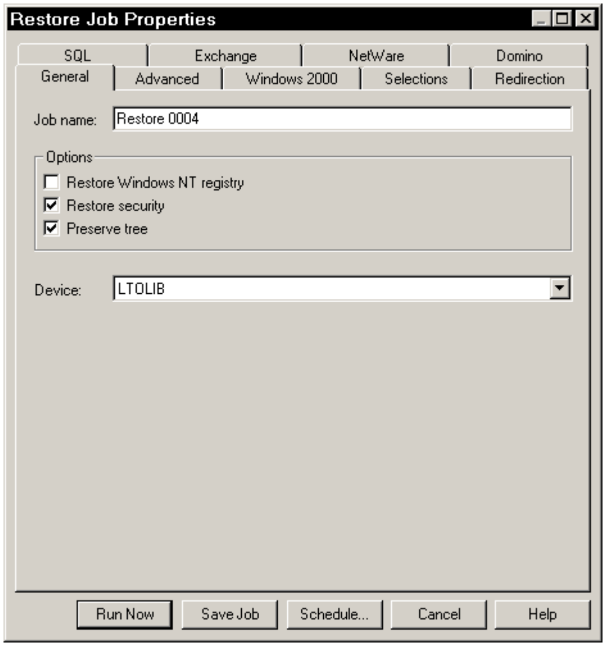


Figure 7-47 Restore job general properties

If we click on the **Advanced** tab we can specify what action to take if the file already exists on the target disk volume - overwrite, skip or skip if existing file is more recent. When you have made your selections in Figure 7-48, click **Run Now** to initiate the restore.

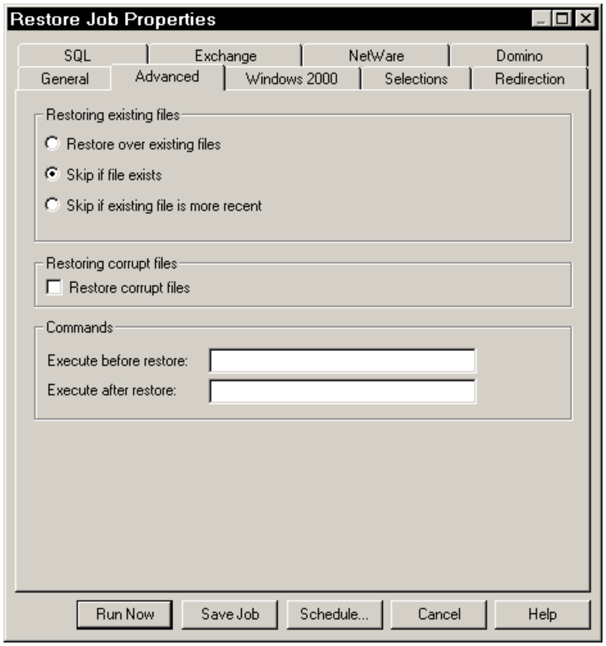


Figure 7-48 Restore job properties advanced tab

Again, if we go to the activity window and double-click on the job we can view details of the progress and completion. The window in Figure 7-49 shows the progress of the backup including the number of bytes transferred and the average transfer rate.

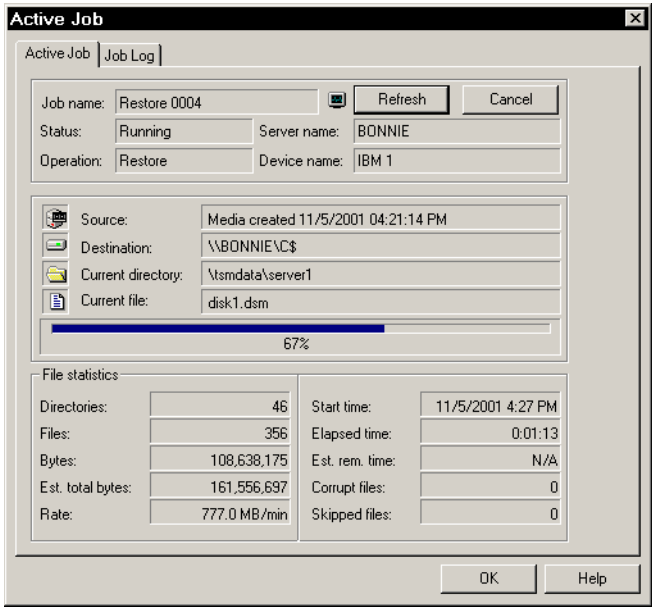


Figure 7-49 Active job details

When the operation has completed, we can view the details in the job log (Figure 7-50).

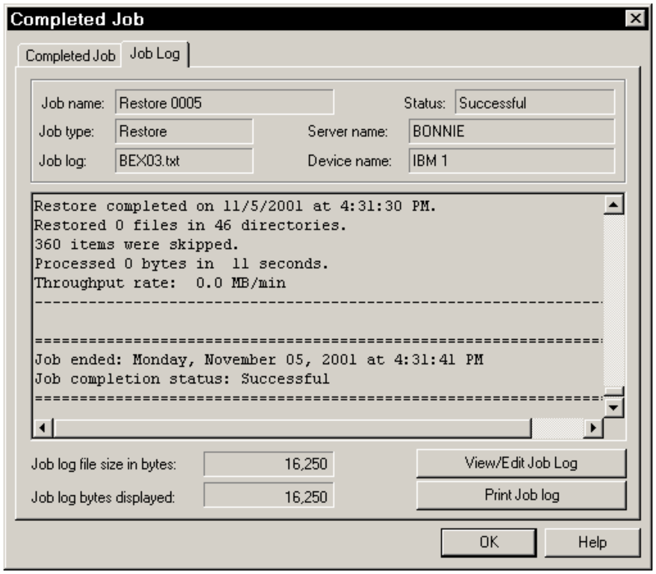


Figure 7-50 Completed job log

8

Configuring BakBone NetVault on Windows 2000 and Linux

This chapter describes the steps to configure NetVault Version 6 by BakBone in the Windows 2000 and Linux environments. We show how to setup a basic tape library connection, and then how to use the BakBone NDMP client on the Linux server.

8.1 NetVault by BakBone

NetVault by BakBone is an easy to use, fully functional, high performance, scalable backup and recovery storage management product. NetVault supports a broad range of server and client operating systems in LAN, SAN and NAS environments as shown in Table 8-1.

Table 8-1 NetVauls supported platforms

Server Platforms	Client Platforms
Compaq Tru64 4.0D-F, 5.0 FreeBSD 4.2 HP-UX 10.20, 11.00 IBM AIX 4.2, 4.3 Linux (intel) Kernel 2.2 Linux (Intel) Kernel 2.4 Microsoft Windows 2000 Microsoft Windows NT 4.0 NCR MP-RAS 3.02 SCO Unixware 2.1.3, 7 SGI Irix 6.2, 6.5 Solaris (Intel) 7, 8 Solaris (SPARC) 2.6, 7, 8	Compaq Tru64 4.0D-F, 5.0 FreeBSD 4.2 HP-UX 10.20, 11.00 IBM AIX 4.2, 4.3 Linux (Intel) Kernel 2.2 Linux (Intel) Kernel 2.4 Microsoft Windows 2000 Microsoft Windows 95/98 Microsoft Windows NT 4.0 NCR MP-RAS 3.02 Novell Netware 4.11(sp7a), 5.1(sp2a) SCO Unixware 2.1.3, 7 SGI Irix 6.2, 6.5 Solaris (Intel) 7, 8 Solaris (SPARC) 2.6, 7, 8

NetVault also supports a wide range of media and devices including the IBM LTO product range. NetVault uses industry standard, non-proprietary formats for writing to tape. These are **`cpio`** for UNIX and Microsoft Tape Format (MTF) for Windows. For easy data interchange and disaster recovery protection, NetVault produced tapes can be read by any UNIX or Windows based system supporting the standard.

In the event of a problem with the library, server hardware and/or applications, NetVault tapes can be restored to any machine, regardless of whether the NetVault application is present.

The latest device, library and operating system specific information can be obtained from the BakBone website at

`http://www.bakbone.com`

We will first describe the basic installation of the NetVault application onto Linux and Windows 2000 as the actual configuration of the product is almost identical on both systems.

8.2 Installing NetVault on Windows 2000

In this section we show the steps necessary to configure NetVault Version 6.03 on Windows 2000 using an IBM 3583 library. We tested for both SCSI direct attach and SAN attach.

For SCSI direct access connection, we used the following hardware, shown in Figure 8-1:

- Pentium II server with Windows 2000 Advanced Server (build 2195).
- Adaptec 29160 LVD SCSI card
- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives.

Figure 8-1 Windows 2000 direct SCSI configuration

For the SAN environment we used the following hardware, shown in Figure 8-2:

- A Pentium II server with Windows 2000 Advanced Server (build 2195).
- QLogic 2200F FC HBA
- IBM 2109 Fibre Channel switch
- IBM 2108 SAN Data Gateway (SDG)
- IBM 3583 library attached via SCSI port to the SAN Data Gateway. A single SCSI bus supported both the library controller and the two 3580 tape drives

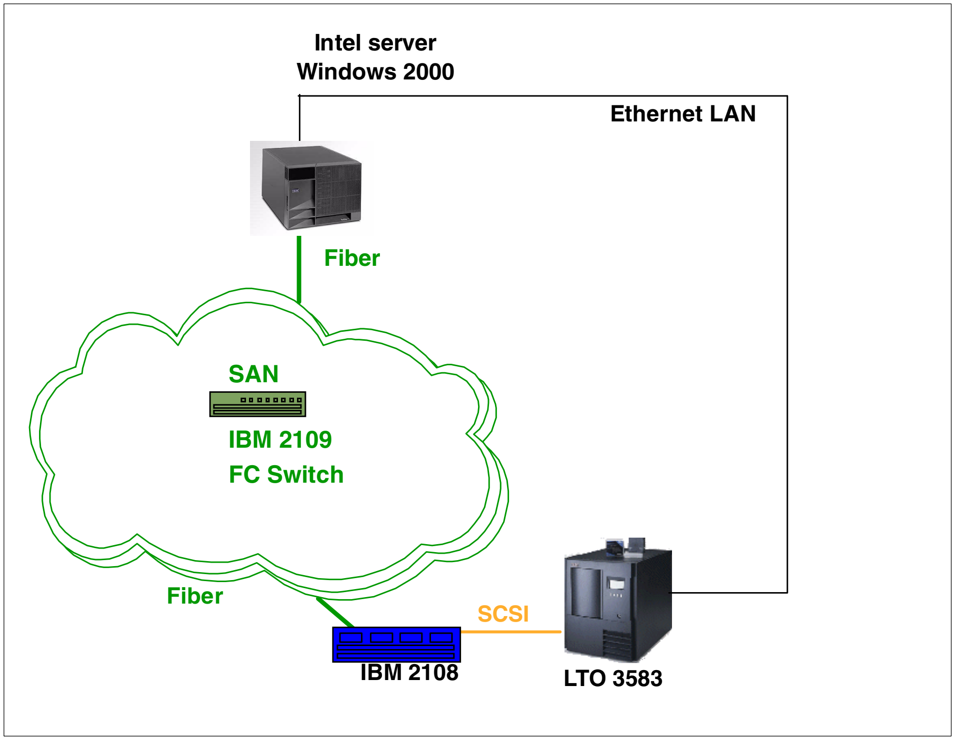


Figure 8-2 Windows 2000 SAN configuration

8.2.1 Installation preparation

The preparation for installing NetVault depends on whether your tape library is already installed.

Existing LTO installation

If your LTO drive was already installed on your server, check to see if the IBM drivers are being used. The IBM Ultrium drivers are not required for the NetVault software. If you have already installed these, disable them as described in 2.2.6, "Deleting LTO devices" on page 60.

New LTO installation

If this is a brand new installation, first install the adapter card to Windows 2000 and load the drivers. This procedure is given in 2.2.2, “Installing the SCSI adapter” on page 30, and 2.3, “Windows 2000 Fibre channel HBA driver installation” on page 63 for the FC card.. Disable the RSM service if required as described in “Disabling RSM” on page 61. Shutdown the server, physically cable the tape library, and reboot the system.

All LTO installations

Your drive and libraries should now show up as unknown devices using the native Windows driver. Check in Windows Device Manager. The drives should appear similar to Figure 2-26 on page 44 and the changer, if present, as in Figure 2-18 on page 40.

8.2.2 Installing NetVault

The NetVault application code is available on diskette, CD-ROM or zip package (Internet). Both the CD-ROM and zip packages are built from the diskette images. To start the installation, execute **setup.exe**.

You will see an introductory screen (Figure 8-3)

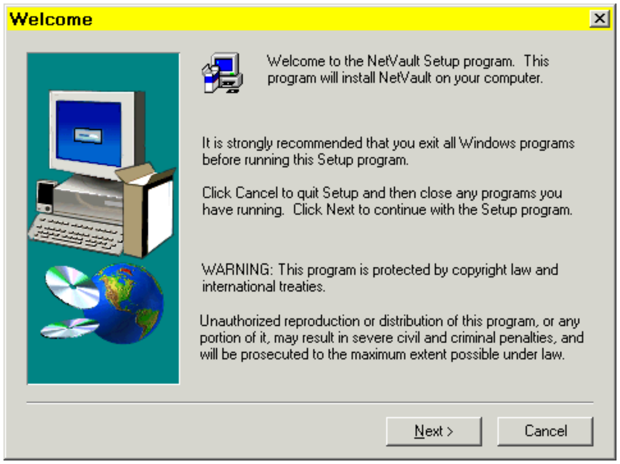


Figure 8-3 Initial NetVault installation screen

and then the licensing agreement (Figure 8-4).

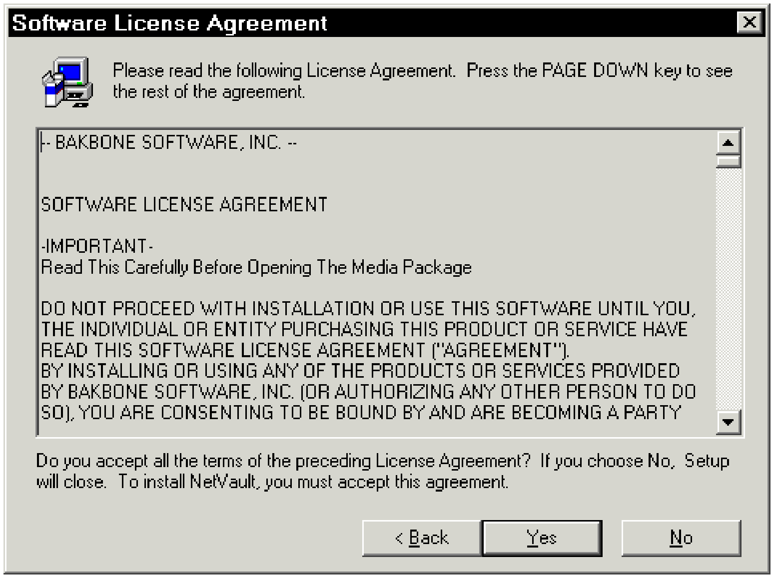


Figure 8-4 License agreement

You are prompted to enter your name and your company and then to specify where to install NetVault (Figure 8-5)

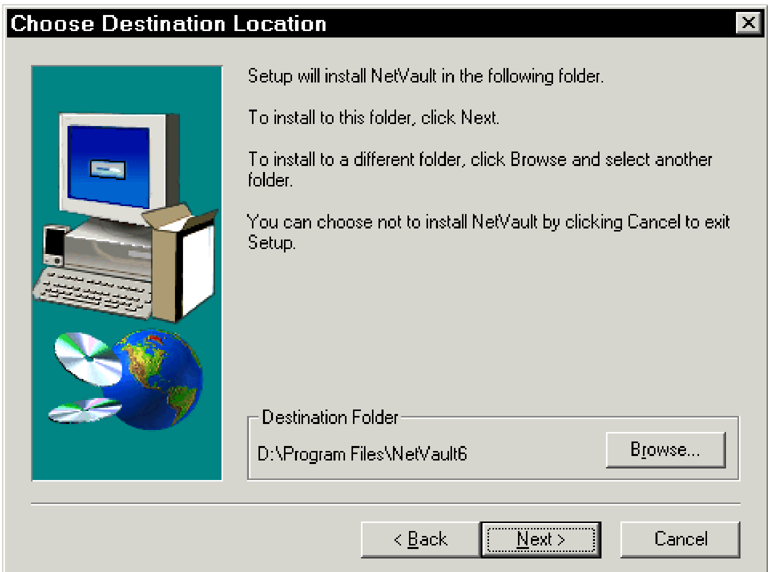


Figure 8-5 Destination folder

Next, specify where you want NetVault to install its database (Figure 8-6). Refer to the NetVault documentation for guidance on sizing the database to help decide where to locate it. For our simple testing, we accepted the default location.

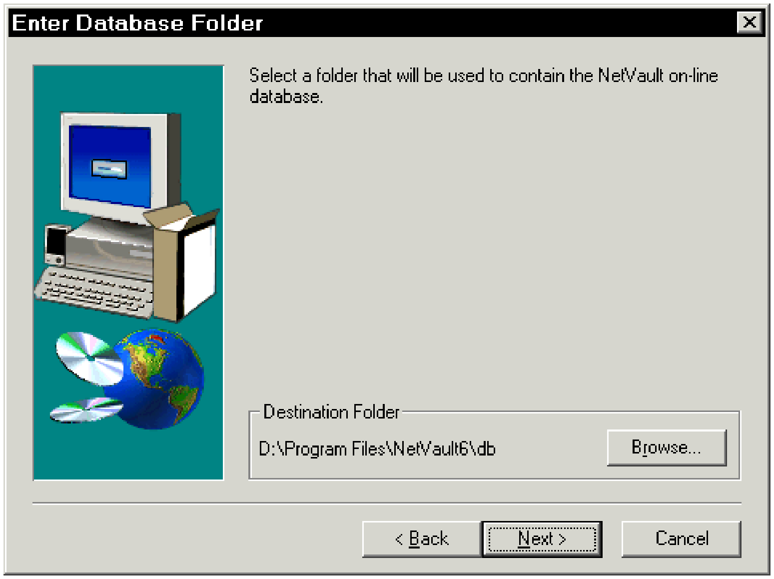


Figure 8-6 Database location

Next choose which type of NetVault installation you want (Figure 8-7). we select **NertVault Server System**.

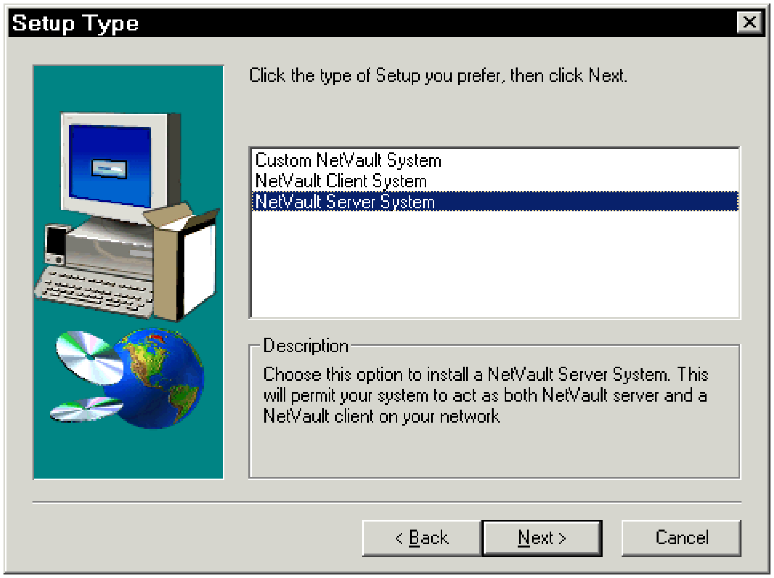


Figure 8-7 Setup type

In the next panel, (Figure 8-8) enter your machine name. We installed on a system called DIOMEDE.

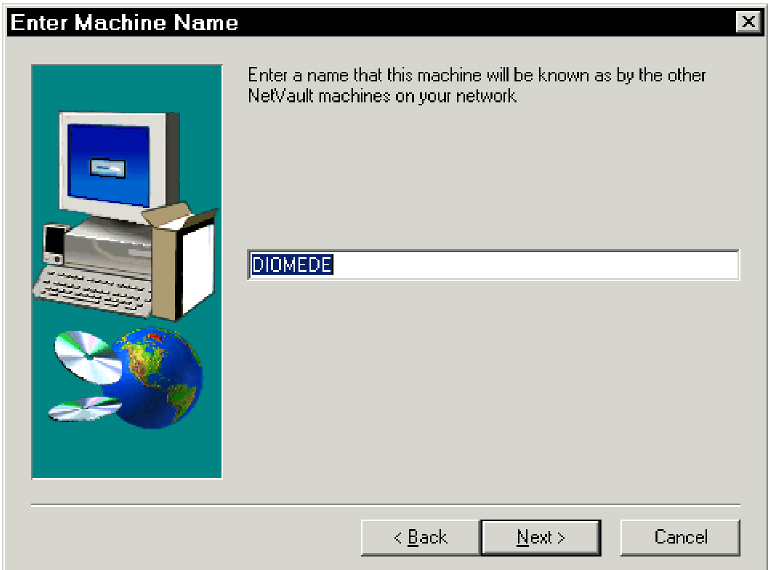


Figure 8-8 Enter machine name.

Next you will need to create a password for access to your NetVault domain (Figure 8-9).

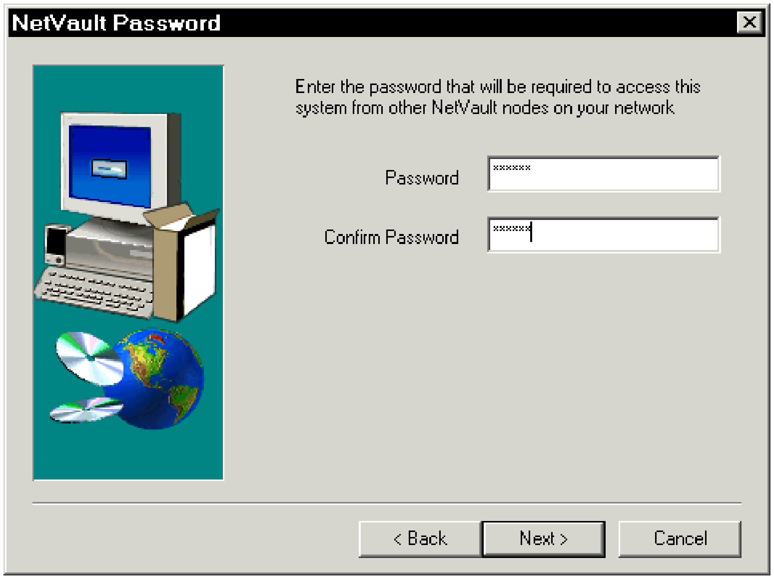


Figure 8-9 NetVault password

The installation now takes place. When it has finished you will be prompted to reboot the system to allow the NetVault service to start.

You can now configure your LTO device into NetVault as shown in 8.4, "Configuring NetVault" on page 356.

8.3 Installing NetVault on Linux

In this section we show the steps necessary to configure NetVault Version 6.03 on Linux with a 3583 library.

We used the following hardware (Figure 8-10):

- Intel server with Redhat Linux 7.1 Server (Redhat 7.1.2.96-79, kernel 2.4.2.2 UP)
- Adaptec 29160 LVD SCSI card
- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives.

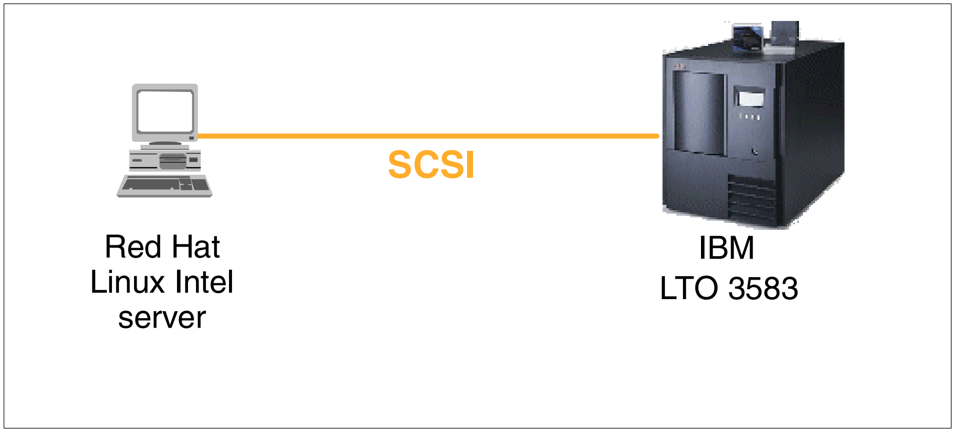


Figure 8-10 Linux lab environment

8.3.1 Installation preparation

The preparation for installing NetVault depends on whether your tape library is already installed.

Existing LTO installation

If your LTO drive was already installed on your server, check to see if the IBM drivers are being used. The IBM Ultrium drivers are not required for the NetVault software. If you have already installed these, disable them as described in 3.2.2, “Uninstalling the Ultrium device drivers and utilities” on page 151.

New LTO installation

If this is a brand new installation, first install the adapter card to Linux and load the drivers. This procedure is given in 3.1.2, "Identifying and activating the SCSI controller" on page 125. Shutdown the server, physically cable the tape library, and reboot the system. Check the configuration of the devices, using the procedures in 3.1.3, "Kernel compilation and installation checklist" on page 129 and following sections.

All LTO installations

Your drive and medium changer should now be available to the operating system.

8.3.2 Installing NetVault

The NetVault application code is available on CD-ROM or compressed tar package (Internet). We downloaded the image from the BakBone website which arrived as a compressed tar file. Uncompress the file, then unpack the tar image into a temporary directory in preparation for installation as shown in Example 8-1.

Example 8-1 Unpacking NetVault Image

```
[root@diomede tmp]# uncompress 6linux60_010220.tar
[root@diomede tmp]# tar -xvf 6linux60_010220.tar
NetVaultDistribution/
NetVaultDistribution/readme.txt
NetVaultDistribution/install
NetVaultDistribution/relnotes.txt
NetVaultDistribution/nvdist
[root@diomede tmp]#
```

Make sure to review the files readme.txt and relnotes.txt before installing. These files contain up to date information about the product and installation issues.

Change directory to NetVaultDistribution and execute **./install**.

Example 8-2 Installing NetVault

```
[root@diomede tmp]# cd NetVaultDistribution
[root@diomede NetVaultDistribution]# ./install


       NetVault 6 - Release V603_R010220
          (C) 1998-2000 NetVault Ltd

       Unix Installation/Removal Utility


Shutting down NetVault services...
```

Accept the license agreement.

Example 8-3 License Agreement

```
   1539749 v2


   Do you accept all the terms of the preceding license agreement
   If you choose No this setup will close. To install NetVault you must
   accept this agreement

   Press y to accept, n otherwise (y/n)y
```

You will be prompted to enter an installation directory, NetVault database location, preferred installation type (server, client, custom), server components, host name and password. We accepted the defaults for the directory - however you should consult the NetVault documentation for guidance on sizing the database to help decide where to locate it. We select a server type installation and all components.

Example 8-4 Server configuration

```
This program will install NetVault 6 V603_R010220
Are you sure you want to continue? (y/n): y

Please enter the path where you would like the NetVault directory
to be created (The NetVault database directory will be specified separately)
Installation Directory ('/usr'):

Please enter the path for the NetVault database directory
Database Directory: (/usr/NetVault6/nvdb):

Please select the type of installation to perform:
1) Server
```

```
2) Client
3) Custom

Please select (1-3): 3

Available Components:

1) Data Plugin files
2) Device control files
3) GUI files
4) Online help files
5) Server files

Please select components to install, separated by commas, eg 1,2,5:
1,2,3,4,5

You have chosen to install:
- Data Plugin files
- Device control files
- GUI files
- Online help files
- Server files
Is this correct? (y/n): y

Enter a name that this machine will be known as by the other NetVault
machines on your network
NetVault Machine Name ('diomede.almaden.ibm.com'):

Enter the password that will be required to access this system from
other NetVault nodes on your network
Password:
Confirm Password:
```

The installation now completes using the options entered.

Example 8-5 Software installation

```
Please wait while the software is installed...
Copying 'Core files': copied
Copying 'Data Plugin files': copied
Copying 'Device control files': copied
Copying 'GUI files': copied
Copying 'Online help files': copied
Copying 'Server files': copied
Creating symbolic links: done
Successfully installed '/usr/NetVault6/packages/con1110.npk'
Successfully installed '/usr/NetVault6/packages/cpy1110.npk'
Successfully installed '/usr/NetVault6/packages/nvd1210.npk'
Successfully installed '/usr/NetVault6/packages/nvf1610.npk'
```

```
Successfully installed '/usr/NetVault6/packages/raw1410.npk'
\Key installed: 'TRUE'
Will link to '/usr/NetVault6/etc/startup.sh'
Installed NetVault services
Restarting NetVault services... ok
Installation completed successfully.
[root@diomede NetVaultDistribution]#
```

After successfully completing the installation, the product is ready to be configured and started.

8.4 Configuring NetVault

In this section we will describe how to configure the 3583 library. Other LTO models use a similar configuration method - refer to the *NetVault Administrator's Guide* for general operational information.

There are very few differences in the NetVault configuration between Linux and Windows 2000. These will be highlighted where necessary.

The NetVault Configurator needs to be executed initially to verify the base NetVault configuration.

In Windows 2000, use exists under **Start -> Programs -> NetVault6** to start the NetVault Configurator.

In Linux, the NetVault configurator is started from the command line in Linux and requires a running X display. The command line is:

```
/usr/NetVault6/bin/nvconfigurator
```

You wil see the panel in Figure 8-11.

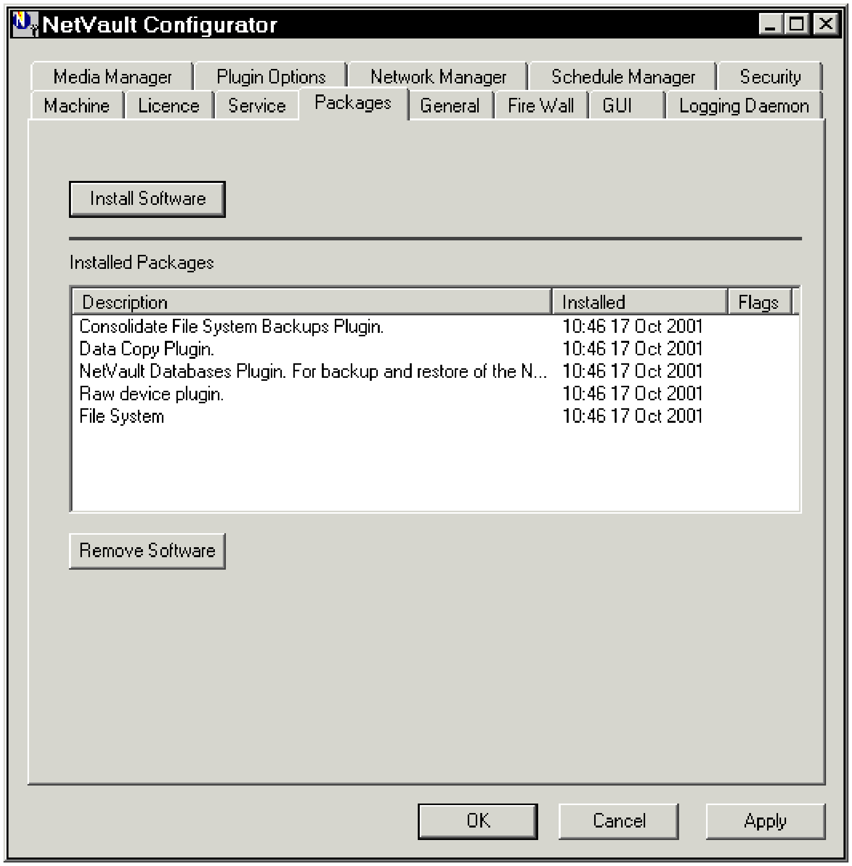


Figure 8-11 NetVault Configurator

We did not need to make any changes to any of the fields in the configurator however we did download the latest patch from the BakBone website. This patch included the lastest library/device support and was distributed as a zip file which we unpacked into a temporary directory.

To load the patch, hit the **Install Software** button. Figure 8-12 shows the beginning of the installation program.

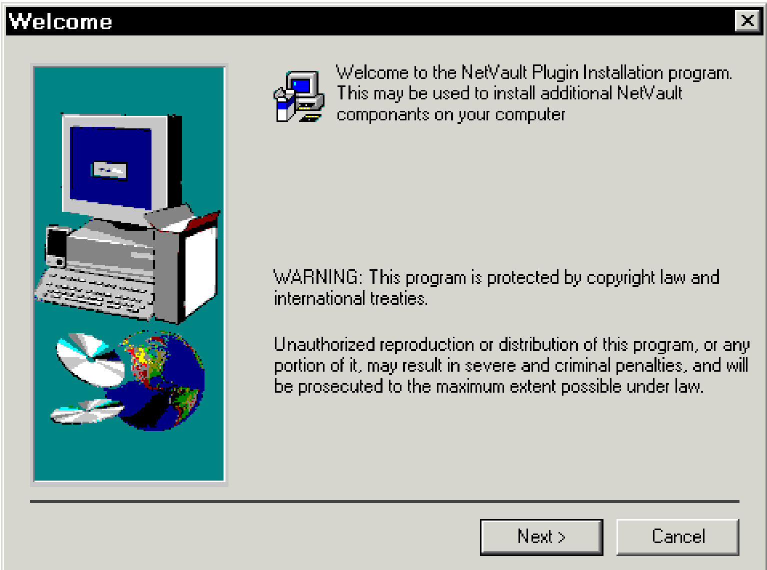


Figure 8-12 Update/Plugin Installation ProgramFigure 8-12

Enter the filename of the downloaded patch file as in Figure 8-13.

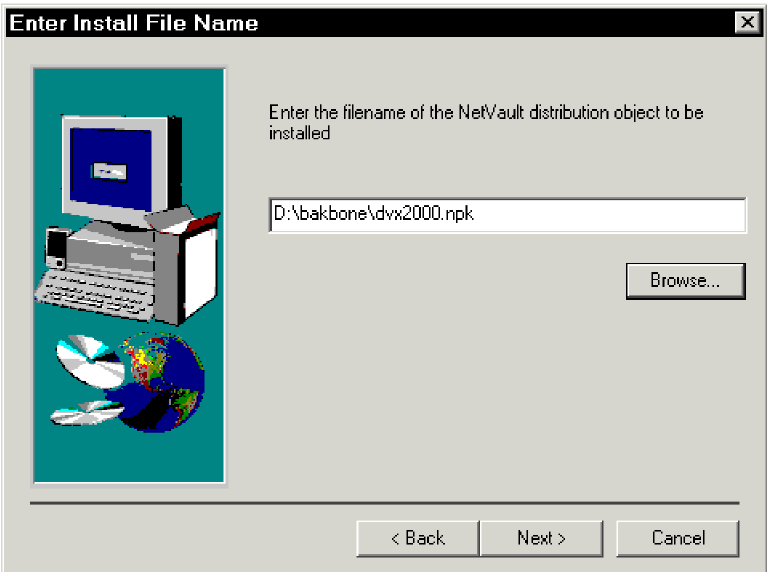


Figure 8-13 Enter Install Filename

The patch will be identified before installation as in Figure 8-14. Click **Next** to install the patch.

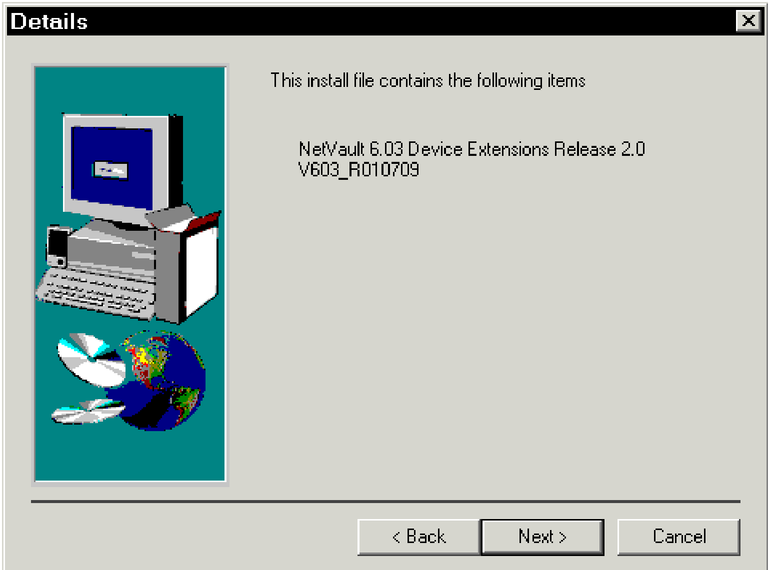


Figure 8-14 Software Identification Window

8.4.1 Configuring the 3583 library

The library now needs to be identified to the NetVault server. For Windows, start the NetVault GUI via **Start -> Programs -> NetVault6 -> NetVault**. For Linux, run the command **`/usr/NetVault6/bin/nvgui`**. You will see the main administration panel for NetVault (Figure 8-15).

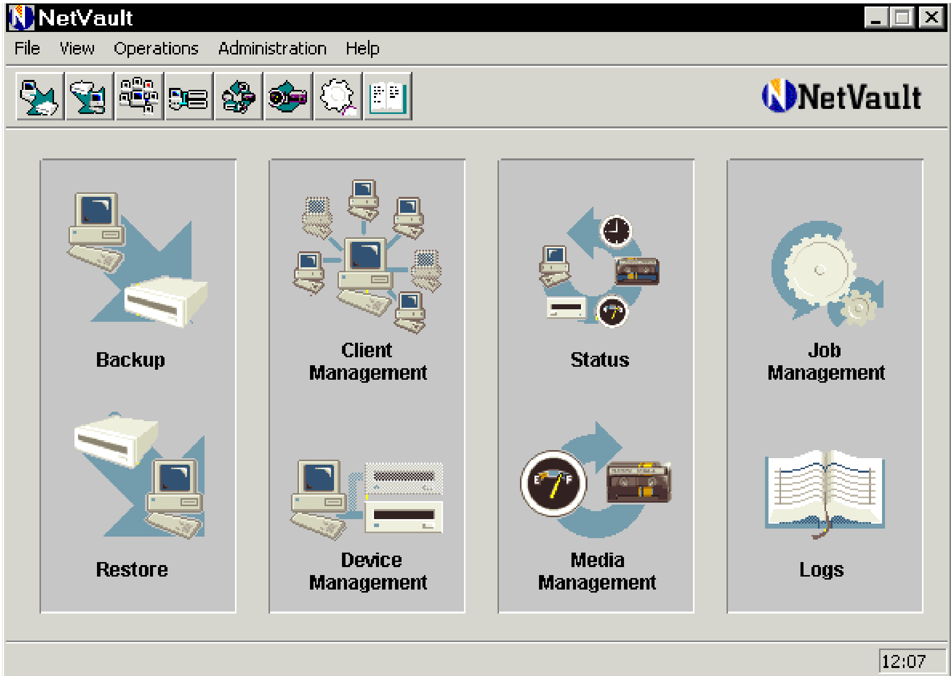


Figure 8-15 Primay NetVault interface(NetVault GUI)

Select the Device Management icon to open up the display in Figure 8-16. The panel is empty because we have not configured any devices yet. Select **Add** then **Add Library** from the pulldown menu.

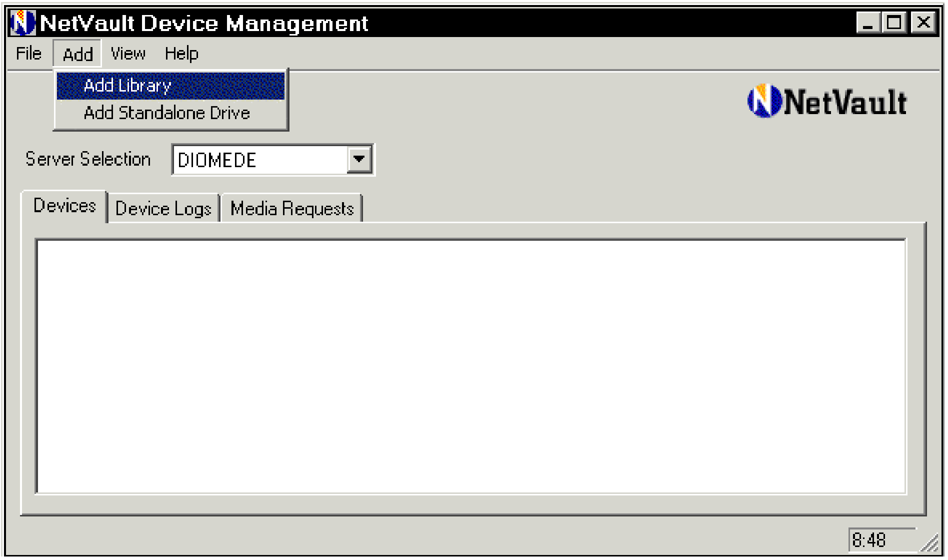


Figure 8-16 Device Management

The Device Management window will now be started (Figure 8-17) with a list of all the discovered servers and clients. The servers and clients listed are those machines that are running the NetVault service. They will be listed as candidate machines which could potentially have a library.

Select the server or client with the library to be added (DIOMEDE in our case), then right mouse click and select **Open**.

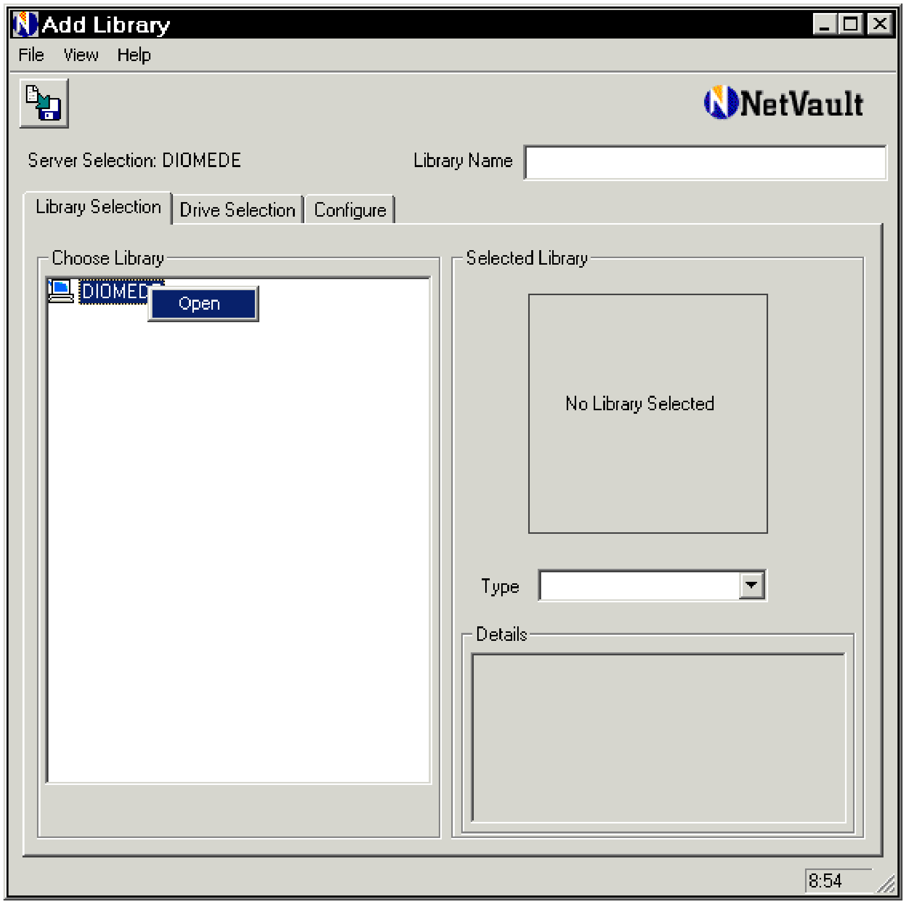


Figure 8-17 Select library server

The panel will then display any candidate libraries the server has detected (Figure 8-18). We can see that the 3583 displays as a Robotic Library but is as yet unrecognized by the NetVault application. Now we need to select the compatible NetVault device. Right mouse click on the library device and select it.

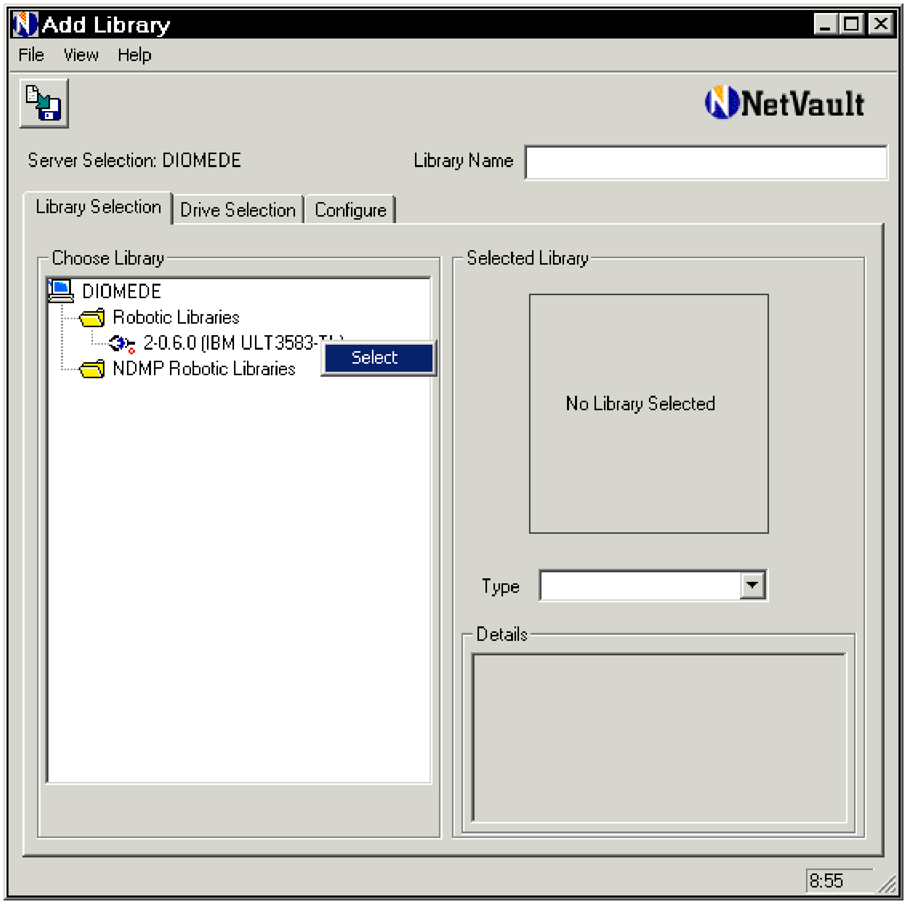


Figure 8-18 Selecting the library device

The NetVault application will now determine if the device exists as a supported library and will display a picture and type name for the device. Note the picture of the 3583 as shown in Figure 8-19.

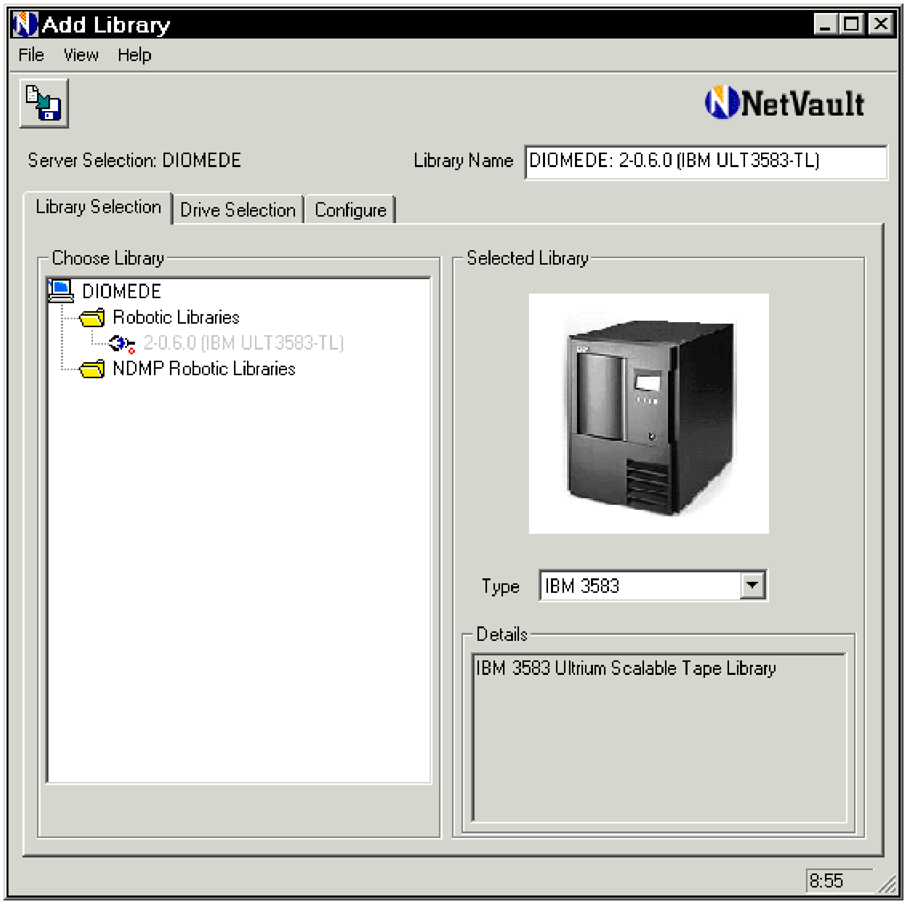


Figure 8-19 Displaying library device

Ensure that the correct library device type is selected. We will now configure the appropriate tape devices. Select the **Drive Selection** tab (Figure 8-20).

You will notice that the library name is displayed in the Library Name field and two tape drive bays are already determined to exist in the library (in the Selected Drives panel). We will now identify these two tape drives. Right mouse click on the server name and select **Open**.

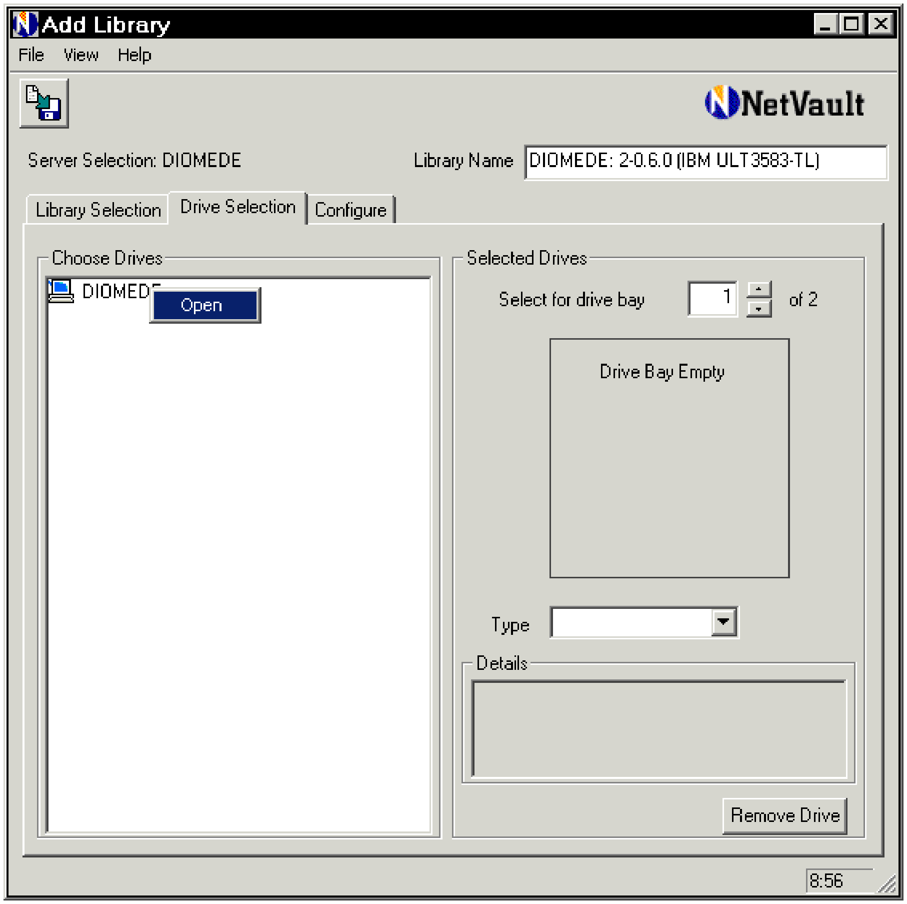


Figure 8-20 Selecting library devices

The library entry will now be displayed with two unknown tape devices, indicated by the fact that no photo appears (Figure 8-21). Right click on the first tape device and pick **Select**.

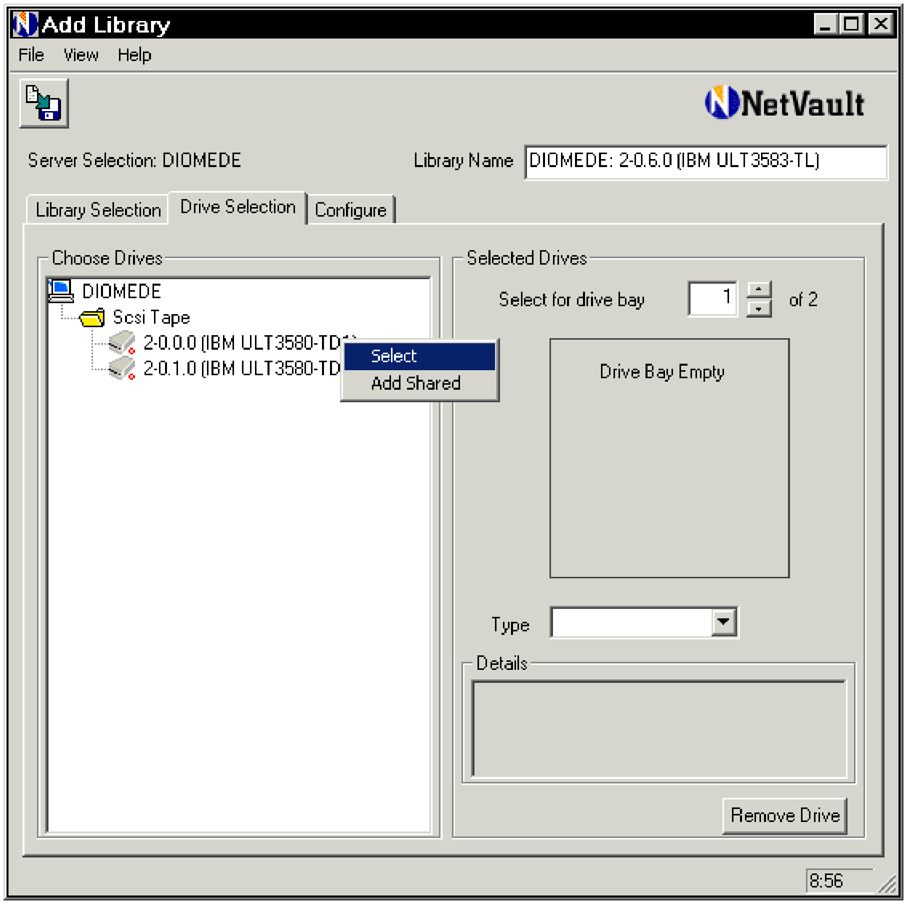


Figure 8-21 Selecting first device

The NetVault application will now determine if the device exists as a supported tape device and will display a picture and type name for the device (Figure 8-22).

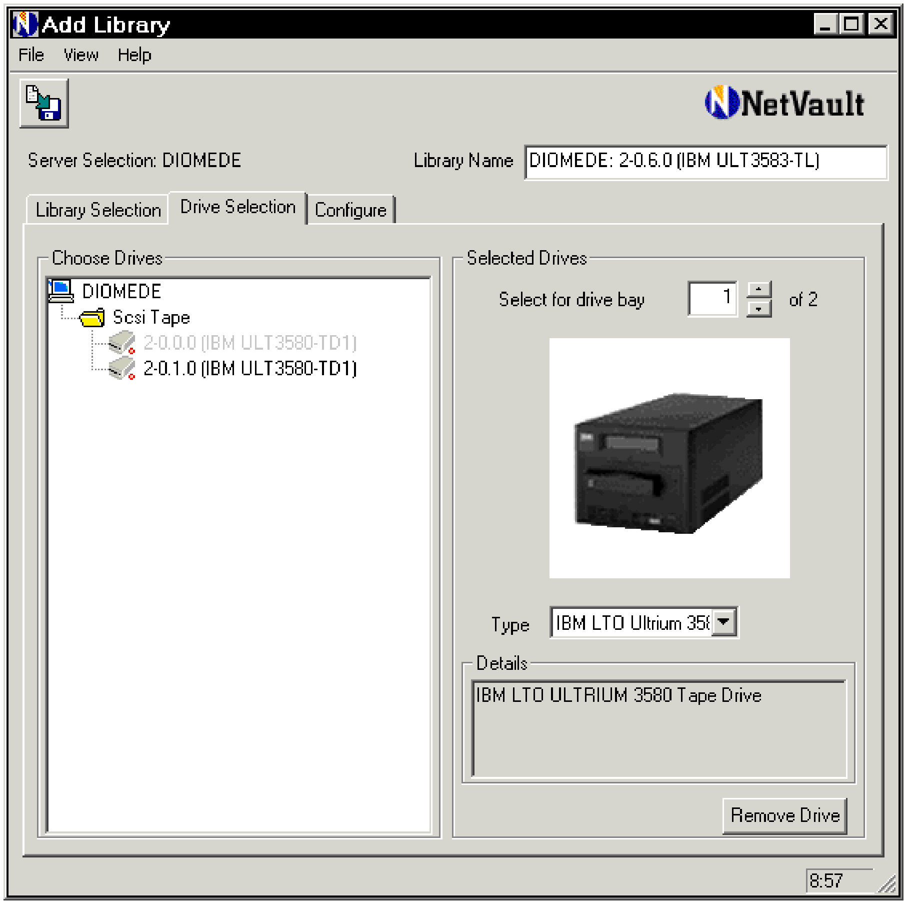


Figure 8-22 Identifying the tape device

If the drive is correctly identified and displayed, (3580 in our case), select the second device for identification. To do this, increment the *Select for drive bay* counter on the right hand side.

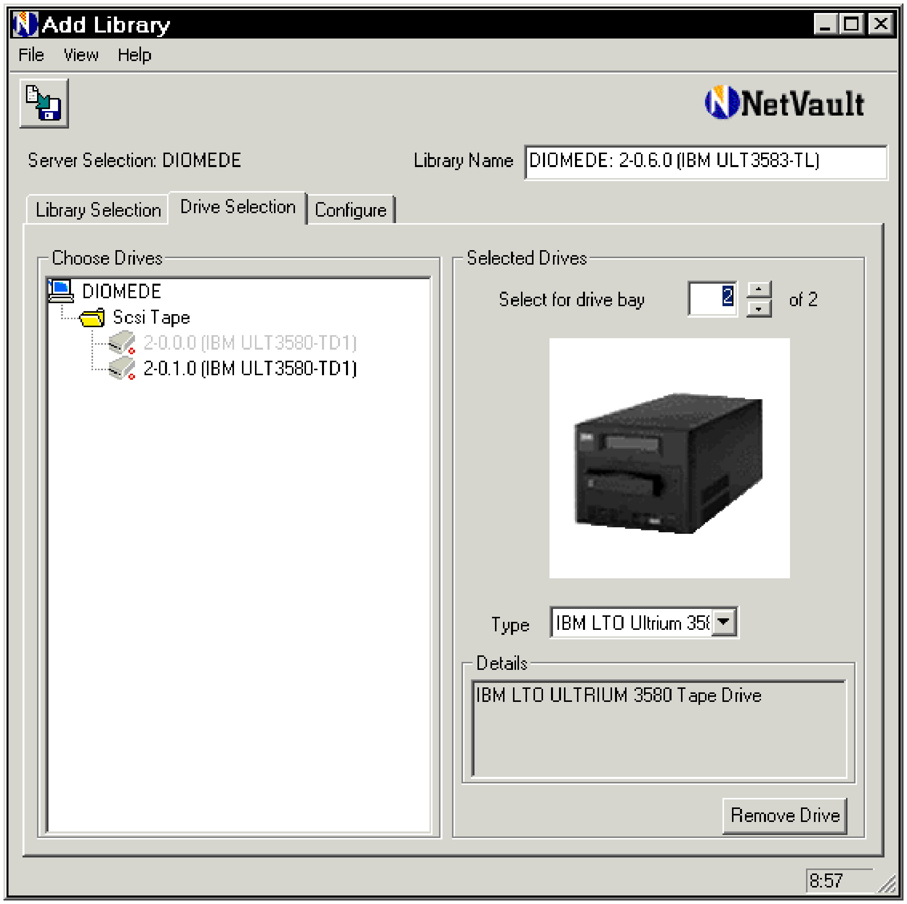


Figure 8-23 Selecting another drive bay

Identify the second drive using the same select process.

We will now verify selections by selecting the **Configure** tab. Note that the library and drives now show up as configured devices. If the listing is correct, save the configuration and make it available to NetVault by clicking the **Save** icon in the top left hand corner (Figure 8-24)

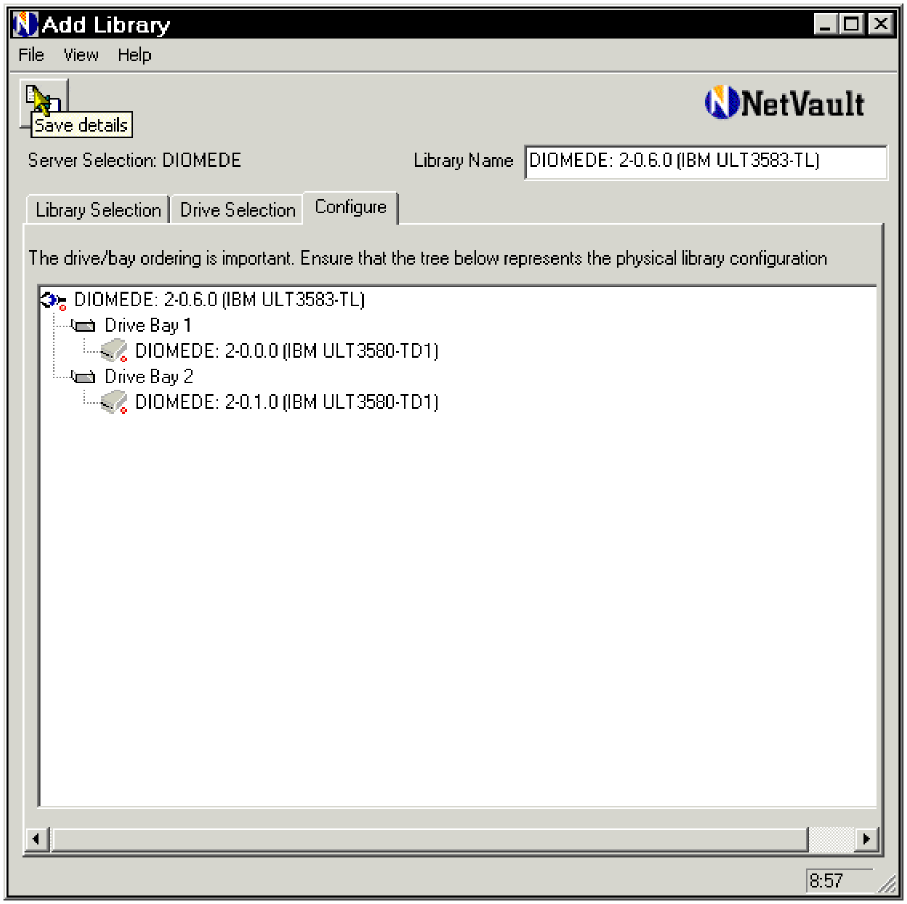


Figure 8-24 Verify library and tape selections

Figure 8-25 shows the configuration has been successful and the library is now available to NetVault.

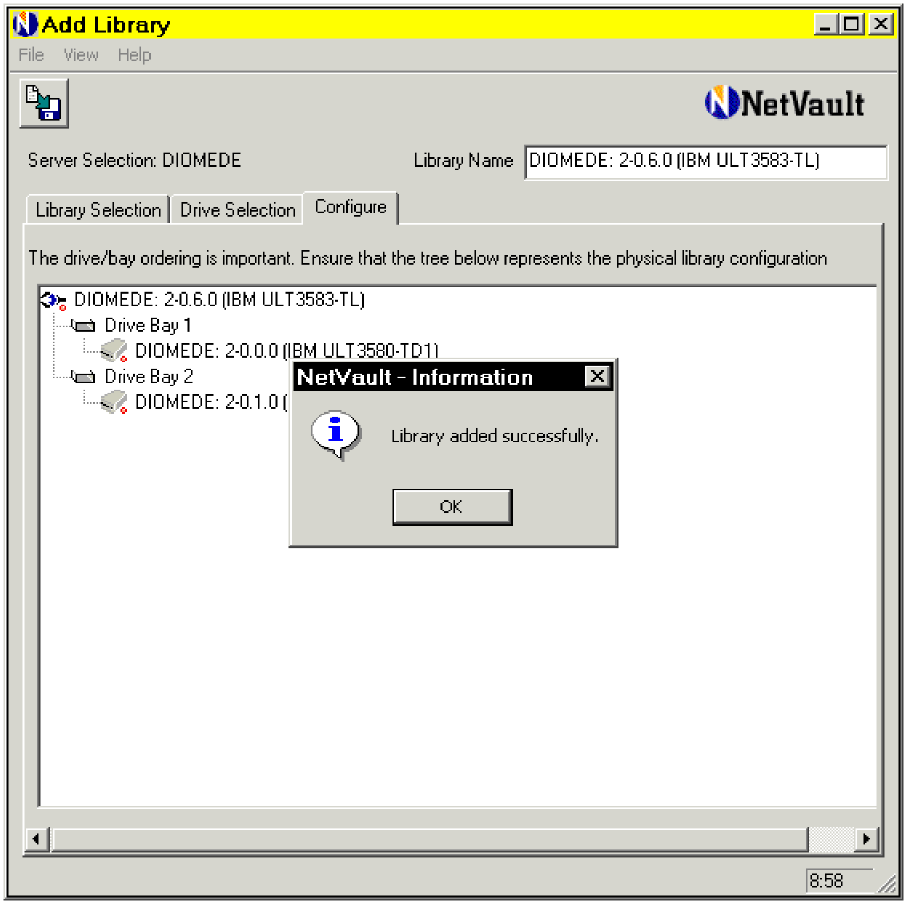


Figure 8-25 Completion of library addition

Now that the library is available, NetVault determines the status of the library and discovers the media. The results are displayed back in the **Device Management** window (Figure 8-26). We can see that cartridges have been detected, including their barcode labels in slots 2 and 7.

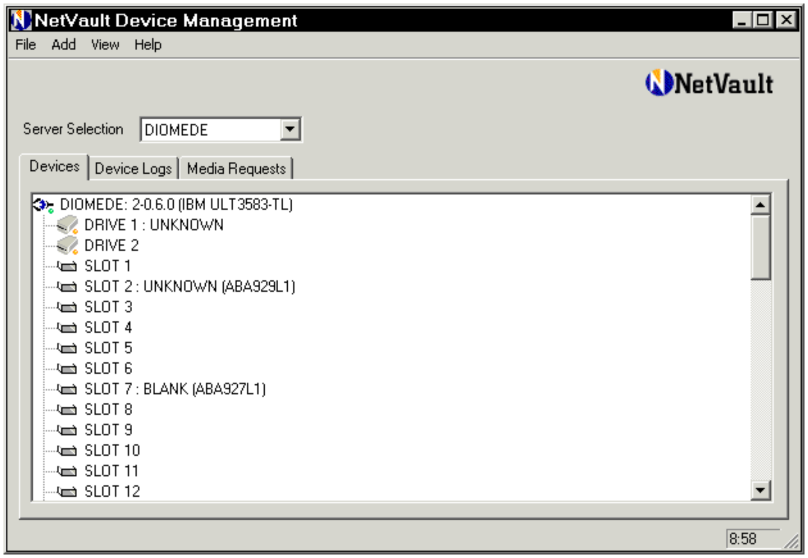


Figure 8-26 Library Status

This ends the NetVault installation. You can now use the library for client backups. Refer to the NetVault documentation for information on how to set up clients.

8.5 NetVault NDMP plugin

The NetVault application includes support for the NDMP protocol. The NDMP protocol provides to Network Attached Storage (NAS) devices a mechanism for backing up and restoring data. By using an open network protocol (TCP/IP) and providing a well documented API, this has allowed backup vendors to implement NDMP solutions for NAS devices. NDMP uses a client/server model to access library and tape devices managed by backup applications. The NAS device acts as an NDMP server, whilst the backup vendor provides an NDMP client plugin.

For the NetVault application, a NAS device is managed as a client allowing the NAS device to acess NetVault managed drives and libraries both locally and remotely.

8.5.1 Installation of NDMP Client

We used the following hardware (Figure 8-27):

- Pentium server running Linux 7.1, kernel 2.4 with BakBone NetVault V6.03 installed
- QLogic 2200F FC HBA
- Brocade SilkWorm Fibre Channel switch
- NetApps F760 filer running ONTAP 6.0.1R3/NDMP V3
- IBM 3584 library with two Fibre Channel 3580 drives.

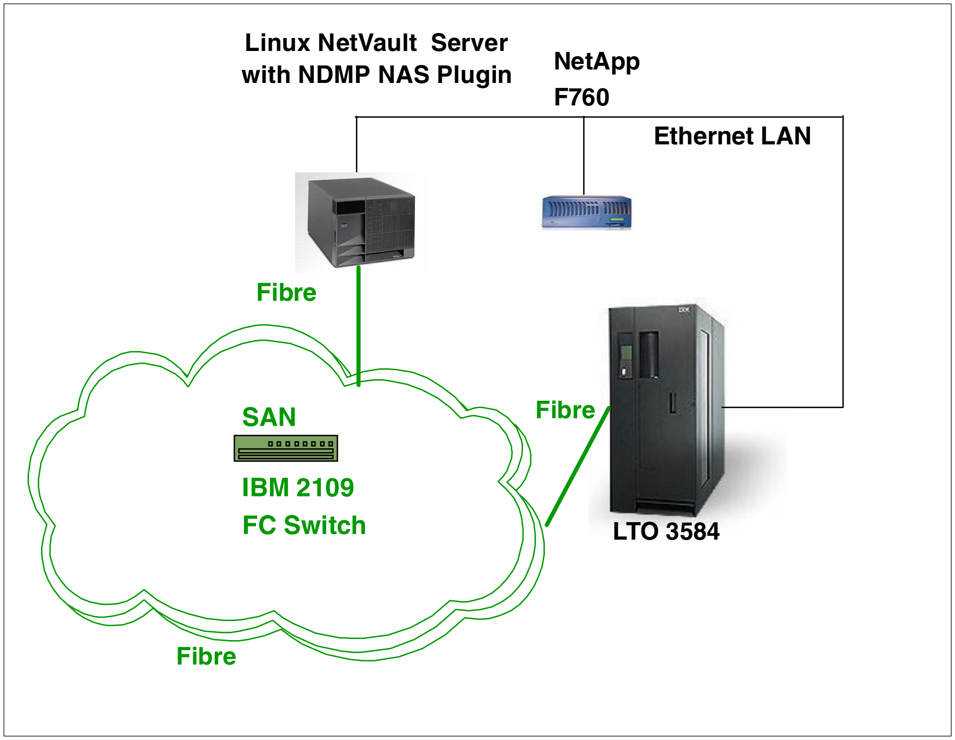


Figure 8-27 SAN lab environment

The first step is to see if the NDMP plugin is installed on the library server (the Pentium system with hostname X342). Select **Client Management** from the Management Console (shown in Figure 8-15 on page 360.

The **Client Management** screen (Figure 8-28) displays the managed clients (on the left hand side) and other machines available to become clients (on the right hand side). Right mouse click on the desired client (X342) and select **Properties**.

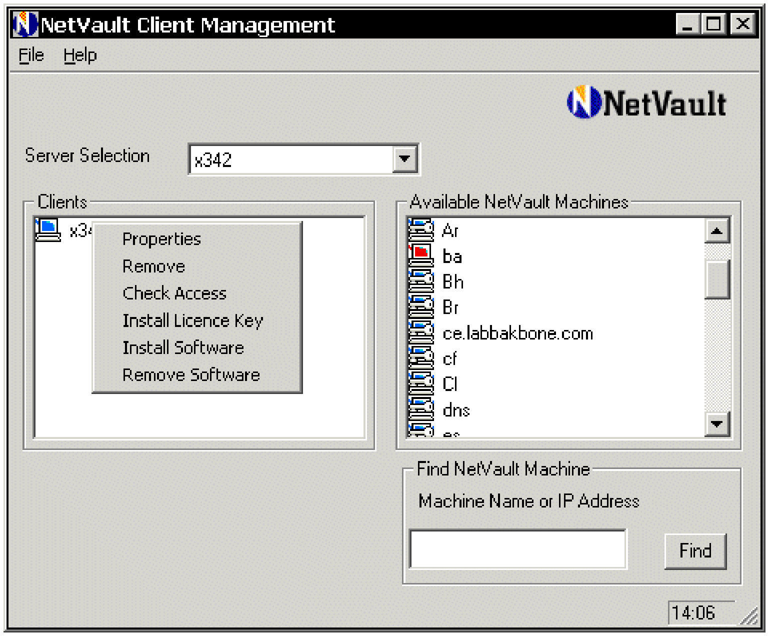


Figure 8-28 Client Management

Figure 8-29 shows that the NDMP Client Plugin has already been installed. If it not, then return to the Client Management screen and select **Install Software**.

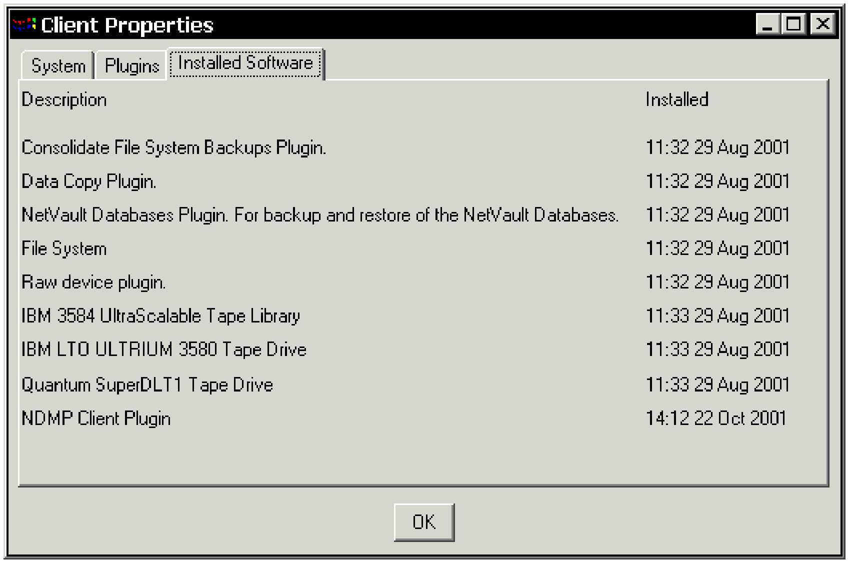


Figure 8-29 Client Properties

We can now identify the NetApp filer to the NDMP client and commence doing backups.

From the NetVault main window (Figure 8-15 on page 360), select **Backup**. The list of managed clients and servers displays as in Figure 8-30.

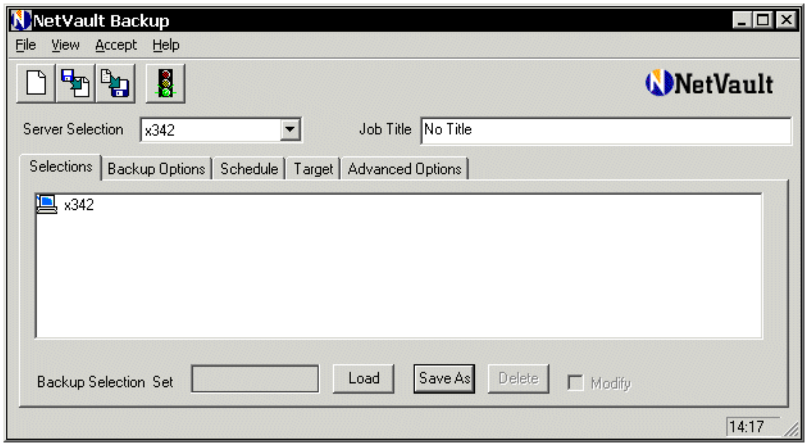


Figure 8-30 NetVault Backup

Double-click on the x342 NetVault server and the backup properties will be displayed (Figure 8-31).

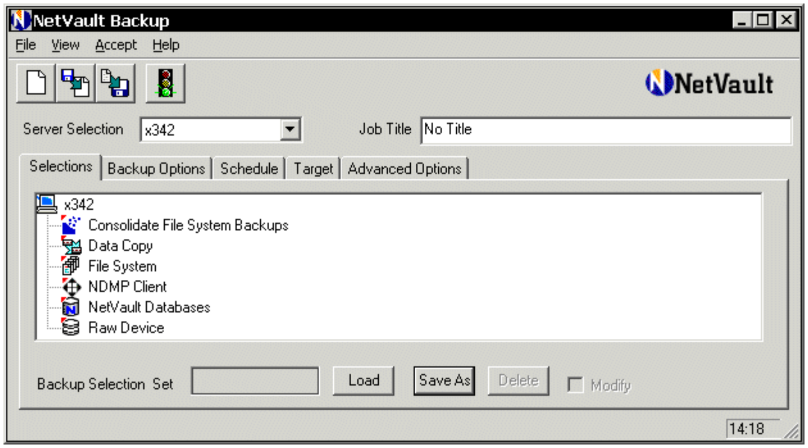


Figure 8-31 Display backup properties

Double-click on the NDMP Client entry to display the NDMP Server configuration screen (Figure 8-32). Add the appropriate details for your NetApp filer. For the **Name** field, choose an arbitrary name for your NDMP system (for example, the hostname). Enter the TCP/IP address in the **Address** field. You should leave the **Port** at the default 10000 and enter in a user ID and password which is valid on the box. The other fields can be left at the defaults.

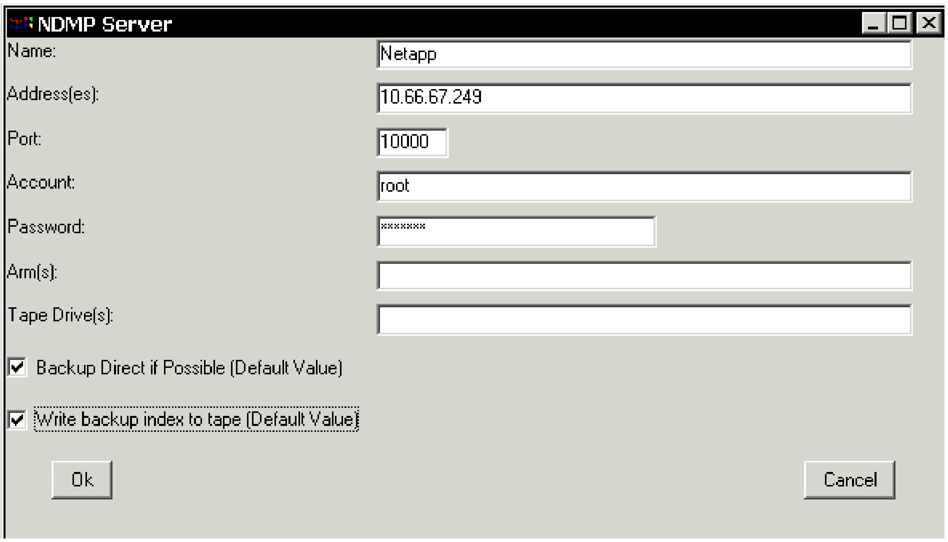


Figure 8-32 Configuring NDMP Server

After configuring the NDMP server, it will now be displayed under the NDMP client entry Figure 8-33).

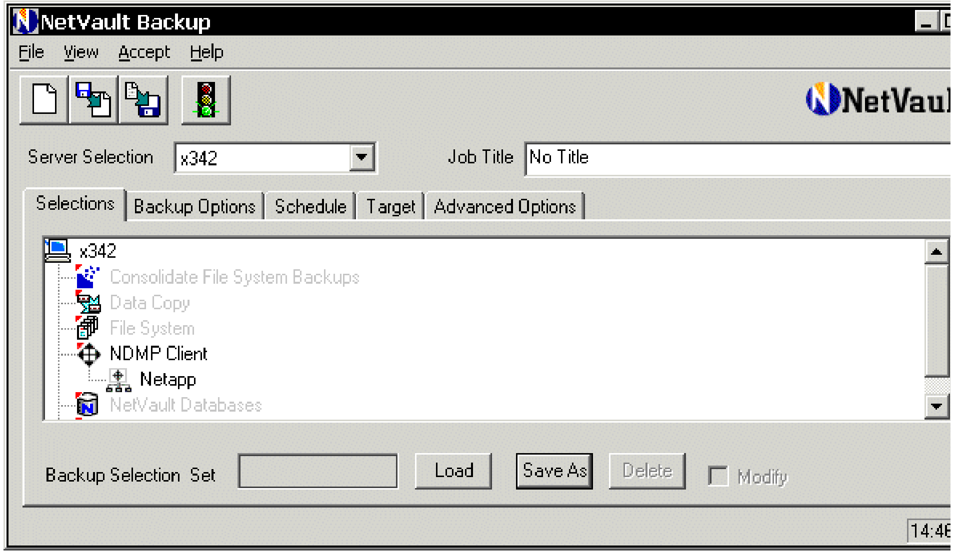


Figure 8-33 NetVault NDMP client

The NDMP server NetApp has now been added and client backups and restores can be tested. To run a test backup, double-click on the NDMP Client (Netapp). This displays the NDMP Backup Request screen as shown in Figure 8-34. Enter the volume to be backed up, the dumplevel (0 in our example as we are taking a full backup) and accept the default Data Block Size of 64Kb. All the other fields can use the default values. Click the **OK** button then submit the job by clicking on the traffic light icon in Figure 8-33.

Figure 8-34 NDMP backup request

The data will now be backed up to a specified backup device using BakBone.

9

Configuring CA BrightStor ARCserve on Windows 2000

This chapter describes the steps necessary to configure BrightStor ARCserve 2000 from Computer Associates International on Windows 2000 using an LTO library.

9.1 BrightStor ARCserve 2000 by Computer Associates

BrightStor ARCserve 2000 from Computer Associates comes with support for a variety of server platforms. We will be showing the steps to configure an IBM 3583 Ultrium library for use with Windows 2000.

BrightStor ARCserve 2000 provides native support for Windows. Its advanced features provide centralized management, assured virus-free backup/restore, SAN severless backup and integrated fail-over with Microsoft Cluster Services. An extensive set of options and agents complement and extend the world-class backup/restore and management capabilities of BrightStor ARCserve 2000 to deliver complete data protection across organizations of all sizes

BrightStor ARCserve 2000 provides data and storage availability, scalability, interoperability, high performance and superior management features to comprehensively address the challenges faced by today's dynamic eBusinesses. An extensive set of options and agents extends data protection throughout the enterprise, and delivers enhanced functionality including online backup of applications and data files, advanced device and media management, fast and seamless disaster recovery and support for Fibre Channel Storage Area Networks (SANS).

For more information on BrightStor ARCserve 2000, see their website

`http://www.ca.com`

9.2 Installing BrightStor ARCserve 2000

We tested for both direct SCSI and SAN connectivity.

For the SAN environment we used the following hardware, shown in Figure 9-1:

- Intel server with Windows 2000 Advanced Server (build 2195).
- Emulex LP8000 FC HBA
- IBM 2109 Fibre Channel switch
- IBM 2108 SAN Data Gateway (SDG)
- IBM 3583 library SCSI/SDG attachment. A single SCSI bus supported both the library controller and the two 3580 tape drives.
- BrightStor ARCserve 2000 version 7.0, build level 1050, Advanced Edition server with Tape Library option

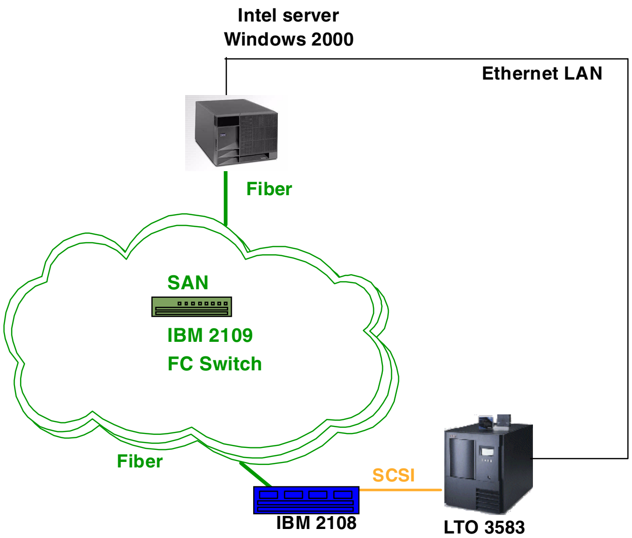


Figure 9-1 Windows 2000 SAN lab

For the direct SCSI environment we used the following hardware, shown in Figure 9-2:

- Intel server with Windows 2000 Advanced Server (build 2195).
- Adaptec 29160 LVD SCSI card
- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives.
- BrightStor ARCserve 2000 version 7.0, build level 1050, Advanced Edition server with Tape Library option

Figure 9-2 Windows 2000 SCSI lab

9.2.1 Installation preparation

The preparation for installing ARCserve 2000 depends on whether your tape library is already installed.

Existing LTO installation

If your LTO drive was already installed on your server, check to see if the IBM drivers are being used. The IBM Ultrium drivers are not required for ARCserve 2000. If you have already installed these, disable them as described in 2.2.6, “Deleting LTO devices” on page 60.

New LTO installation

If this is a brand new installation, first install the adapter card to Windows 2000 and load the drivers. This procedure is given in 2.2.2, “Installing the SCSI adapter” on page 30. Disable the RSM service if required as described in “Disabling RSM” on page 61. Shutdown the server, physically cable the tape library, and reboot the system.

All LTO installations

Your drive and libraries should now show up as unknown devices using the native Windows driver. Check in Windows Device Manager. The drives should appear similar to Figure 2-26 on page 44 and the changer, if present, as in Figure 2-18 on page 40.

9.2.2 Installing ARCserve

The installation process starts automatically when loading the product CD-ROM (Figure 9-3).

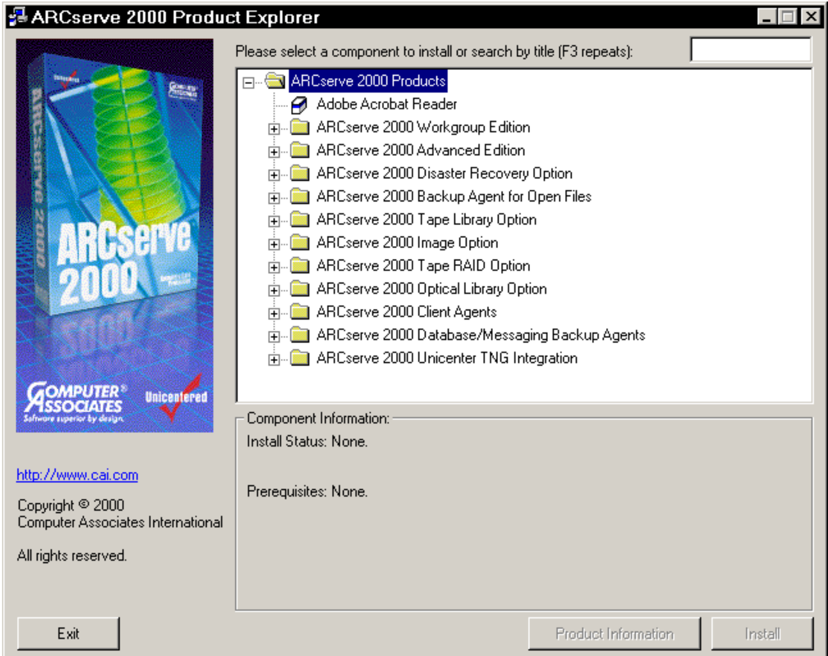


Figure 9-3 Main installation window

For the 3583 library attachment, we needed to install the ARCserve Advanced Edition and the ARCserve Tape Library Option. Expand the **Advanced Edition** tree and either select **Standard Setup** and then **Install** or right mouse click and select **Install** as shown in Figure 9-4.

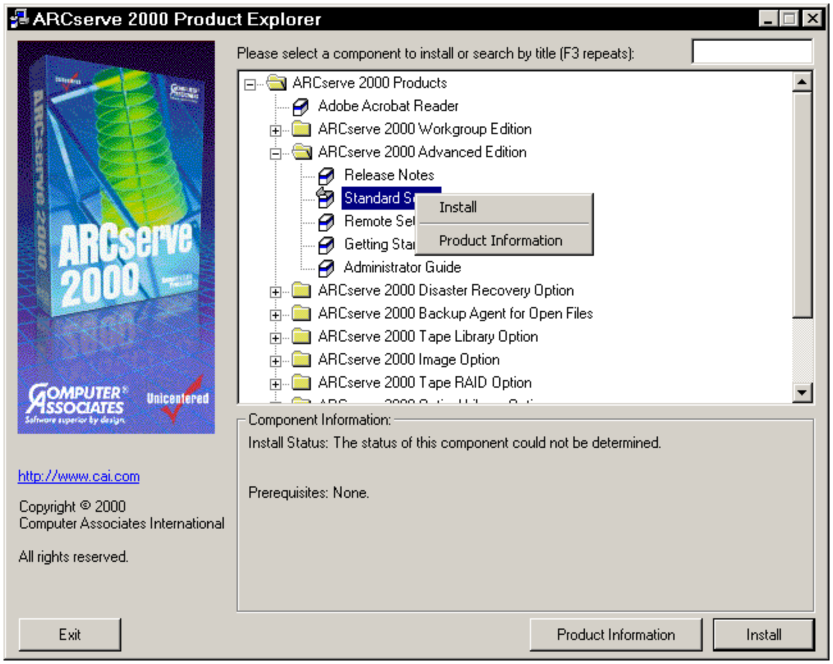


Figure 9-4 Advanced Edition install

Subsequent screens show a license agreement, and a customer information screen. Enter in a user name and our organization. Next, select the type of installation (Figure 9-5). We choose the Complete install.

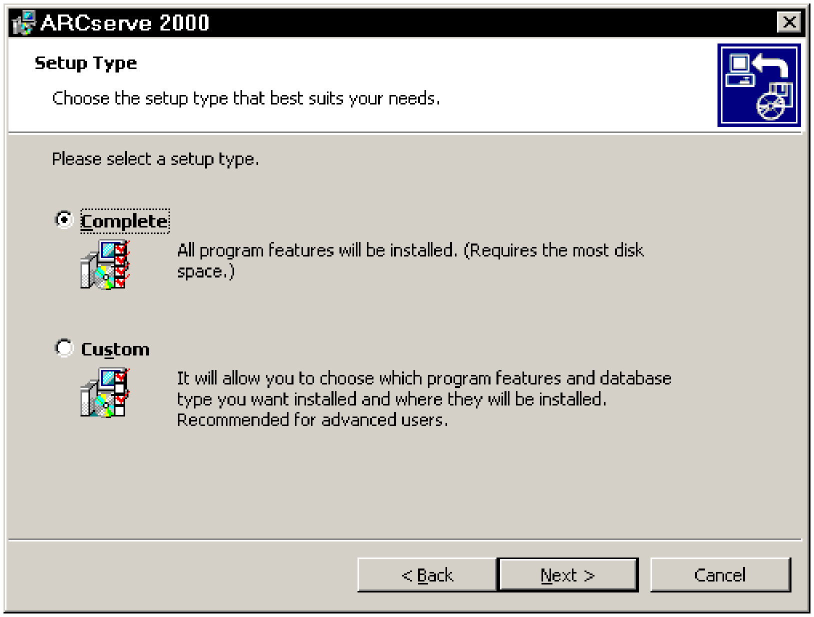


Figure 9-5 Setup Type

The production destination folder is now displayed as shown in Figure 9-6. We used the default values, but in real customer environments consideration should be given to the growth of the ARCserve database. Please consult the ARCserve manuals for guidelines.

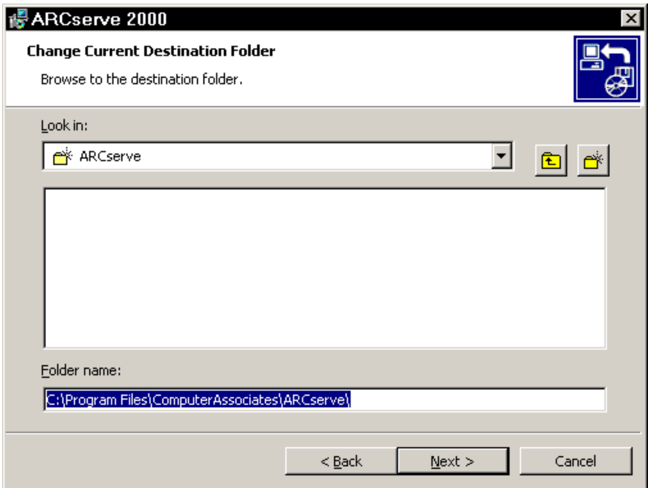


Figure 9-6 Destination folder

Figure 9-7 asks you to select the database product to manage the ARCserve data. The default is the standard included database, however you could also use Microsoft SQL Server if it is already installed.

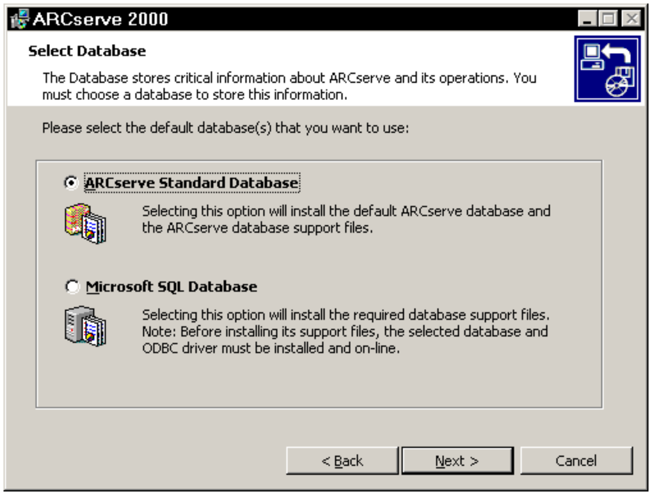


Figure 9-7 ARCserve database

The installation process now proceeds using the entered parameters. When it is complete, return to the main installation screen. Select the Tape Library Option as in Figure 9-8 and install.

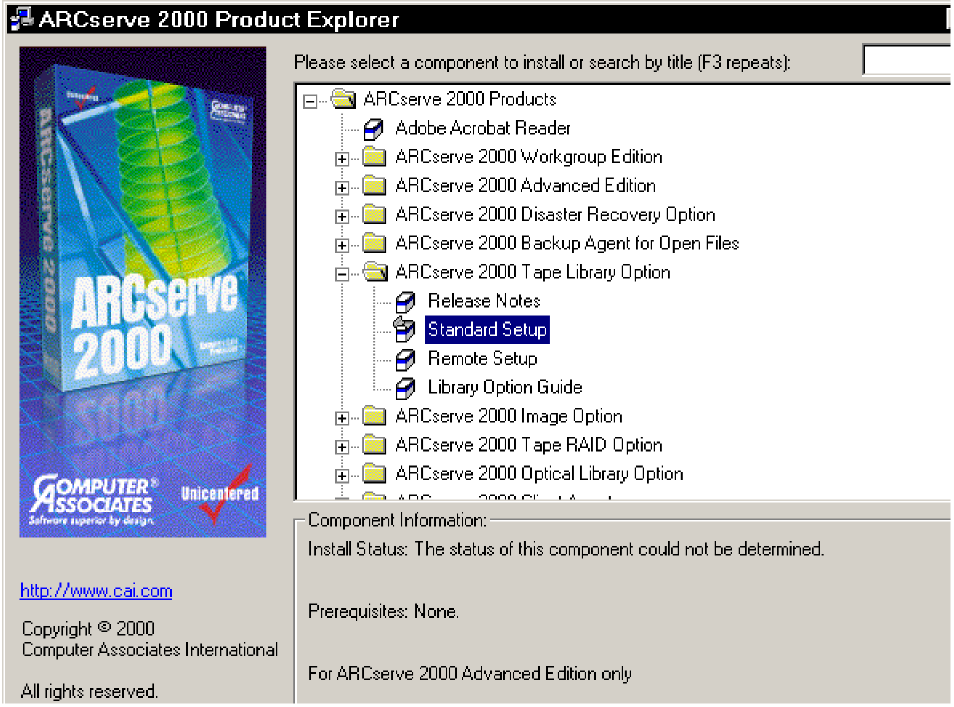


Figure 9-8 Tape Library Option installation

The Tape Library Option installation is similar to the Advanced Edition installation. You will see the license agreement, customer information and so on. At the installation conclusion, exit the Tape Library Option installation and the main installation window.

You will have received License Keys with your product CD-ROM. Run **Start -> Programs -> RegisterIT.** Click **Next** from the window in Figure 9-9.

Figure 9-9 RegisterIT Welcome

In the window, (Figure 9-10) we select **Register Later** and then **Next**.

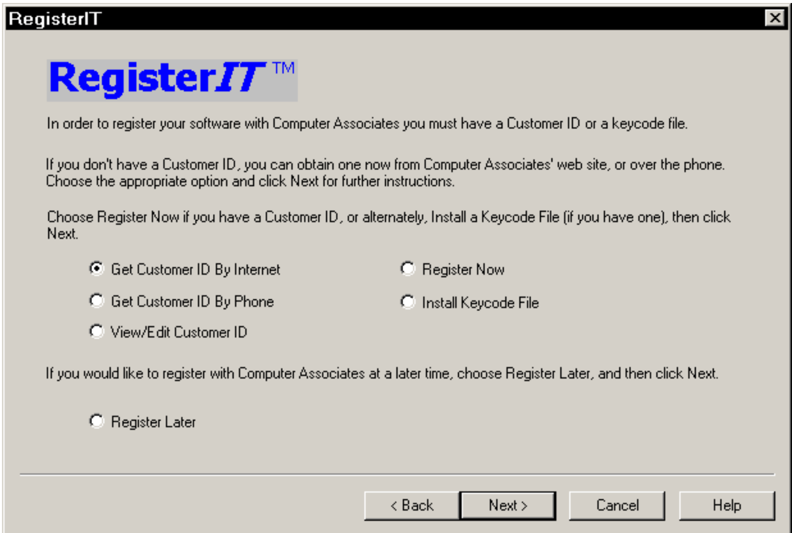


Figure 9-10 Registration

We now install the license keys for the two products we have installed.

From the screen shown in Figure 9-11, use the **Product Name** pulldown to get a list of products to be licensed and select ARCserve 2000 Advanced Edition.

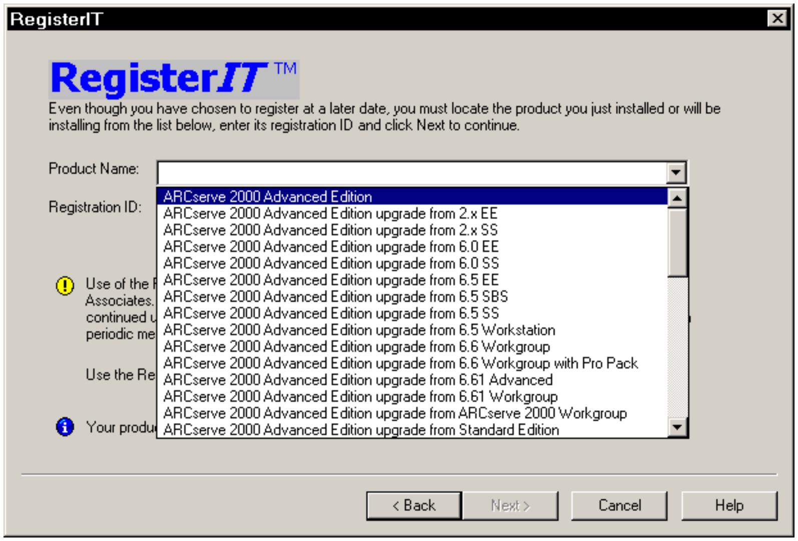


Figure 9-11 Registering Advanced Edition

Enter your license key in the **Registration ID** window and click **Next**. Log messages will display indicating success or failure as in Figure 9-12.

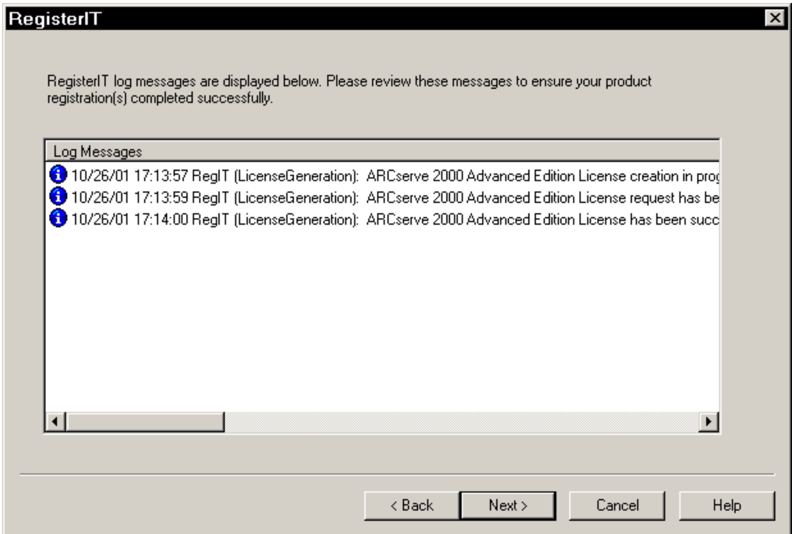


Figure 9-12 RegisterIT log messages

Use the **Back** button to go back and register the **Tape Library Option** in the same fashion. The log messages will once more indicate success or failure (Figure 9-13).

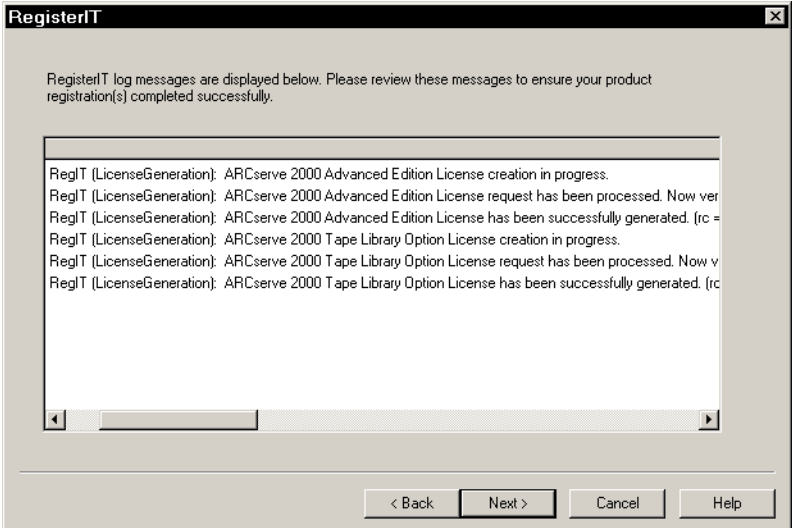


Figure 9-13 RegisterIT log messages

At this point we rebooted the server and connected the tape library. After rebooting the system, run **Start -> Programs -> ARCserve -> ARCserver Device Configuration**. You will see the window shown in Figure 9-14. Click **Next** to begin the configuration.

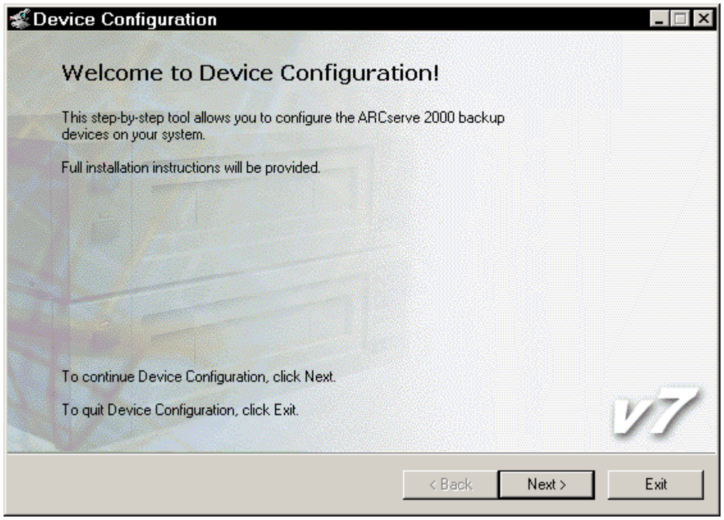


Figure 9-14 Initial Device Configuration

On the next screen, (Figure 9-15), select the ARCserve server to which the library will be attached. In our case, we were using the computer named CLYDE.

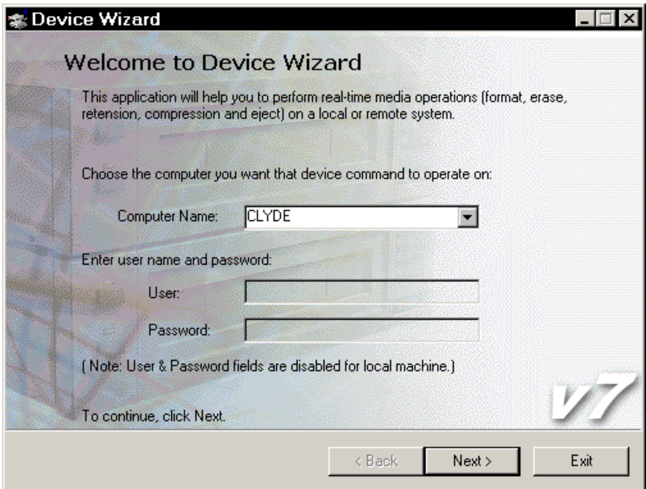


Figure 9-15 Server selection

The software detects the devices and lists them - including library and drives as shown in Figure 9-16. We can see that it has detected our 3583 library and 3580 drives. The tape drives need to be associated with library. Simply left click on the library in the left hand window, then left click on a tape drive in the right hand window and assign the drive to the library.

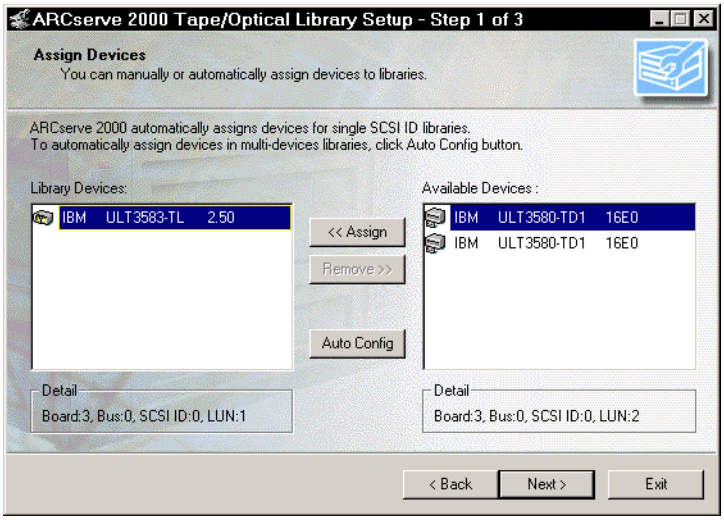


Figure 9-16 Manual library drive assignment

We had the option of manually assigning the drives to the library or we could allow ARCServe to automatically determine the assignment. We allowed ARCServe to automatically determine the assignment as below in Figure 9-17.

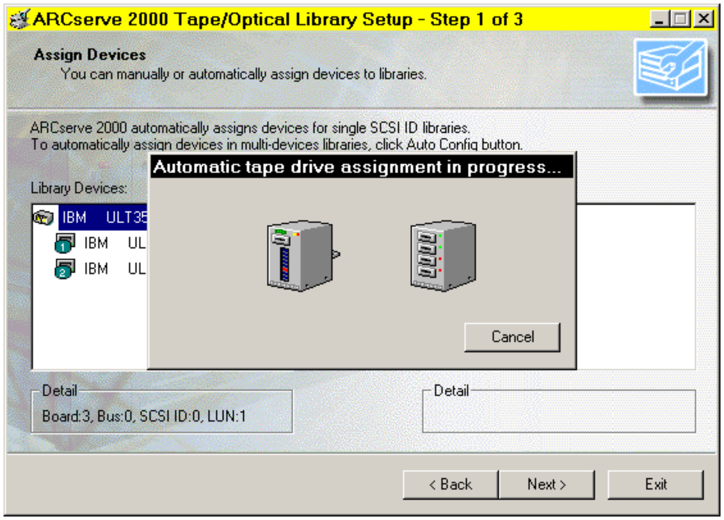


Figure 9-17 Automatic library drive assignment

Having assigned the drives to the library, move to the next screen (Figure 9-18) and assign a cleaning tape if desired.

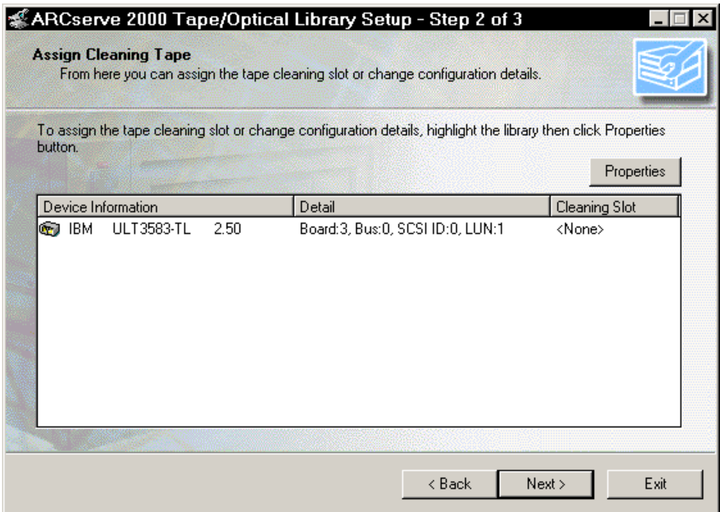


Figure 9-18 Cleaning Tape

Advanced library options can now be set for library initialization as in Figure 9-19. These options effect library startup times and drive availability. We accepted the default values.

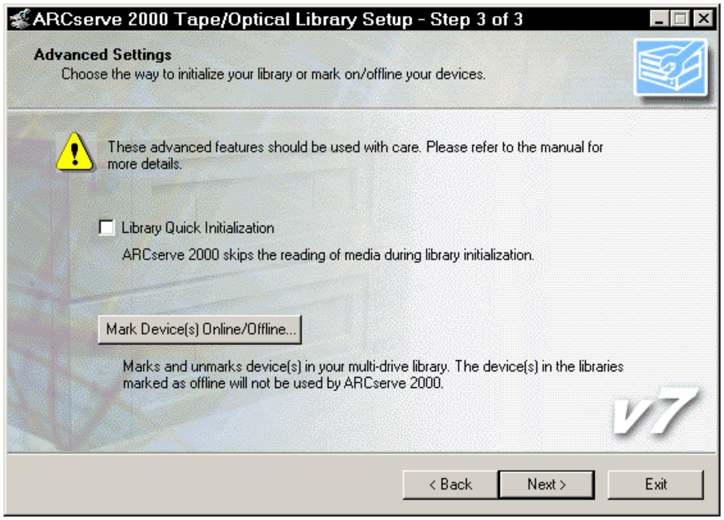


Figure 9-19 Advanced library options

The next screen (Figure 9-20) shows a device summary table for the library.

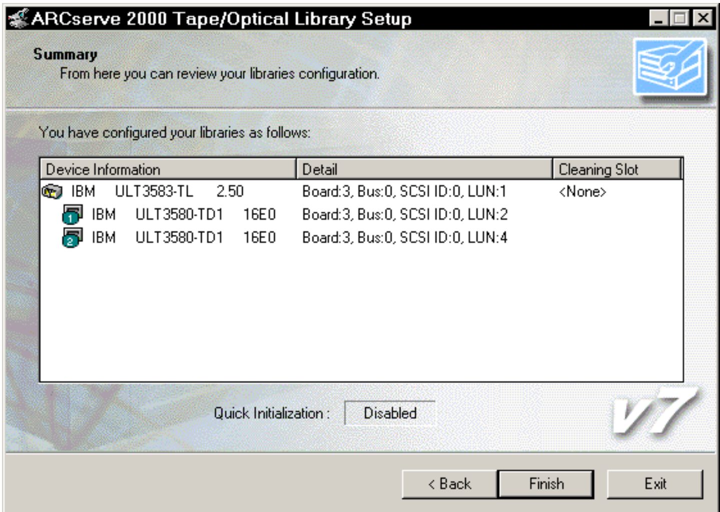


Figure 9-20 Device setup summary

The next screen (Figure 9-21) concludes the device configuration.

Figure 9-21 Configuration Completion

The Tape Engine now needs to be restarted to make the library available for use. Run **Start - > Programs -> ARCserve -> ARCserve Manager**. The main screen (Figure 9-22) displays.

Figure 9-22 ARCServe Manager

Select **Quick Access** (Figure 9-23).

Figure 9-23 Quick Access

There are three engines managed by Server Admin: the Job, Tape and Database engines. Click the **Server Admin** icon to display the screen shown in Figure 9-24.

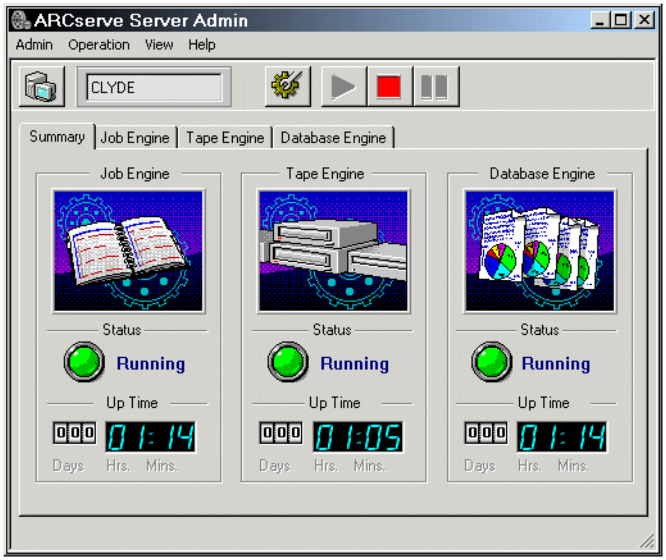


Figure 9-24 Server Admin engine management

The Tape Engine state is displayed (Figure 9-25). Select the tab for Tape Engine and hit the play symbol to start the engine.

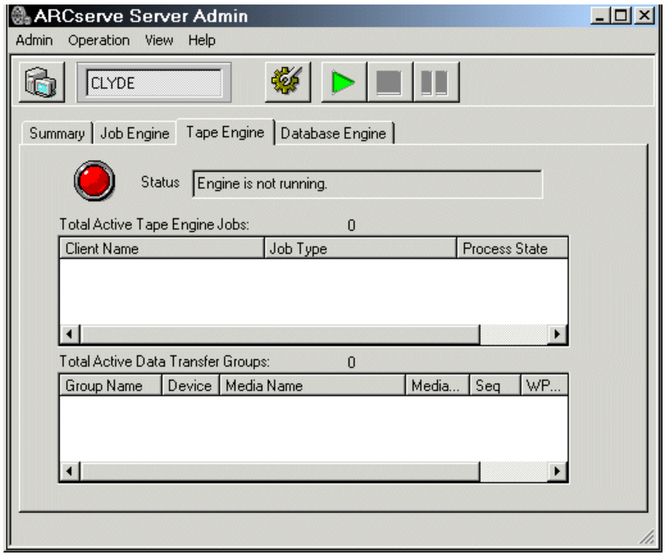


Figure 9-25 Starting the Tape Engine

Having started the Tape Engine, the library will be inventoried and then made available for usage. Appropriate media pools, media and clients can now be created to allow backups to occur. Please refer to the ARCServe manuals for instruction.

10

Configuring Arkeia on Linux

This chapter describes the steps necessary to configure Arkeia from Knox on Linux using an IBM LTO library.

10.1 Arkeia from Knox Software

Arkeia greatly simplifies data protection by providing automated backup and recovery. It supports a wide variety of computers, operating systems and storage devices. Arkeia is easy to install, quick to configure and conveniently scalable from a simple network to a complex enterprise. Arkeia accommodates full and incremental backups, scheduled or on demand, and preserves directory structure, registry, symbolic links and special attributes. The system manages file system data and, with extension modules, provides on-line backup for Oracle databases.

Arkeia uses multi-flow technology and client side compression, making it capable of backup speeds that could exceed the network's rated speed. Its unique transaction engine allows multiple backups and restores to be performed simultaneously with total reliability.

In the case of network and system errors, Arkeia is designed to restart, recover and survive. Arkeia's systems management facility allows prioritization of other processing activities while a backup is in progress and leverages standard TCP/IP protocol to intelligently monitor network errors. Should a network error occur Arkeia restarts the backup procedure from the point of interruption.

Arkeia's centralized catalog keeps a full record of all data and metadata managed by the system. It appends the relevant part of the catalog onto each tape. In the event of complete backup server failure the catalog can be rebuilt and the data recovered by using the fail-safe restore utility.

For more information on the Arkeia product, go to their website,

`http://www.arkeia.com`

10.2 Installing Arkeia

In this section we show the steps necessary to configure Arkeia Version 4.2 on Linux with a 3583 library.

We used the following hardware (Figure 10-1):

- Intel server with Redhat Linux 7.1 Server (Redhat 7.1.2.96-79, kernel 2.4.2.2 UP)
- Adaptec 29160 LVD SCSI card
- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives.

Figure 10-1 Linux Arkeia environment

10.2.1 Installation preparation

The preparation for installing Arkeia depends on whether your tape library is already installed.

Existing LTO installation

If your LTO drive was already installed on your server, check to see if the IBM drivers are being used. The IBM Ultrium drivers are not required for Arkeia. If you have already installed these, disable them as described in 3.2.2, "Uninstalling the Ultrium device drivers and utilities" on page 151.

New LTO installation

If this is a brand new installation, first install the adapter card to Linux and load the drivers. This procedure is given in 3.1.2, “Identifying and activating the SCSI controller” on page 125. Shutdown the server, physically cable the tape library, and reboot the system. Check the configuration of the devices, using the procedures in 3.1.3, “Kernel compilation and installation checklist” on page 129 and following sections.

All LTO installations

Your drive and medium changer should now be available to the operating system using Linux native device drivers.

10.2.2 Package installation

The following section displays the steps to install the Arkeia RPM (Red Hat Package Format) packages. Tefer to the Arkeia Installation Manuals for specific information about disk and resource requirements. We are installing on a system called DIOMEDE.

The Arkeia Red Hat 7.0 Linux Version 4.2 code level RPM package contains the following:

Example 10-1 Package listing

```
total 4042
-rwxr-xr-x 1 root root  216661 Oct 16 17:41 arkeia-arkc-4.1.17-1.i386.rpm
-rwxr-xr-x 1 root root  472904 Oct 16 17:42 arkeia-client-4.2.15-1.i386.rpm
-rwxr-xr-x 1 root root  1420091 Oct 16 17:43 arkeia-gui-4.2.7-1.i386.rpm
-rwxr-xr-x 1 root root  2027889 Oct 16 17:43 arkeia-server-4.2.8-2.i386.rpm
```

The rpm packages can now be installed. The order of installation is client, server, GUI. We installed the client, then server, then command line , then GUI packages.

Example 10-2 Installing rpm packages

```
[root@diomede Arkeia]# rpm -Uvh arkeia-client-4.2.15-1.i386.rpm
Preparing...                ########################################### [100%]
  1:arkeia-client           ########################################### [100%]
[root@diomede Arkeia]# rpm -Uvh arkeia-server-4.2.8-2.i386.rpm
Preparing...                ########################################### [100%]
  1:arkeia-server           ########################################### [100%]
[root@diomede Arkeia]# rpm -Uvh arkeia-arkc-4.1.17-1.i386.rpm
Preparing...                ########################################### [100%]
  1:arkeia-arkc             ########################################### [100%]
[root@diomede Arkeia]# rpm -Uvh arkeia-gui-4.2.7-1.i386.rpm
Preparing...                ########################################### [100%]
```

```
  1:arkeia-gui            ########################################### [100%]
[root@diomede Arkeia]#
```

The product is installed in the /usr/knox directory. The product is essentially self configuring using already defined system information for Arkeia default values such as the server name. Verify /usr/knox/nlp/admin.cfg has the correct server name (replace the entry with your own hostname if required) and restart the NLSERVD daemon if necessary. Then start the Arkeia GUI. These steps are shown in Example 10-3.

Example 10-3 Arkeia Configuration

```
[root@diomede knox]# cd nlp
[root@diomede nlp]# cat admin.cfg
diomede.almaden.ibm.com
[root@diomede nlp]# NLSERVD
Another Nlservd is already running. Restarting it ...
[root@diomede nlp]# ARKEIA
```

The GUI welcome screen displays as shown in Figure 10-2. Authenticate with the Arkeia server by entering a valid Linux id and password.

Figure 10-2 Server authentication

The main administration window displays (Figure 10-3).

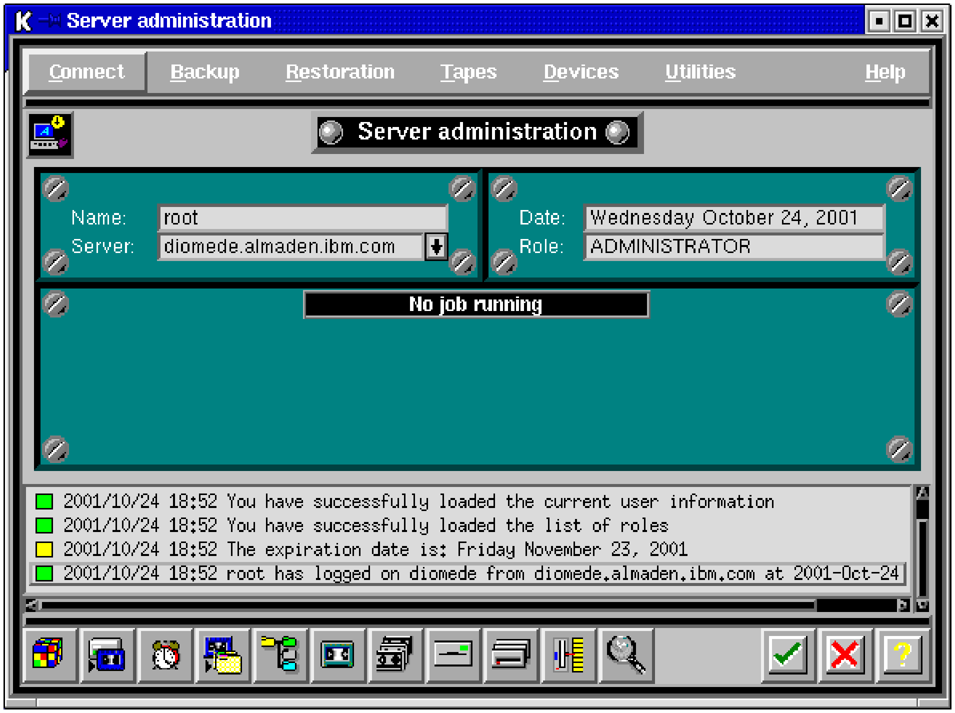


Figure 10-3 Server administration window

10.3 Configuring the LTO library

To define the LTO library to Arkeia, do the following:

- install licenses
- define library
- define drives
- associate the drives with library

Firstly, install the product licenses. From the **Server administration** window, select **Utilities** -> **License Management**. The screen in Figure 10-4 displays.

Fill in the license details for the server as provided from the vendor. The license values have been intentionally left blank here.

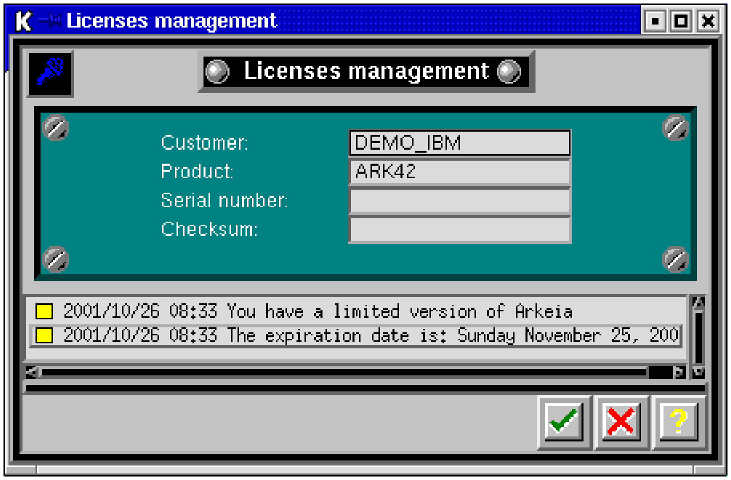


Figure 10-4 Server license

Install the license for the library (Figure 10-5).

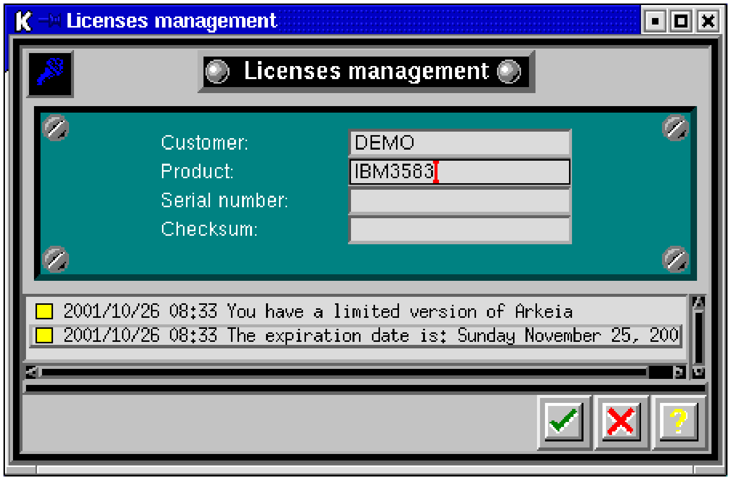


Figure 10-5 Tape library license

After the license details have been added, the library, tape devices and drivepacks can now be configured. Select **Devices** -> **Libraries Management** from the Server administration window (Figure 10-3 on page 404). In the Libraries management window (Figure 10-6), select **New** and fill in the appropriate details for the new library. The library name field is arbitrary (we choose LTO), but the type and control device fields must correspond to the correct library type (IBM3583) in our case and the Linux device name for the library changer (/dev/sg2). Use the **Type** pulldown to select the library type.

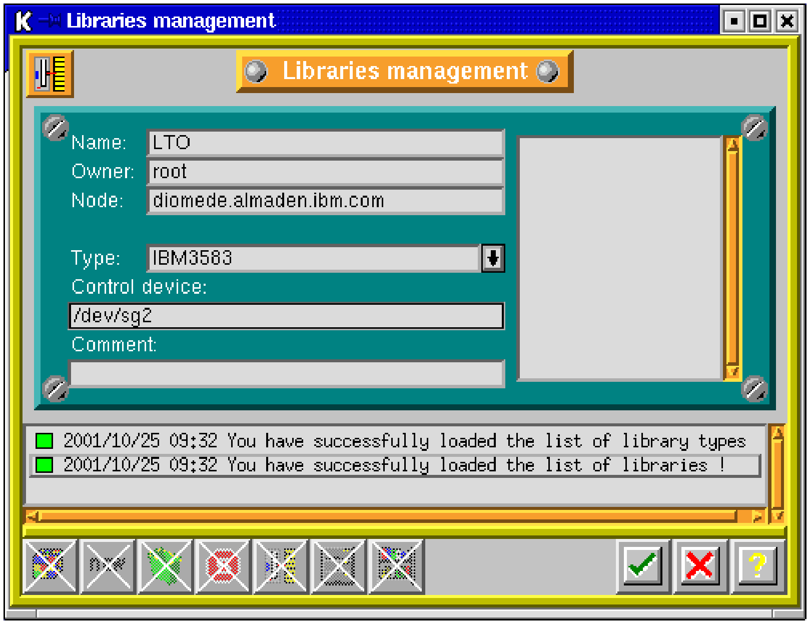


Figure 10-6 Adding a new library

We used the commands and utilities documented in 3.1.4, “Identifying and accessing the LTO device” on page 131 to determine the exact Linux device name.

Click the green checkmark box to add the library. It now appears in the panel on the right hand side and the log message shows it was successfully added (Figure 10-7).

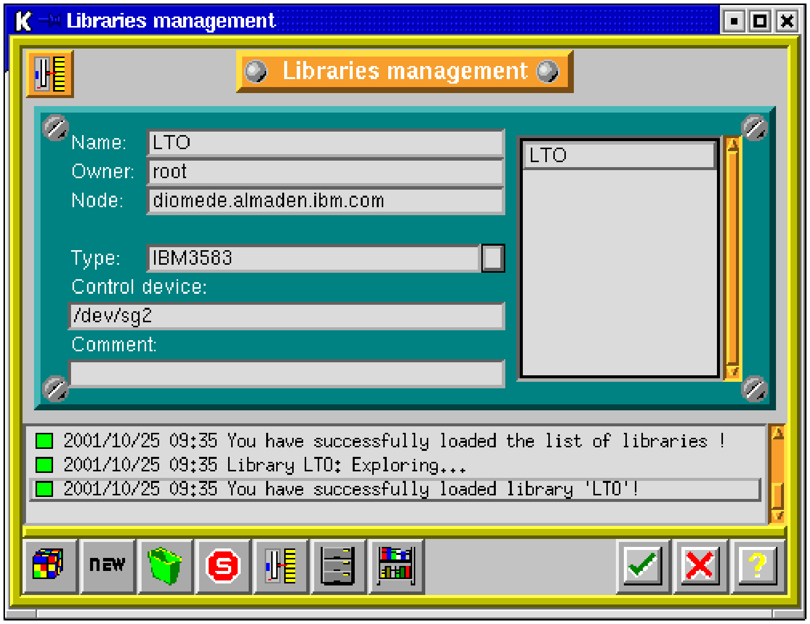


Figure 10-7 Library added

The tape devices can now be added and associated with the library device. Select **Devices** -> **Drives management** from the Server Administration window (Figure 10-3 on page 404). Select **New** in the Drives management window (Figure 10-8).

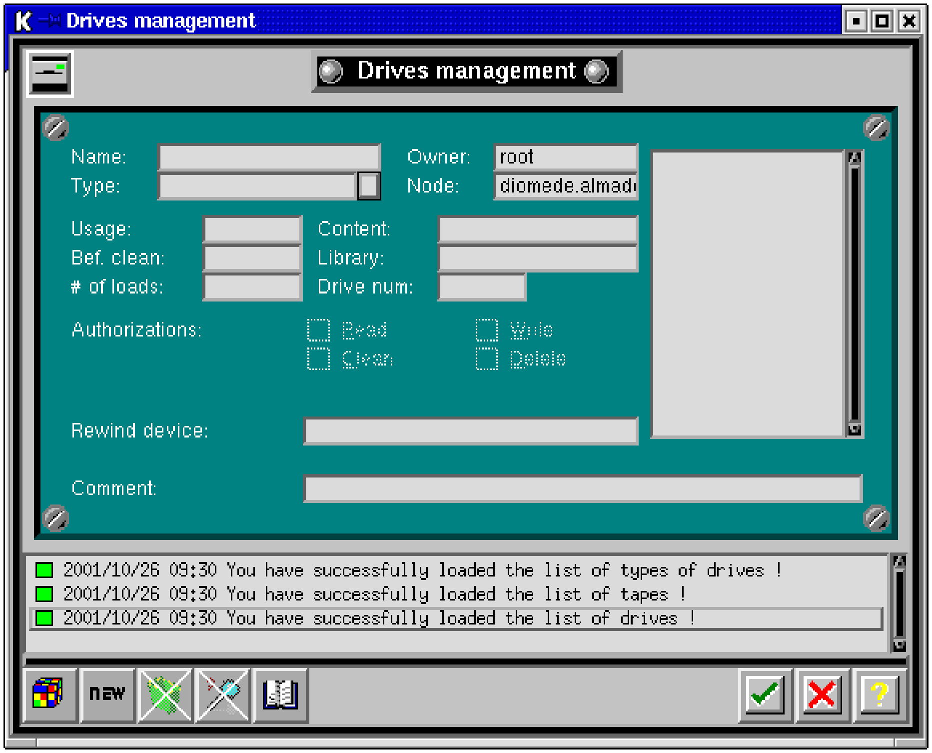


Figure 10-8 Drives management

Enter an arbitrary name for the tape device name (we chose LTO_DRIVE1). Select the tape type from the **Type** pulldown list as in Figure 10-9.

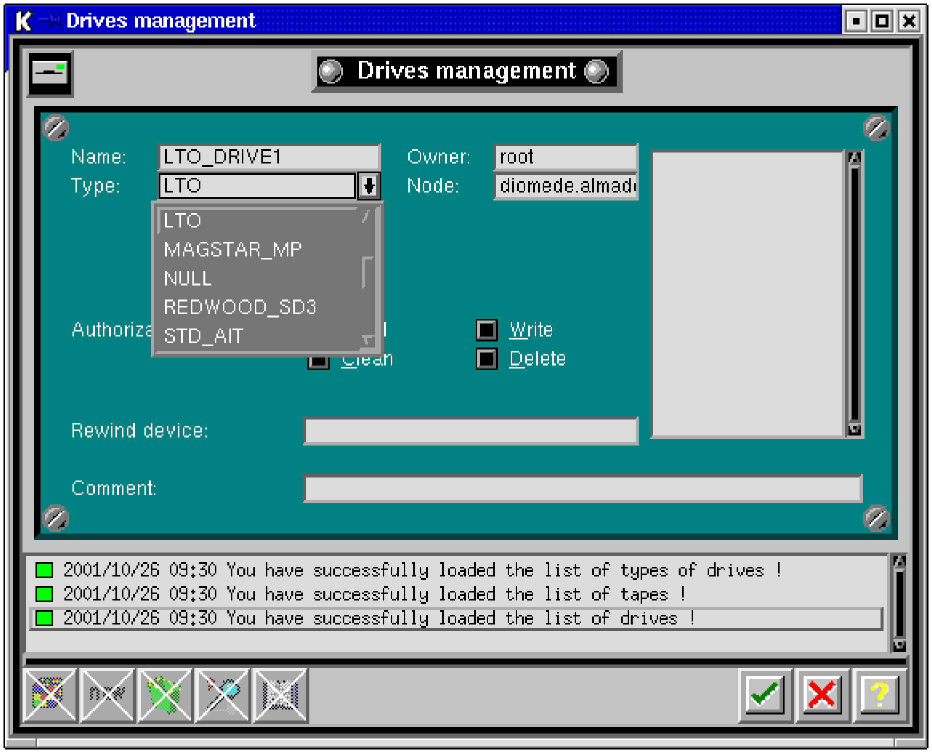


Figure 10-9 Drive type selection

The rewind device corresponds to the Linux rewind device name for the drive, which is /dev/st0. We determined the device names by examining the **dmesg** boot message output (as described in 3.1.4, “Identifying and accessing the LTO device” on page 131). Enter this as shown in Figure 10-10.

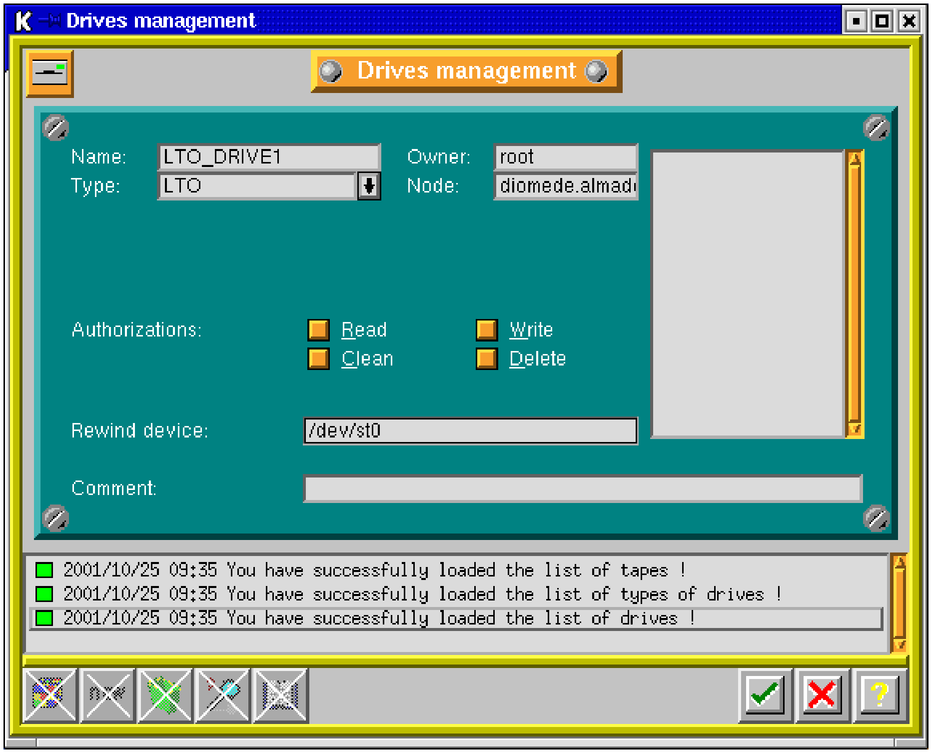


Figure 10-10 Rewind device name

Click the green checkmark box to add the drive. It now appears in the panel on the right hand side and the log message shows it was successfully added (Figure 10-11).

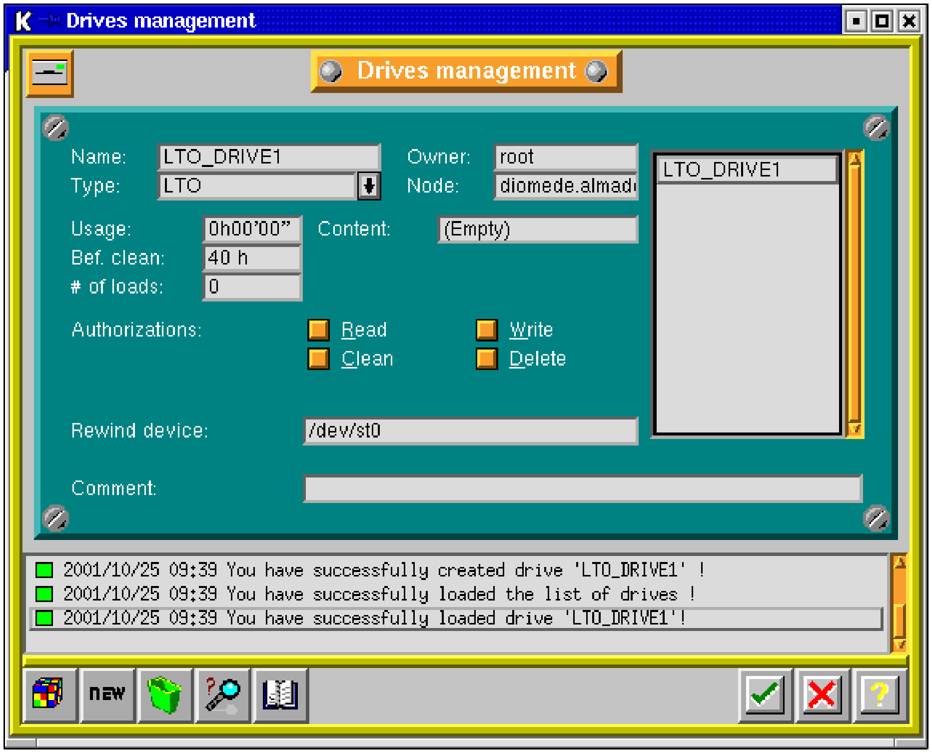


Figure 10-11 Drive added

Now select **New** to add additional drives or close the window to complete the task. We added our second drive, /dev/st1 and called it LTO_DRIVE2. Once all drives have been added, they need to be associated with the library.

From the Server administration window, select **Devices** -> **Libraries management**. The library device should be displayed (LTO in our example, shown in Figure 10-12). You can use the graphics at the bottom of the window or right mouse click on the library name to get a list of options for the library. We have used the popup menu and selected **Drive options**.

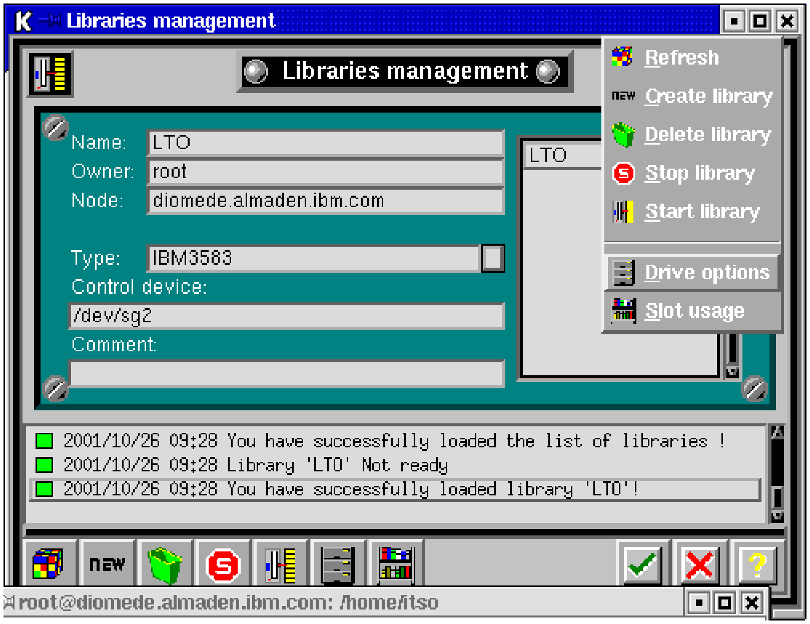


Figure 10-12 Library drive associations

The window will contain a list of empty drive entries (Figure 10-13). We will now associate the drives we have added with the drive slots in the library.

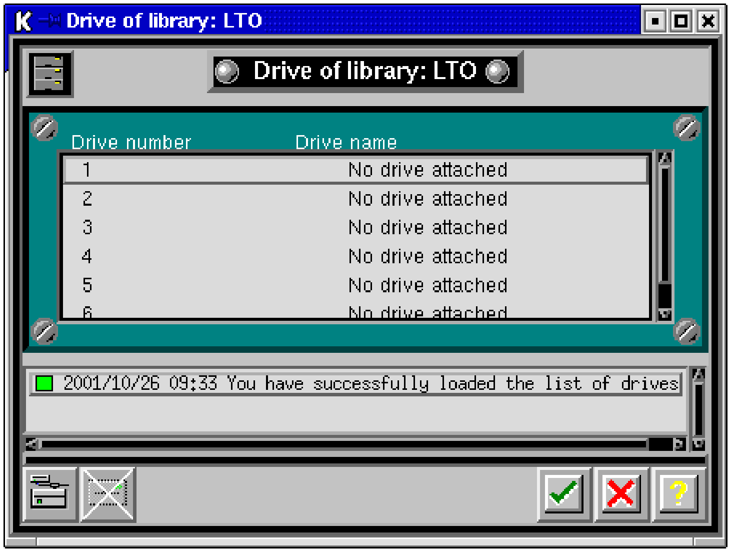


Figure 10-13 Library drives

Right mouse click on the Drive number (1 first) and select **Attach drive** as shown in Figure 10-14.

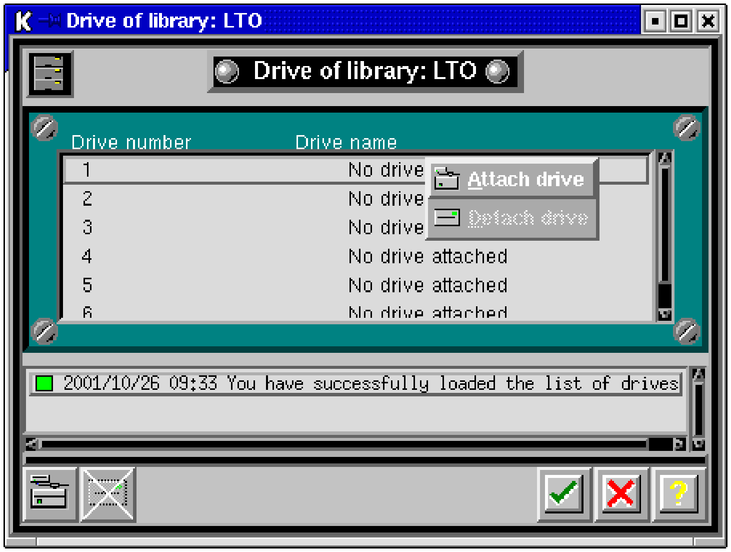


Figure 10-14 Attaching drive

A list of available drives will be shown for attachment (Figure 10-15). Select the drive, LTO_DRIVE1 and click the green checkmark box to associate the drive.

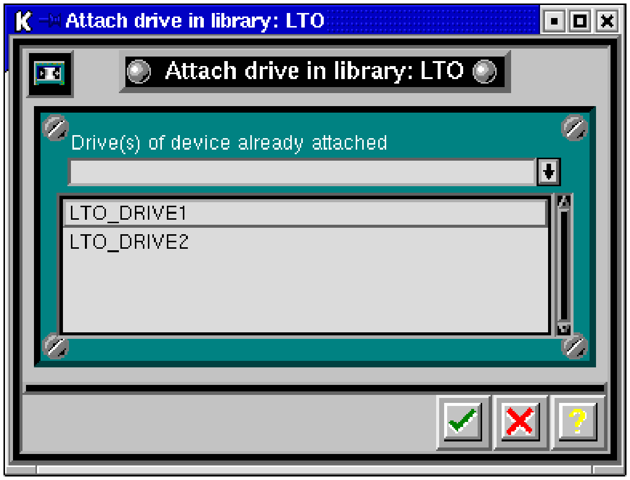


Figure 10-15 Drive selection

The library and drive association has now been made and is displayed in Figure 10-16.

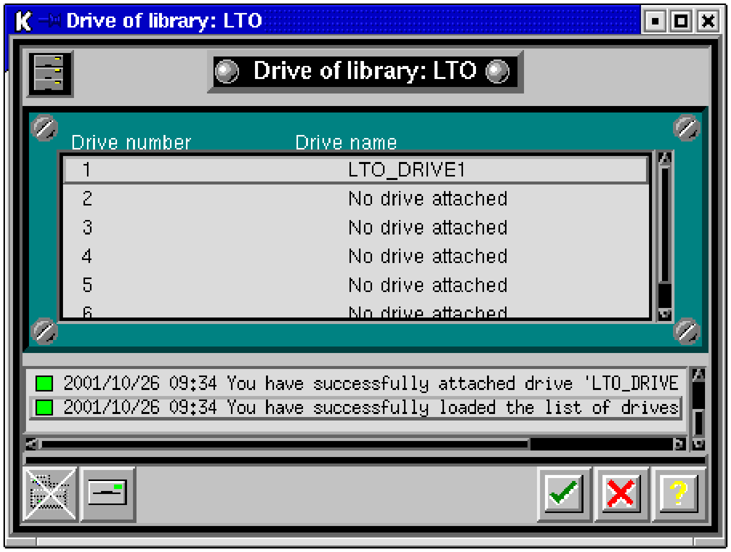


Figure 10-16 Library Drive association

Repeat the same process to associate the second drive LTO_DRIVE2 into Drive number 2.

This completes the basic configuration of the LTO drive for Arkeia. There are additional steps that will need to be performed to allow backups to occur:

- define drivepacks
- create pools
- create tape labels
- create savepacks

The specific requirements for these tasks will be determined by the design requirements. Consult the Arkeia manuals for more details of these tasks and design considerations.

11

Configuring Legato NetWorker on Windows 2000

This chapter describes the steps necessary to configure Legato NetWorker on Windows 2000 using an IBM LTO library.

11.1 Legato NetWorker overview

Legato NetWorker provides backup, recovery, and other storage management services. It is supported on many different client and server platforms as well as popular application backup (e.g. Oracle, Exchange etc.) NetWorker products for different operating systems are interoperable, and provide flexibility in designing a storage management setup.

NetWorker uses a client/server architecture, organized around a data zone, comprised of 3 different functions - Server, Client and Storage Node. A data zone is a single NetWorker server with one or more clients and/or Storage Nodes.

NetWorker Server

The NetWorker server software provides control and scheduling for NetWorker operations. The NetWorker server defines the clients, devices, and media used by the NetWorker server, defines the schedules for backups and other operations, and monitors all the NetWorker operations.

NetWorker Client

The NetWorker Client provides recover and on-demand backup functionality, and it communicates with the NetWorker Server. The NetWorker Client software is installed on all computers which will back up to the NetWorker Server.

NetWorker Storage Node

Data can be backed up to devices either directly attached to a Server or to a Storage Node. A Storage Node controls storage devices such as tape drivers, autochangers, and silos but does not do the other configuration that a Server performs.

11.2 Legato Networker installation

In the following we describe the Legato NetWorker installation for the Windows 2000 platform. For more details, you can refer to the official Legato documentation, that can be found at this link.

`http://www.legato.com/support/documentation/`

In these examples, we are documenting the installation of Legato NetWorker with a SCSI point to point connection to a 3583 Ultrium Scalable Tape Library with two drives.

11.3 Installation on Windows 2000

For a detailed explanation of the installation process, refer to the book *NetWorker for Windows 2000/NT*. This book can be downloaded from the LEGATO web site, the link is:

`http://web1.legato.com/cgi-bin/catalog?sf=Releases&level=10-1`

Be sure that Legato NetWorker is supported in your specific environment. You have to cross check on both the IBM and Legato web sites to verify this:

`http://www.storage.ibm.com/hardsoft/tape/conntrix/isv358x.html`
`http://www.legato.com/products/compatibility/networker.cfm`

We installed Legato NetWorker in the following environment, shown in Figure 11-1.

- Pentium server with Windows 2000 Advanced Server (build 2195).
- Adaptec 29160 LVD SCSI card
- IBM 3583 library SCSI attached. A single SCSI bus supported both the library controller and the two 3580 tape drives
- Legato NetWorker Version 6.1

Following we detail the installation process on our server DIOMEDE, with the required steps to configure the 3583 Ultrium Scalable Tape Library.

Figure 11-1 SCSI attach configuration

11.3.1 Installation preparation

Before starting to install Legato NetWorker, you should have installed the adapter card to Windows 2000 and loaded the IBM Ultrium drivers. These procedures are given in 2.2, “LTO installation for Windows 2000 with SCSI” on page 29. Disable the RSM service if it is running as described in “Disabling RSM” on page 61.

11.3.2 Software installation

To start the installation, run the command **autorun** from the product CD. You will see the start screen shown in Figure 11-2.

Figure 11-2 Legato NetWorker installation start screen

We select to install the Windows 2000 version of the software and select the option to run the installation program directly from its current location as shown in Figure 11-3.

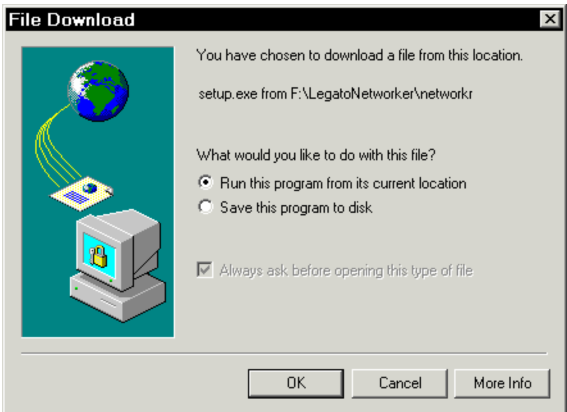


Figure 11-3 Select to run the installation program from its current location

We can ignore the security warning about a missing Authenticode signature and select both client and server for installation in the directory of our choice as shown in Figure 11-4.

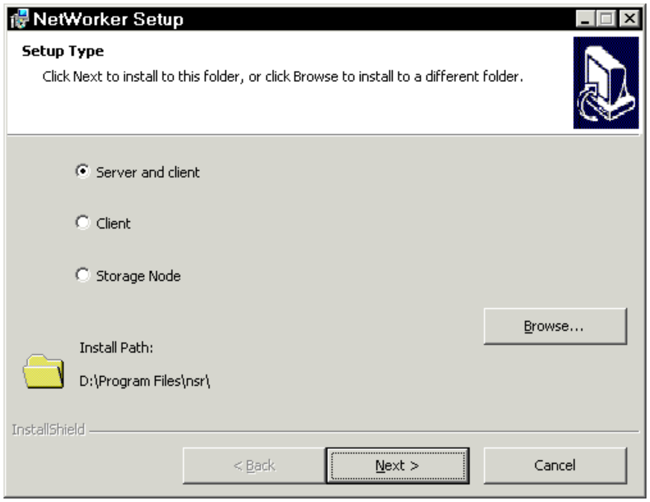


Figure 11-4 Selecting NetWorker client and server software for installation

As we are installing a single server environment we do not need to specify additional servers to backup the data on this computer (see Figure 11-5).

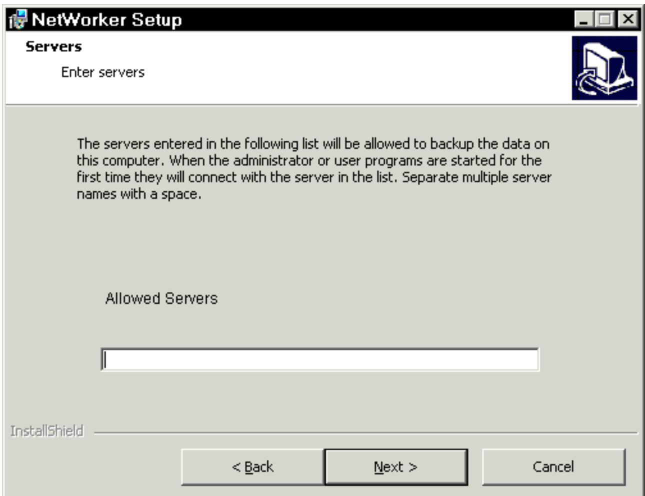


Figure 11-5 Selection of additional servers is not required

You will be asked to confirm the selected parameters before proceeding with the installation. Installation time depends on the capacity of the server. When it is complete, you see a message that installation was successful. Click **Finish** to end the installation setup.

11.3.3 Legato NetWorker library configuration

Before we can use Legato NetWorker with our LTO library we have to configure our devices. NetWorker. We use the tool **jbconfig** to make the LTO Library available to Legato NetWorker. Example 11-1 shows the procedure of defining the LTO library with **jbconfig**. The process automatically detects our hardware so that it can be configured.In our case, this is the 3583 library, referred to as a SCSI Jukebox, and our two tape drives. Since we are using the IBM Ultrium drivers, we use these device names, \\.\Tape0 and \\.\Tape1.

Example 11-1 Library configuration via jbconfig

```
D:\Program Files\nsr\bin>jbconfig
        1) Install a SmartMedia Jukebox.
        2) Install an Autodetected SCSI Jukebox.
        3) Install an Autodetected NDMP SCSI Jukebox.
        4) Install an SJI Jukebox.
        5) Install an STL Silo.

What kind of Jukebox are you installing? [1] 2
These are the SCSI Jukeboxes currently attached to your system:
  1) scsidev@2.6.0: Standard SCSI Jukebox, Vendor <IBM>, Product <ULT3583-TL>
Which one do you want to install? 1
Installing an 'Standard SCSI Jukebox' jukebox.
Name you would like to assign to the jukebox device? LTO3583
A brief description of the jukebox device? [scsidev@2.6.0: Standard SCSI
Jukebox]
Pathname of the control port for the jukebox device? [scsidev@2.6.0]
Do you want automated device cleaning support enabled? (yes/no) no

Will media drive 1 be shared by multiple device paths? (yes/no) no

Enter hostname that owns media drive 1: ? [diomede]
Enter pathname of media drive 1: ? [\\.\Tape0]
using '\\.\Tape0' as device name
Should the drive be configured as a NDMP device? (yes/no) no
This media device has not been configured yet.  Please
select a media device type for \\.\Tape0.
        1) 3480                         22) dlt8000
        2) 3570                         23) dst (NT)
        3) 3590                         24) dtf
        4) 4890                         25) file
        5) 4mm                          26) himt
```

```
         6) 4mm 12GB                    27) logical
         7) 4mm 20GB                    28) LTO Ultrium
         8) 4mm 4GB                     29) optical
         9) 4mm 8GB                     30) qic
        10) 8mm                         31) SD3
        11) 8mm 20GB                    32) sdlt
        12) 8mm 5GB                     33) SLR
        13) 8mm AIT                     34) tkz90
        14) 8mm AIT-2                   35) tz85
        15) 8mm Mammoth-2               36) tz86
        16) 9490                        37) tz87
        17) 9840                        38) tz88
        18) 9940                        39) tz89
        19) dlt                         40) tzs20
        20) dlt1                        41) vhs
        21) dlt7000                     42) VXA
Choice?
Choice? 28

Will media drive 2 be shared by multiple device paths? (yes/no) no

Enter hostname that owns media drive 2: ? [diomede]
Enter pathname of media drive 2: ? [\\.\Tape1]
using '\\.\Tape1' as device name
Should the drive be configured as a NDMP device? (yes/no) no
This media device has not been configured yet.  Please
select a media device type for \\.\Tape1.
         1) 3480                        22) dlt8000
         2) 3570                        23) dst (NT)
         3) 3590                        24) dtf
         4) 4890                        25) file
         5) 4mm                         26) himt
         6) 4mm 12GB                    27) logical
         7) 4mm 20GB                    28) LTO Ultrium
         8) 4mm 4GB                     29) optical
         9) 4mm 8GB                     30) qic
        10) 8mm                         31) SD3
        11) 8mm 20GB                    32) sdlt
        12) 8mm 5GB                     33) SLR
        13) 8mm AIT                     34) tkz90
        14) 8mm AIT-2                   35) tz85
        15) 8mm Mammoth-2               36) tz86
        16) 9490                        37) tz87
        17) 9840                        38) tz88
        18) 9940                        39) tz89
        19) dlt                         40) tzs20
        20) dlt1                        41) vhs
        21) dlt7000                     42) VXA
Choice? 28
```

```
Your jukebox does not report that it has a bar code reader, but it does
report that it can handle volume tags.  Some jukeboxes that have barcode
readers report this way.  If your jukebox has a barcode reader,
do you want bar code reader support enabled? (yes/no) yes
Do you want volume labels to match bar code labels? (yes/no) yes

Jukebox has been added successfully

Would you like to configure another jukebox? (yes/no) no
```

For our environment we do not need special features like multiple device paths or NDMP support. We do activate barcode support and specify that volume labels should match the barcode labels. Now we can check the success of the operation via the NetWorker Administrator interface. To initiate that, select **Start -> Programs -> NetWorker Group -> NetWorker Administrator**. Figure 11-6 shows the start screen of the NetWorker Administrator. Note we have a number of systems which are also running Legato NetWorker, client and or server, which are automatically detected and displayed when you expand the NetWorker Servers and NetWorker Clients headings.

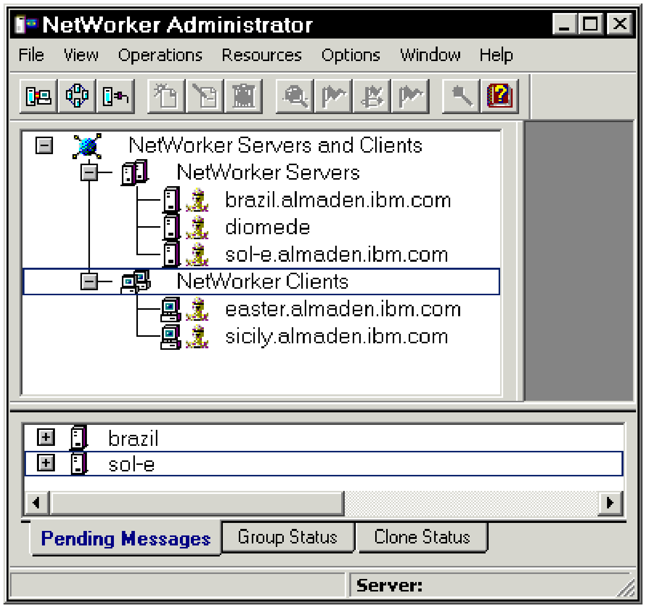


Figure 11-6 NetWorker administration (start screen)

We select our machine DIOMEDE by double-clicking it. The screen in Figure 11-7 displays.

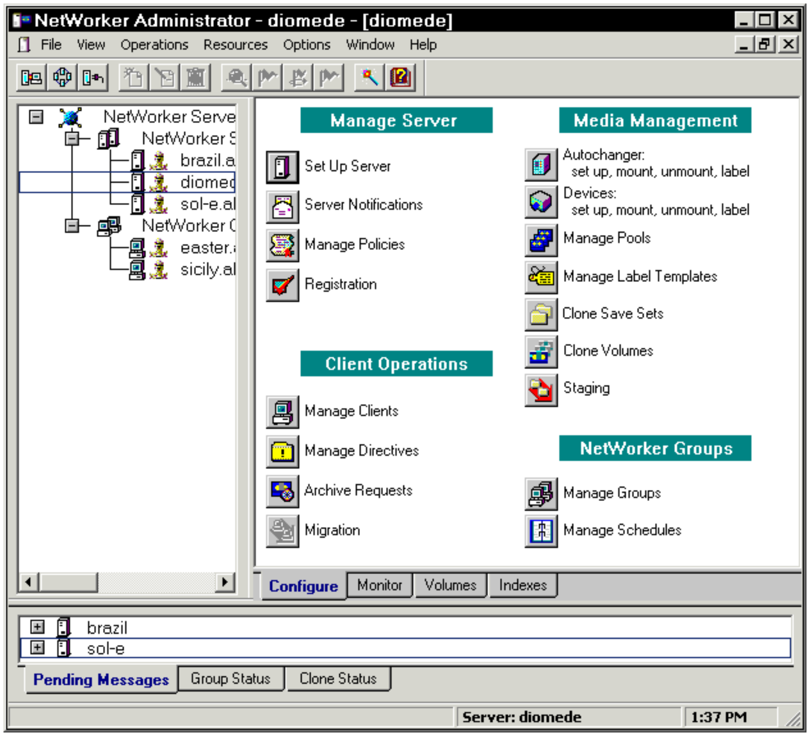


Figure 11-7 Selecting our NetWorker server DIOMEDE

If we select the **Autochanger** entry in the Media Management menu the library and the tape drives are displayed as in Figure 11-8.

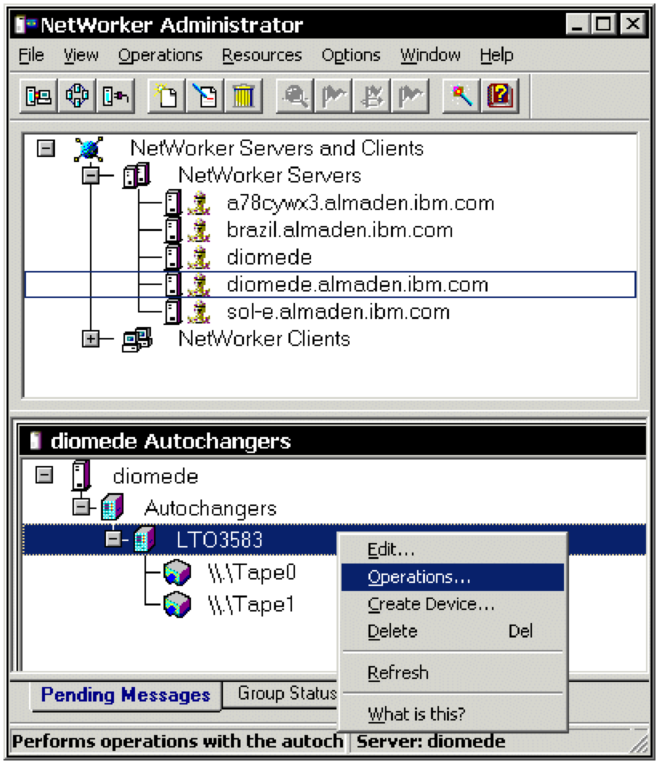


Figure 11-8 Displaying library and tape devices available to DIOMEDE

Now we are ready to work with the LTO Library and to make the tape cartridges available to Legato Networker. After selecting the LTO library, called LTO3583 from the Networker Administrator display, right-click and select the **Operations** option. The displayed dialog box offers us a number of library operations as shown in Figure 11-9.

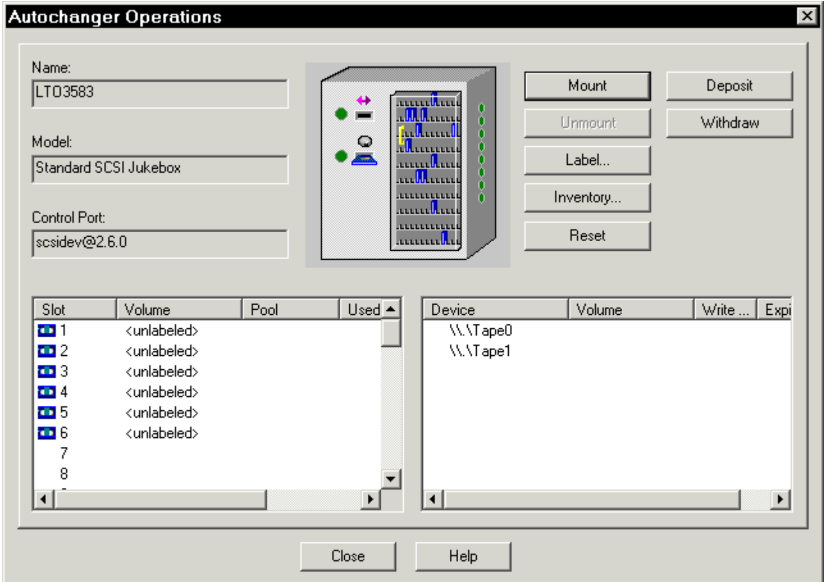


Figure 11-9 Selection menu for library operations

The tape cartridges in our library appear as *unlabeled*. To label the cartridges in the library, click the **Label** button. This brings up the dialog shown in Figure 11-10.

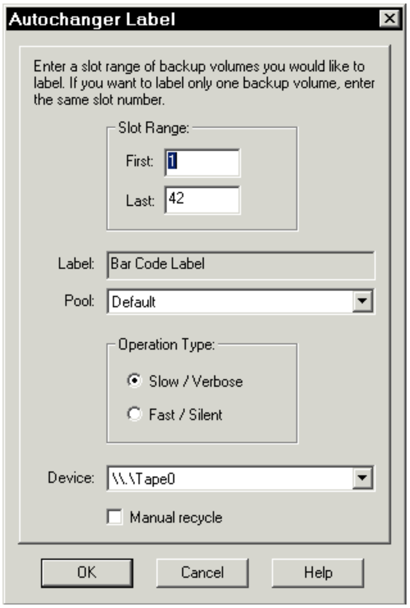


Figure 11-10 Tape labeling dialog box

We select the range of slots where we want to label the cartridges and the tape drive that should be used during the labeling operation. Legato NetWorker displays the progress of the labeling process with the dialog box shown in Figure 11-11.

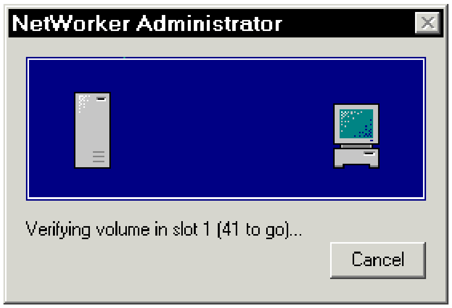


Figure 11-11 Volume labeling progess display

When the labeling process has finished the Autochanger Operations dialog box shows the cartridges with their label names as in Figure 11-12.

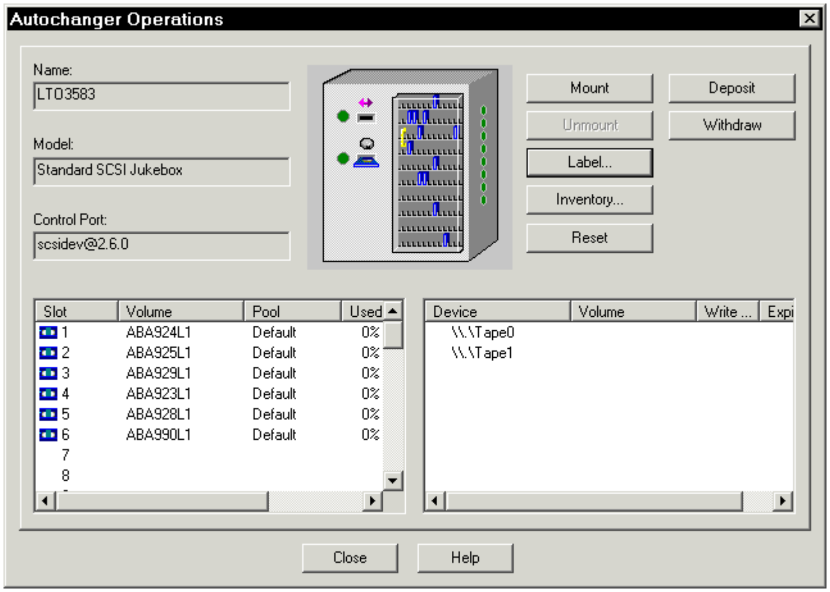


Figure 11-12 Display of cartridges after labelling

11.3.4 Legato NetWorker client backup

At the beginning of our installation we decided to install NetWorker client and server on our system. Therefore we can immediately start the NetWorker client to create a backup of our system. select **Start -> Programs -> NetWorker Group -> NetWorker User**. From the main window (Figure 11-13), click the **Backup** icon.

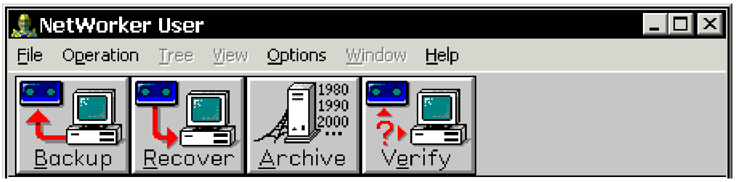


Figure 11-13 Backup main window

The NetWorker client backup interface appears. Select the files for backup by highlighting them and clicking the blue tick box as shown in Figure 11-14.

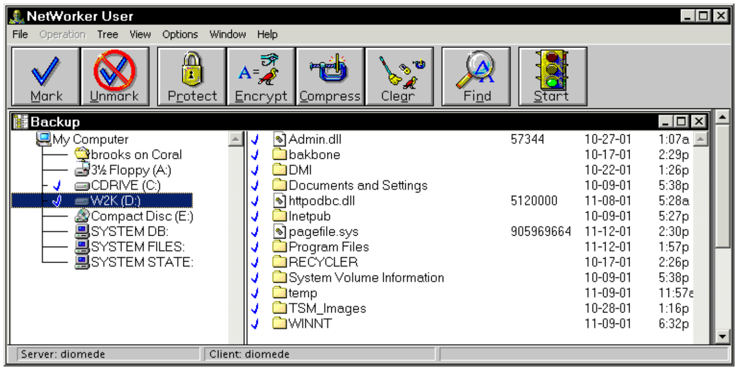


Figure 11-14 Legato NetWorker client screen with file selections for backup

We press the **Start** traffic light button and after a short period of time a tape will be mounted in our LTO Ultrium library to receive the backup. The NetWorker client shows the status of the backup operation, Figure 11-15.

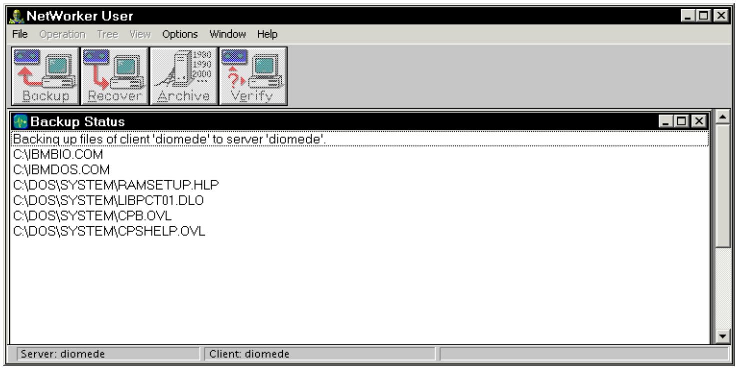


Figure 11-15 Legato NetWorker client during backup operation

The Legato NetWorker documentation provides additional information about configuration and optimization tasks.

Part 3

Appendix

A

NDMP

In this appendix we give an overview of the Network Data Management Protocol (NDMP) and its function.

A.1 NDMP

This information is an extract from website:

http://www.ndmp.org

Functional specifications, whitepapers, news groups, discussions for and about NDMP are found at this site.

A.2 The Network-Attached Storage vendor challenge

In the case of network-attached storage, the general-purpose server vendor challenge is compounded. Network-attached storage "appliances" are designed to optimize a single function, namely file service. As such, they do not have the general-purpose operating system required for porting a backup software solution. Indeed, the backup software is likely to have a great deal more lines of code than the dedicated OS itself. Backing up and restoring data over the network is slow and ties up the network.

A.2.1 The solution

Backup is an issue that must be addressed by the server vendor, backup software vendor, and backup device vendor communities collectively. The common objective is to provide centrally managed, enterprise-wide data protection for the user in a heterogeneous environment. A common backup architecture must be defined, and the problem of backup must be partitioned between vendor types. This is achieved by defining and promoting an open standard network backup protocol. NDMP is this protocol.

Vendor compliance with NDMP provides users with plug-and-play ability in a heterogeneous environment. Best-of-breed solutions, ideally suited for the specific demands of a given network environment, can be chosen from server, backup device, and backup software vendors, and interoperability is assured.

By partitioning the problem between vendors, each vendor implements solutions in compliance with one well-defined standard network protocol. Interoperability efforts and widespread vendor support are eliminated. The vendor is free to focus on core competencies, thus improving the user offering and decreasing time-to-market.

A.2.2 The basic elements of backup

Enterprise backup is a highly complex procedure. The data to be backed up must be defined, and complex interactions with the backup media device and extensive cataloguing and control must be managed. Good enterprise wide backup solutions are designed to assure data protection and efficient restoration of mission-critical data in the event of data loss. This means a great number of control and management features are implemented at the front end, at backup.

In a generic sense, the complex task of backup can be broken into the following tasks:

- Discovery
- Configuration
- Scheduling
- Media management
- Tape device control
- Autoloader device control
- Data client software
- User interface

A.2.3 The common backup architecture

We have spoken about the three vendor types associated with backup, namely the file server, backup device, and backup software vendors. Now let's take a look at how file system data and control data flows among the three.

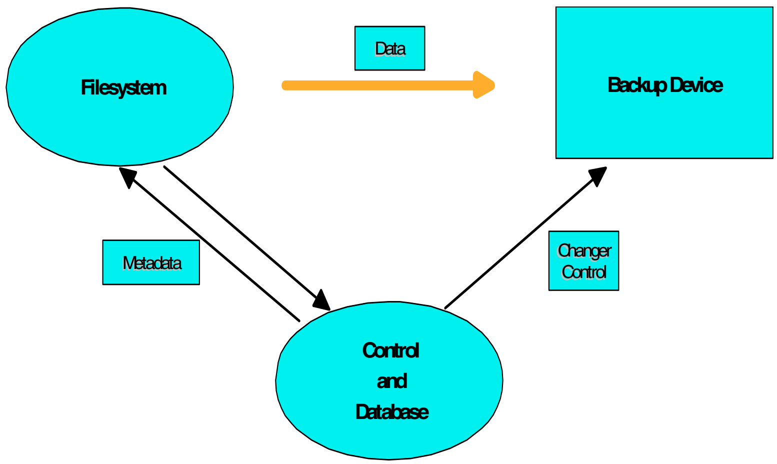


Figure A-1 Common backup architecture

Enterprise data is stored in file systems. During a backup, this data is copied to the backup device (e.g., tape in a tape library or jukebox). The backup software controls what is being backed up and manages the database or catalog of the data being backed up.

While this is the common architecture of backup today, individual backup software vendors implement their own "protocols" to manage this data flow. While the architecture remains constant, the system calls differ by software package and, sometimes, by server platform.

A.2.4 NDMP and the common architecture

NDMP is an open network protocol that defines common functional interfaces used for these data flows. With NDMP, vendors use common interfaces for common architecture data flows. File system data flows from the file system to the backup device using a common interface, regardless of the platform or device. Control or file meta data is passed to and from the backup software using common interfaces, regardless of the software package.

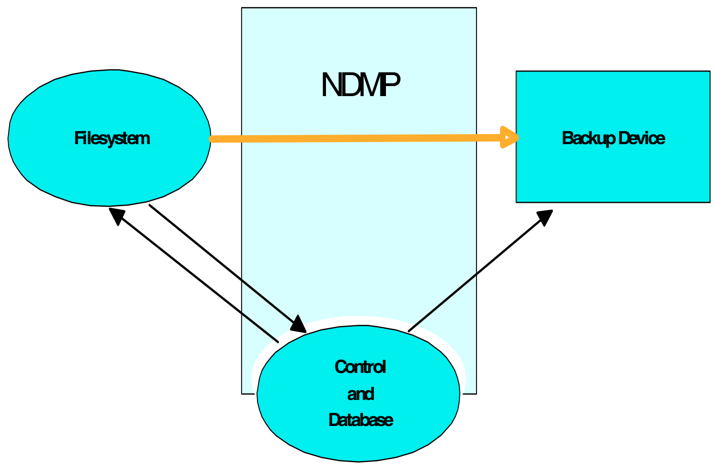


Figure A-2 Common architecture of backup with NDMP

NDMP specifies the communication between the server and the backup software. Communication is defined using a series of defined interfaces. These are XDR encoded messages that are exchanged over a bidirectional TCP/IP connection.

The architecture is a client/server model, and the backup software is considered a client to the NDMP server. For every connection between the client on the backup software host and the NDMP host there is a virtual state machine on the NDMP host that is controlled using NDMP. This virtual state machine is referred to as the NDMP server.

An NDMP server can be thought of as providing two services:

- A DATA server - This service either reads from disk and produces an NDMP data stream (in a specified format) or reads an NDMP data stream and writes to disk, depending upon whether a backup or restore is taking place.
- A TAPE server - This service either reads an NDMP data stream and writes it to tape or reads from tape and writes an NDMP data stream, depending upon whether a backup or restore is taking place. All tape-handling functions, such as split-image issues, are dealt with by this service.

Each service has a separate state diagram that dictates its behavior, e.g. the tape server (mover state machine) can enter the pause state while tapes are being changed by the NDMP client.

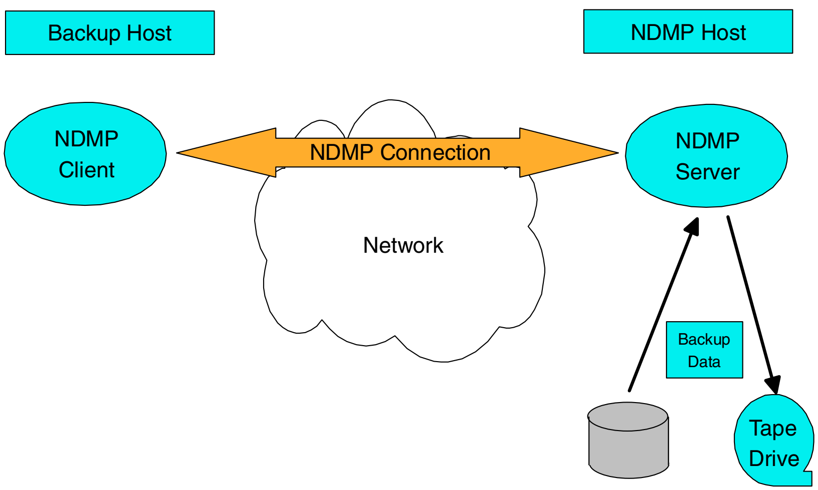


Figure A-3 Simple NDMP configuration

A.2.5 Server implementation of NDMP

The server vendor implements NDMP by including connect, configure, data, tape, and SCSI interfaces in the operating system code.

- Connect Interface: This allows authentication of the client and negotiates the version of the protocol being used.

- Configure Interface: This interface allows the backup software to discover the configuration of the NDMP server.
- Data Interface: This interface deals with the format of the backup data. Backup software initiates backups and restores using this interface.
- Tape Interface: The tape interface provides complete control of a tape drive.
- SCSI Interface: The SCSI interface allows low-level control of SCSI devices such as jukeboxes.

A.2.6 Backup software vendor implementation of NDMP

Backup software adopting NDMP implements notify, file history, and logging interfaces.

- Notify Interface: This notifies the backup software that the NDMP server requires attention.
- File History Interface: This interface allows the NDMP server to make entries in the file history of the backup software. The file history is important for later file retrieval.
- Logging Interface: This interface provides messages that are used by the operator to monitor backup progress and diagnose problems.

A.2.7 Backup device vendor implementation of NDMP

Jukebox vendors need only ensure that they remain compliant with SCSI standards. Device drivers are not required in an NDMP environment.

A.3 The standardization of NDMP

The full specification for NDMP was submitted to the Internet Engineering Task Force (IETF) in October 1996. Through the Internet Draft and Request For Comment (RFC) processes, the specification will continue to evolve and gain widespread industry support.

The full specification and additional NDMP information is published at

`http://www.ndmp.org/info`

NDMP was co-developed by Legato and Network Appliance. The two companies authored the specification and implemented the protocol as a proof of concept.

With a proven concept and working specification in place for NDMP, Intelliguard and Network Appliance approached a number of other companies asking for support. Initially, 17 vendor companies endorsed the initiative to make NDMP an open standard backup protocol. Now that the protocol has been submitted to the IETF, and more companies are hearing about the initiative, support for NDMP is growing. NDMP-compliant products will be available to users as vendors implement the protocol in their future product releases.

Intelliguard and Network Appliance already ship NDMP-compliant backup software and file servers.

A.4 Conclusion

NDMP provides a logical partitioning of the backup activity, through a series of well-defined interfaces that addresses the flow of file system and control data in the backup and restore process. System and backup software vendors add a limited amount of code in their software, as defined by NDMP.

NDMP-compliant servers and devices ship "backup ready." Once attached to the network, the NDMP-compliant backup software can provide backup protection to the server as part of an enterprise-wide solution. NDMP compliance provides true plug-and-play interoperability to users. Users can choose the best enterprise-wide backup software solutions and hardware to meet the demands of their particular environment.

NDMP-compliant server vendors can concentrate resources on improving file system internals and tape transfer mechanisms, assured that these enhancements can be utilized by all NDMP-compliant software solutions. As such, enhancements can be utilized by all of the server vendor’s customers.

Backup software vendors implementing NDMP are free to redirect resources to feature enhancements that are available to all of their customers, regardless of platform.

NDMP is openly available and will continue to evolve through the IETF and the NDMP Task Force. As NDMP evolves, it is anticipated that increasing functionality will be added. NDMP continues to gain vendor support, and NDMP-compliant products will be available very soon. Continued vendor support and the release of compliant products will make NDMP a standard whose time has arrived.

While vendor development efforts are simplified by NDMP, the real winners are our mutual customers the I.S. user and management community.

The NDMP is defined in fine granularity within the NDMP specification. However, a quick synopsis follows:

Currently an NDMP server can be thought of providing two services:

- A DATA server - This service either reads from disk and produces an NDMP data stream (in a specified format) or reads an NDMP data stream and writes to disk, depending upon whether a backup or restore is taking place.

- A TAPE server - This service either reads an NDMP data stream and writes it to tape or reads from tape and writes an NDMP data stream, depending upon whether a backup or restore is taking place. All tape-handling functions, such as split-image issues, are dealt with by this service.

Each service has a separate state diagram that dictates its behavior, e.g. the tape server (mover state machine) can enter the pause state while tapes are being changed by the NDMP client.

NDMP messages are categorized into distinct groups or NDMP interfaces, such as SCSI, CONFIG and TAPE. These messages (as well as actions and errors) can trigger state changes.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

IBM Redbooks

For information on ordering these publications, see “How to get IBM Redbooks” on page 446.

- *Designing an IBM Storage Area Network,* SG24-5758
- *Planning and Implementing an IBM SAN*, SG24-6116
- *IBM SAN Survival Guide,* SG24-6143
- *Tivoli Storage Management Concepts Guide*, SG24-4877
- *Getting Started with Tivoli Storage Manager: Implementation Guide*, SG24-5416
- *Using Tivoli Storage Manager in a SAN Environment,* SG24-6132
- *The IBM LTO Ultrium Tape Libraries Guide*, SG24-5946
- *Using IBM LTO Ultrium with Open Systems*, SG24-6502

Other resources

These publications are also relevant as further information sources:

- *IBM Ultrium Device Drivers: Installation and User’s Guide,* GA32-0430
- I*BM Ultrium Device Drivers: Programming Reference* WB1304
- *Tivoli Storage Manager for Windows Quick Start*, GC35-0409
- *Tivoli Storage Manager for Windows Adminitrator’s Guide* GC35-0410

Referenced Web sites

These Web sites are also relevant as further information sources:

- `IBM LTO Family homepage`

  `http://www.ibm.com/storage/lto`

- LTO homepage

  `http://www.lto.org/`
- Emulex homepage

  `http://www.emulex.com/`
- QLogic homepage

  `http://www.qlogic.com/`
- Linux homepage

  `http://www.linux.org/`
- Microsoft homepage

  `http://www.microsoft.com/`
- NDMP homepage

  `http://www.ndmp.com/`
- Network Appliances homepage

  `http://www.netapp.com/`
- Arkeia homepage

  `http://www.arkeia.com/`
- BakBone homepage

  `http://www.bakbone.com/`
- CA homepage

  `http://www.ca.com/`
- Legato homepage

  `http://www.legato.com/`
- Tivoli Storage Manager homepage

  `http://www.tivoli.com/products/index/storage_mgr`
- Veritas homepage

  `http://www.veritas.com/`

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Abbreviations and acronyms

NIC

AIX	Advanced Interactive Executive
API	Application Programming Interface
BIOS	Basic Input/Output Services
BSD	Berkeley Software Distribution
CDE	Common Desktop Environment
CIFS	Common Internet File System
CLI	Command line interface
DCE	Distributed Computing Environment
DHCP	Dynamic Host Configuration Protocol
DMI	Desktop Management Interface
DLT	Digital Linear Tape
DVD	Digital Video Disc
ESRM	Enterprise Storage Resource Management
FC	Fibre Channel
FC-AL	Fibre Channel Arbitrated Loop
ftp	file transfer protocol
GA	Generally Available
GBIC	Gigabit Interface Converter
HA	High Availability
HBA	Host Bus Adapter
HD68	High Density 68-pin
HLA	High Level Address
HP	Hewlett-Packard
HSM	Hierarchical Storage Management
HVD	High voltage Differential
I/O	Input/Output
IBM	International Business Machines Corporation
IETF	Internet Engineering Task Force
ISV	Independent Software Vendor
ITSO	International Technical Support Organization
LAN	Local Area Network
HLA	Low Level Address
LM	Library Manager
LTO	Linear Tape-Open
LTO-DC	LTO Data Compression
LUN	Logical Unit Number
LVD	Low Voltage Differential
MAC	Media Access Control
MIB	Management Information Base
MMC	Microsoft Management Console
MMC	Microsoft Management Console
MTF	Microsoft Tape Format
NAS	Network Attached Storage
NDMP	Network Data Management Protocol
NFS	Network File System
NIC	Network Interface Controller
NTFS	NT file system
NVRAM	Non Volatile Random Access Memory
OID	Object Identifier
PTF	Program Temporary Fix
RFC	Request for Comment

RISC	Reduced Instruction Set Computer
RMU	Remote Management Unit
ROM	Read Only Memory
RPM	Red Hat Package Manager
RSM	Removable Storage Manager
RSS	Remote Storage Server
SAN	Storage Area Network
SCSI	Small Computer Systems Interface
SDG	SAN Data Gateway
SMC	SCSI Medium Changer
SMIT	System Management Interface Tool
SNMP	Simple Network Management Protocol
SNS	Simple Name Server
TB	terabytes
TCP/IP	Transmission Control Protocol/Internet Protocol
TDP	Tivoli Data Protection
TSM	Tivoli Storage Manager
VHDCI	Very High Density Cable Interconnect
VPN	Virtual Private Network
VPS	Virtual Private SAN
WWN	World Wide Name
WWNN	World Wide Node Name
WWPN	World Wide Port Name
XDR	External Data Representation

Index

M

N

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Implementing IBM LTO in Linux and Windows environments

Redbooks

How to setup Ultrium devices with and without a SAN

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Operation and implementation tips

This Redbook covers the implementation details of attaching IBM LTO tape subsystems (Ultrium products) to servers running Linux and Windows 2000. It describes how the attachment support is provided in the different operating system environments, as well as how to set up the devices using direct SCSI and SAN connections. Many practical examples are given for full step by step instructions. We also discuss how to configure the LTO products with many popular backup products, including Tivoli Storage Manager, VERITAS Backup Exec, BakBone NetVault , CA BrightStor ARCServe, Arkeia and Legato NetWorker are covered.

This redbook will help IBM, Business Partners and customer personnel to better understand and implement the IBM Ultrium LTO product line in Intel-based environments.

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