

IBM TS7610 and TS7620 ProtecTIER Deduplication  
Appliance Express  
V3.3.7

*ProtecTIER User's Guide for VTL  
Systems*



**Note**

Before using this information and the product it supports, be sure to read the information in the "Safety and environmental notices" and "Notices" sections of this publication.

**Edition notices**

This edition applies to version 3.3.7 of the IBM TS7610 and TS7620 ProtecTIER Deduplication Appliance Express system with ProtecTIER and to all subsequent releases and modifications until otherwise indicated in new editions.

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## Safety and Environmental notices

This section contains information about safety notices that are used in this guide and environmental notices for this product.

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### Safety notices

Observe the safety notices when using this product. These safety notices contain danger and caution notices. These notices are sometimes accompanied by symbols that represent the severity of the safety condition.

Most danger or caution notices contain a reference number (Dxxx or Cxxx). Use the reference number to check the translation in the *IBM Systems Safety Notices*, G229-9054 manual.

The sections that follow define each type of safety notice and give examples.

#### Danger notice




A danger notice calls attention to a situation that is potentially lethal or extremely hazardous to people. A lightning bolt symbol always accompanies a danger notice to represent a dangerous electrical condition. A sample danger notice follows:




**DANGER:** An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (D004)

#### Caution notice

A caution notice calls attention to a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice. A caution notice can be accompanied by one of several symbols:

If the symbol is...	It means...
	A generally hazardous condition not represented by other safety symbols.
	This product contains a Class II laser. Do not stare into the beam. (C029) Laser symbols are always accompanied by the classification of the laser as defined by the U. S. Department of Health and Human Services (for example, Class I, Class II, and so forth).
	A hazardous condition due to mechanical movement in or around the product.

If the symbol is...	It means...
	<p>This part or unit is heavy but has a weight smaller than 18 kg (39.7 lb). Use care when lifting, removing, or installing this part or unit. (C008)</p>

Sample caution notices follow:

**Caution**

The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM® has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (C007)

**Caution**

The system contains circuit cards, assemblies, or both that contain lead solder. To avoid the release of lead (Pb) into the environment, do not burn. Discard the circuit card as instructed by local regulations. (C014)

**Caution**

When removing the Modular Refrigeration Unit (MRU), immediately remove any oil residue from the MRU support shelf, floor, and any other area to prevent injuries because of slips or falls. Do not use refrigerant lines or connectors to lift, move, or remove the MRU. Use handholds as instructed by service procedures. (C016)

**Caution**

Do not connect an IBM control unit directly to a public optical network. The customer must use an additional connectivity device between an IBM control unit optical adapter (that is, fibre, ESCON, FICON®) and an external public network. Use a device such as a patch panel, a router, or a switch. You do not need an additional connectivity device for optical fibre connectivity that does not pass through a public network.

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## Power cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

IBM power cords used in the United States and Canada are listed by Underwriter’s Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT,

three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country or region are usually available only in that country or region.

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## **Environmental notices**

The environmental notices that apply to this product are provided in the *Environmental Notices and User Guide, Z125-5823-xx* manual. A copy of this manual is located on the publications CD.



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## Homologation statement

**Attention:** This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact an IBM representative or reseller if you have any questions.





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## About this document

This document provides information for using and maintaining the IBM TS7610 and TS7620 ProtecTIER® Deduplication Appliance Express® system.

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## Terminology

This section provides information about terminology used to describe the IBM TS7610 and TS7620 ProtecTIER Deduplication Appliance Express system.

### TS7610 and TS7620 Appliance Express

#### Cold-swappable components

Components that cannot be removed or replaced while the system is running. Input/output (I/O) activity must be stopped and the server must be disconnected from the A/C power source before removal or replacement is started.

**Attention:** Failure to adhere to the above guidelines could result in component or system damage, data loss, or personal injury.

#### Customer-replaceable unit (CRU)

CRU components can safely and easily be self-serviced by the customer.

#### External component

External components are accessible with the server's cover in place.

#### Field-replaceable unit (FRU)

FRU components require a higher degree of technical expertise and system knowledge for removal and replacement than CRUs and are to be serviced by IBM personnel only.

#### FRU ID

Each component has a unique FRU ID (part number). In the event that you need to order a replacement CRU, or schedule a service call for a FRU, you will need to provide the FRU ID to the IBM customer support representative.

#### Hot-swappable components

Components that do not require stopping I/O activity or disconnecting the server from A/C power before removing or replacing.

#### Internal component

Internal components are located inside the server chassis, and are accessible only if the server's top cover is removed.

#### OpenStorage

OpenStorage allows ProtecTIER to be integrated with NetBackup to provide the means for backup-to-disk without using a virtual tape library (VTL) emulation. Using a plug-in that is installed on an OpenStorage-enabled media server, ProtecTIER can implement a communication protocol that supports data transfer and control between the backup server and the ProtecTIER server. Therefore, to support the plug-in, ProtecTIER implements a storage server emulation.

#### replication

A process that transfers logical objects like cartridges from one ProtecTIER

repository to another. The replication function allows ProtecTIER deployment to be distributed across sites. Each site has a single or clustered ProtecTIER environment. Each ProtecTIER environment has at least one ProtecTIER server. The ProtecTIER server that is a part of the replication grid has two dedicated ethernet ports that are used for replication. Replication ports are connected to the customer's WAN and are configured on two subnets as default.

**replication grid**

A set of repositories that share a common ID and can potentially transmit and receive logical objects through replication. A replication grid defines a set of ProtecTIER repositories and actions between them. It is configured by using the ProtecTIER Replication Manager. The ProtecTIER Replication Manager is a software component installed on a ProtecTIER server or a dedicated host. The ProtecTIER Replication Manager should be able to recognize all of the members of the entire network that it handles on both replication subnets. The ProtecTIER Replication Manager manages the configuration of multiple replication grids in an organization. An agent on every node in each ProtecTIER server interacts with the server and maintains a table of its grid members.

**Note:** Customers must license the Replication features on all ProtecTIER systems participating in the replication grid whether the system is sending or receiving data (or both).

**replication grid ID**

A number from 0 to 63 that identifies a replication grid within an organization.

**replication grid member**

A repository that is a member in a replication grid.

**replication policy (FSI and VTL only)**

A policy made up of rules that define a set of objects (for example, VTL cartridges) from a source repository to be replicated to a target repository.

**repository unique ID (RID)**

A number that uniquely identifies the repository. The RID is created from the replication grid ID and the repository internal ID in the grid.

**replication timeframe (FSI and VTL only)**

A scheduled period of time for replication to take place for all policies.

**shelf** A container of VTL cartridges within a ProtecTIER repository.

**TS7610 Appliance Express**

The short name for IBM's self-contained virtualization solution with an integrated server and storage hardware platform, IBM TS7610 ProtecTIER Deduplication Appliance Express.

**TS7620 Appliance Express**

The short name for IBM's self-contained virtualization solution with an integrated server and storage hardware platform, IBM TS7620 ProtecTIER Deduplication Appliance Express.

**virtual tape library (VTL)**

The ProtecTIER virtual tape library (VTL) service emulates traditional tape libraries. By emulating tape libraries, ProtecTIER ProtecTIER VTL allows you to switch to disk backup without replacing your entire backup environment. Your existing backup application can access virtual robots to move virtual cartridges between virtual slots and drives. The backup

application perceives that the data is being stored on cartridges while ProtecTIER actually stores data on a deduplicated disk repository.

### **visibility switching**

The automated process that transfers the visibility of a VTL cartridge from its master to its replica and vice versa. The visibility switching process is triggered by moving a cartridge to the source library Import/Export (I/E) slot. The cartridge will then disappear from the I/E slot and appear at the destination library's I/E slot. To move the cartridge back to the source library, the cartridge must be ejected to the shelf from the destination library. The cartridge will then disappear from the destination library and reappear at the source I/E slot.

## **FSI**

### **ACL – Access Control List**

A list of permissions attached to an object (file, directory, etc). An ACL specifies which users are allowed to access an object and which operations are allowed on the object.

### **AD – Windows Active Directory**

Windows-based software that manages user and group authentication and authorization between multiple servers.

### **Authentication**

The process of presenting credentials (username/password) to a service and having that service validate you.

### **Authorization**

The process of granting access to resources on a server that is in the network.

### **CIFS – Common Internet File System**

The Microsoft file sharing protocol that supports remote mounts over TCP/IP using the SAMBA server message block (SMB) protocol.

### **DNS – Domain name server**

Used to lookup and translate host names and IP addresses.

### **FSI – File System Interface**

This refers to the overall ProtecTIER File System Interface implementation. When used in this document without any qualifiers it will refer to the initial release supporting the CIFS interface.

### **Kerberos**

A computer network authentication protocol that allows nodes communicating over a non-secure network to prove their identity to one another in a secure manner. When used in this document this term will generally refer to the authentication protocol.

### **NAS - Network attached storage**

Storage that may be accessed over IP networks using a variety of different protocols such as CIFS, NFS, and HTTP.

### **NFS - Networked File system**

A file sharing protocol that supports remote mounts over TCP/IP.

### **Samba**

An open source package that provides a CIFS interface on a Linux server. When used in this document this term will generally refer to the CIFS interface.

**Stream**

Once a connection has been established, the data flowing between a file within the CIFS exported filesystem and a Windows (host) application is referred to as a stream. Both a connection and a file can support multiple streams according to the ProtecTIER FSI implementation.

**User file system**

Pertaining to the ProtecTIER file system created by the user and presented as a CIFS share.

---

## Who should read this document

This publication is intended for customers, system administrators, and personnel responsible for using and maintaining the IBM TS7610 and TS7620 ProtecTIER Deduplication Appliance Express system.

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## Getting information, help, and service

If you need help, service, technical assistance, or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. Available services, telephone numbers, and Web links are subject to change without notice.

**Information**

IBM maintains pages on the World Wide Web where you can get information about IBM products and services and find the latest technical information. For more information refer to Table 1.

*Table 1. IBM Web sites for help, services, and information*

<b>Description</b>	<b>Web address (URL)</b>
IBM home page	<a href="http://www.ibm.com">http://www.ibm.com</a>
Directory of worldwide contacts	<a href="http://www.ibm.com/planetwide">http://www.ibm.com/planetwide</a>

Table 1. IBM Web sites for help, services, and information (continued)

Description	Web address (URL)
Support for IBM System Storage® and TotalStorage products	<p><a href="http://www.support.ibm.com">http://www.support.ibm.com</a></p> <p>The <b>IBM Support Portal</b> page displays. Do the following:</p> <ol style="list-style-type: none"> <li>1. In the <b>Product Lookup</b> field, begin typing TS76. As you type, a list of matching products drops down below the input field.</li> <li>2. Select your product from the drop down list. The product you select appears below the Search field in the <b>Search supports and downloads</b> section. Items specific to the product you selected appear in the five areas below the Search field. You can search for specific information, or select one of the links in the <b>Downloads, Product support content, Tools and resources, Featured links, or Common support links</b>.</li> <li>3. To view a list of available fixes for your product, for example, click on → Downloads (drivers, firmware, PTFs).</li> </ol> <p>Alternatively, you can use the <b>Browse for a product</b> link.</p> <ol style="list-style-type: none"> <li>1. Click <b>Browse for a product</b>.</li> <li>2. Expand ► System Storage.</li> <li>3. Expand ► Tape systems.</li> <li>4. Expand ► Tape virtualization. The page shows a list of products.</li> <li>5. Select your product from the list. The product you select appears below the Search field in the <b>Search supports and downloads</b> section.</li> </ol>
IBM TS7610 ProtecTIER Deduplication Appliance Express and IBM TS7620 ProtecTIER Deduplication Appliance Express Customer Information Center DVD	<p><a href="http://pic.dhe.ibm.com/infocenter/ts7610/cust/index.jsp">http://pic.dhe.ibm.com/infocenter/ts7610/cust/index.jsp</a></p>

## Help and service

You can call 1 (800) IBM SERV for help and service if you are in the U.S. or Canada. You must choose the software or hardware option when calling for assistance.

**Note:** This product is equipped with a Software Call Home feature. When enabled, it will notify IBM Service of software error events. Not all countries currently support this feature, contact your next level of support for more information.

Before calling for support, be sure to have your Software Customer Number available.

Choose the software option if you are uncertain if the problem involves TS7610 or TS7620 Appliance Express software or TS7610 or TS7620 Appliance Express hardware. Choose the hardware option *only* if you are certain the problem solely involves the TS7610 or TS7620 Appliance Express hardware.

When calling IBM for service regarding the TS7610 or TS7620 Appliance Express follow these guidelines for the software and hardware options:

#### **Software option**

Identify the TS7610 or TS7620 Appliance Express as your product and supply your customer number as proof of purchase. The customer number is a 7-digit numeric (0000000 to 9999999) assigned by IBM when the PID is purchased and should be located on the customer information worksheet or on the invoice from the software purchase.

**Note:** If asked for an operating system, say "Storage"

#### **CAUTION:**

**If you supply an incorrect customer number you may be denied support for your software. Please keep track of this important information at the time of purchase.**

#### **Hardware option**

Provide the serial number and appropriate 4-digit Machine Type for the hardware component that displays a problem (for example, 3959).

## **Getting help online**

Provides Web addresses for getting help online.

Be sure to visit the following support page for the TS7610 or TS7620 Appliance Express, complete with FAQs, parts information, technical hints and tips, technical publications, and downloadable files, if applicable:

<http://www.ibm.com/servers/storage/support/tape>

For additional information, see "Websites" on page xxiii.

## **Before you call for service**

Some problems can be solved without outside assistance, by looking in the online or printed documentation that comes with the TS7610 Appliance Express, or by consulting the support Web page.

Be sure to read the information in any README files and release notes that come with the TS7610 Appliance Express.

## **Getting help by telephone**

With the original purchase of the IBM TS7610 and TS7620 ProtecTIER Deduplication Appliance Express, you have access to extensive support coverage. During the product warranty period, you can call the IBM Support Center (1-800-426-7378 in the U.S.) for product assistance covered under the terms of the hardware IBM warranty or the software maintenance contract that comes with product purchase.

**Important:** The TS7610 or TS7620 Appliance Express hardware components have additional support requirements and restrictions. If you experience problems with the hardware installation, refer to the *IBM TS7620 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, and OpenStorage Systems, v3.3, GA32-0914*.

When calling, have the following information available for the component:

- The machine type and serial number, or the software identifier. The software identifier can be either the product name (TS7610 or TS7620 Appliance Express) or the Product Identification (PID) number.
- The serial number or your proof of purchase.
- A description of the problem.
- The exact wording of any error messages.
- The hardware and software configuration information

If possible, have access to your computer when you call.

In the US and Canada, these services are available 24 hours a day, 7 days a week. In the UK, these services are available Monday through Friday, from 9:00 a.m. to 6:00 p.m. In all other countries, contact your IBM reseller or IBM marketing representative.

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## Websites

The most up to date information about the IBM TS7610 ProtecTIER Deduplication Appliance Express, including documentation and the most recent downloads, can be found at the following websites:

- The translated publications for this product are included with the product. These documents and product specification sheets are also available from the following website:  
<http://www-947.ibm.com/systems/support/supportsite.wss/brandmain?brandind=5345868>
- You can order publications through the IBM Publications Ordering System at the following website:  
<http://www.elink.ibm.com/publications/servlet/pbi.wss>
- Access installation and technical support information via the web at:  
[www.ibm.com/support](http://www.ibm.com/support)
- Access the IBM System Storage TS7610 ProtecTIER Deduplication Appliance Express Customer Information Center at:  
<http://pic.dhe.ibm.com/infocenter/ts7610/cust/index.jsp>
- The IBM HBA search Web site is:  
<http://www-01.ibm.com/systems/support/storage/config/hba/index.wss>
- The IBM Web site for Independent Software Vendor (ISV) support is:  
<http://www-304.ibm.com/jct01005c/isv/index.html>
- To access the IBM TS7650G Interoperability Matrix Web site, go to:  
[http://www-03.ibm.com/systems/support/storage/config/ssic/displaysssearchwithoutjs.wss?start\\_over=yes](http://www-03.ibm.com/systems/support/storage/config/ssic/displaysssearchwithoutjs.wss?start_over=yes)
- For the latest information about SAN switches and directors, go to the following Web site:  
[www.ibm.com/servers/storage/san](http://www.ibm.com/servers/storage/san)
- For accessibility information, go to the following Web site:  
[http://www-03.ibm.com/able/product\\_accessibility/index.html](http://www-03.ibm.com/able/product_accessibility/index.html)
- For the latest information about product recycling programs, go to the following Web site:  
[www.ibm.com/ibm/environment/products/prp.shtml](http://www.ibm.com/ibm/environment/products/prp.shtml)

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## Related IBM publications

The following documents provide information about the IBM TS7610 ProtecTIER Deduplication Appliance Express system and recommended additional hardware components.

### IBM TS7610 ProtecTIER Deduplication Appliance Express publications

The following publications provide additional documentation about the TS7610 Appliance Express server:

- *IBM TS7610 ProtecTIER Deduplication Appliance Express Introduction and Planning Guide*, v3.3, GA32-0914
- *IBM TS7620 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, and OpenStorage Systems*, v3.3, GA32-0914
- *IBM TS7610 and TS7620 ProtecTIER Deduplication Appliance Express Service Guide*, v3.3, GA32-0915
- *Best Practices Guide for IBM TS7600 ProtecTIER Deduplication Solutions*, v3.3, GA32-0924
- *IBM TS7610 and TS7620 ProtecTIER Deduplication Appliance Express Software Upgrade Guide*, v3.3, SC27-3641

For additional information, see the *IBM TS7610 ProtecTIER Deduplication Appliance Express and IBM TS7620 ProtecTIER Deduplication Appliance Express Customer Information Center DVD*.

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## How to send your comments

Your feedback is important in helping to provide the most accurate and highest quality information.

To submit any comments about this book or any other IBM System Storage TS7600 with ProtecTIER documentation:

- Send your comments by email to [starpubs@us.ibm.com](mailto:starpubs@us.ibm.com). Be sure to include the following information:
  - Exact publication title and version
  - Publication form number (for example, GC53-1196-03)
  - Page, table, or illustration numbers that you are commenting on with a detailed description of any information that should be changed



---

## **Part 1. Preparing to work with ProtecTIER**

This section of the guide describes the steps for completing the ProtecTIER system setup for new installations and upgrading ProtecTIER servers.

In addition, this part describes how to install and configure the ProtecTIER Manager software and how to manage repositories.



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## Chapter 1. Introduction

The TS7600 ProtecTIER Deduplication Solutions, V3.3.6.1 are advanced disk-based storage systems.

ProtecTIER is a disk-based data storage system. It uses data deduplication technology to store data to disk arrays. The ProtecTIER VTL service emulates traditional automated tape libraries. ProtecTIER OpenStorage implements a storage server emulation, which enables ProtecTIER to serve as a network-attached storage (NAS) backup target.

Before you use ProtecTIER and this document, ensure that you complete the planning, preparation, and installation tasks. These tasks are described in the following publications:

- *IBM TS7610 ProtecTIER Deduplication Appliance Express Introduction and Planning Guide, v3.3, GA32-0914*
- *IBM TS7620 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, and OpenStorage Systems, v3.3, GA32-0914.*

---

## HyperFactor

This topic describes IBM data factoring technology, known as HyperFactor®.

ProtecTIER is the first virtual tape product to contain patented data deduplication technology that IBM calls HyperFactor. This technology detects recurring data in multiple backups. The common data is merged into a single instance store, saving disk space needed to store multiple backups without sacrificing performance or the availability of backups.

HyperFactor is a breakthrough on several fronts:

- It is scalable up to 1024 TB.
- The algorithm used to find the common data between backups does not affect the backup performance of the virtual tape engine.
- Data integrity is not compromised, not even statistically.
- Merged data is stored in a format that preserves restore performance.

HyperFactor saves space by taking advantage of the fact that only a small percentage of data actually changes from backup to backup. Incremental backups include all files with modification dates that have changed since the last full or incremental backup. Full backups store all the data, changed or not.

The amount of space saved depends on many factors, mostly of the backup policies and retention periods and the variance of the data between them. The more full backups retained on ProtecTIER, and the more intervening incremental backups, the more overall space saved.

---

## ProtecTIER Virtual Tape

The ProtecTIER Virtual Tape service acts like a traditional tape drive.

The ProtecTIER Virtual Tape (VT) service emulates traditional tape libraries. Because ProtecTIER VT emulates tape libraries, you can switch to disk backup without replacing your entire backup environment. Your existing backup application can access virtual robots to move virtual cartridges between virtual slots and drives. The backup application perceives that the data is being stored on cartridges while ProtecTIER stores data on a deduplicated disk repository on the storage fabric.

---

## ProtecTIER OpenStorage

This topic provides an overview of the ProtecTIER OpenStorage service.

With OpenStorage (OST), ProtecTIER can be integrated with NetBackup to provide the means for backup-to-disk without having to emulate traditional tape libraries. Using a *plugin* installed on an OST-enabled media server, ProtecTIER can implement a communication protocol that supports data transfer and control between the backup server and the ProtecTIER server. To support the plugin, ProtecTIER implements a storage server emulation.

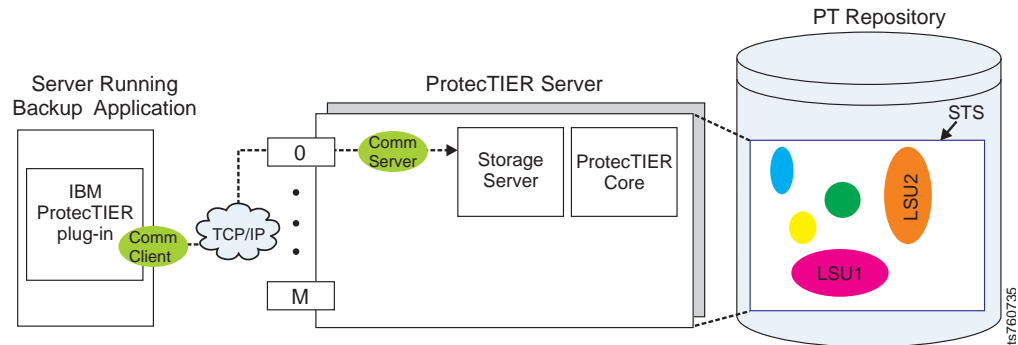


Figure 1. OpenStorage emulation

---

## ProtecTIER File System Interface (FSI)

This topic provides an overview of the ProtecTIER File System Interface (FSI).

With FSI, ProtecTIER emulates a network attached storage (NAS) backup target capable of using HyperFactor, as well as ProtecTIER Native Replication bandwidth reduction techniques for storing and replicating deduplicated data. ProtecTIER FSI enables backup servers running backup applications to connect over IP networks to ProtecTIER, without the use of FC connectivity and allows customers to use their existing tools and capabilities to integrate a ProtecTIER NAS-based backup target into your environment.

---

## ProtecTIER Manager

This topic provides an overview of the ProtecTIER Manager software.

The ProtecTIER Manager application can be installed on one or more workstations, enabling you to monitor the status of nodes in your ProtecTIER system along with the accompanying repositories and services. ProtecTIER Manager is used to initially configure your ProtecTIER system and to change the configuration.

---

## Configuration

The following information provides an overview of the ProtecTIER system configuration.

The TS7610 or TS7620 Appliance Express system is a one-node system. A one-node system uses a single server to transfer data from the backup server to the storage fabric, as illustrated in the following figure:

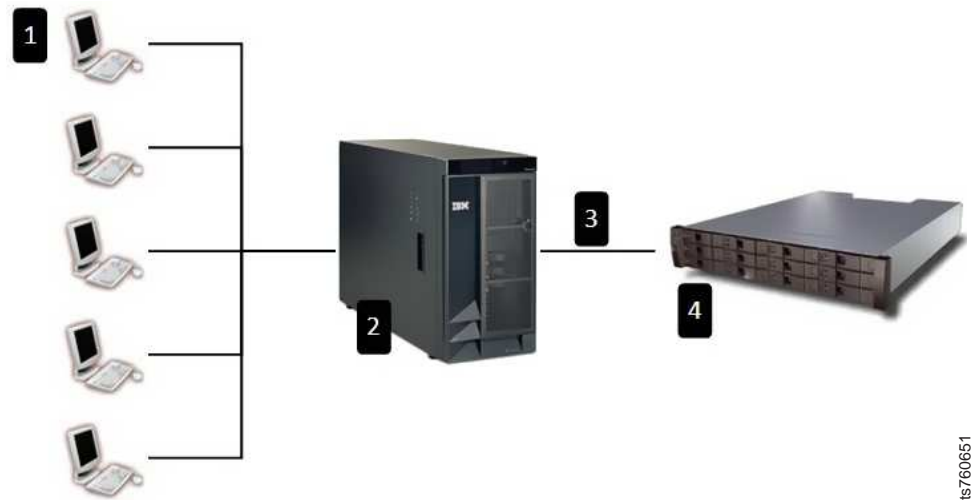


Figure 2. One node system

- 1** ProtecTIER Manager workstations (supplied by customer)
- 2** Main backup server (supplied by customer)
- 3** Fibre Channel cable connection (cable that is supplied by customer) for VTL and Ethernet cable (cable that is supplied by customer) for OST or FSI
- 4** TS7610 Appliance Express server

The TS7610 or TS7620 Appliance Express connects to the backup server. The backup server connects to one or more ProtecTIER Manager workstations that can be used to manage the ProtecTIER system.

---

## Native replication

Native replication lets you replicate between repositories connected to a wide area network (WAN) with TCP/IP protocol.

Replication enables you to set rules (depending on your required replication needs) for replicating data objects across ProtecTIER repositories. The ProtecTIER repositories can be different in size as well as physical layout. Since ProtecTIER deduplicates data before storing it, only the changes are transferred to the remote site. You define the rules for replicating data objects in replication policies on a repository.

A replication grid is a logical set of repositories that can replicate from one to the other. The ProtecTIER Replication Manager is a server that remotely manages the configuration of the grid (for example, grid creation or deletion, repository membership in the grid, and so on). In most cases, the ProtecTIER Replication Manager resides on the ProtecTIER server.

Before defining replication policies, however, you must first create physical connections between the repositories. To create physical connections, you define replication groups. Depending on your environment, you create replication groups in either "many-to-one" or "many-to-many" topologies.

In a "many-to-one" topology, you create replication groups in which source repositories can receive local backups and replicate to a single destination. The destination repository can then act as a Disaster Recovery site for any number of the source repositories, and still allow local backups, as well as replication, from the active source repositories.

In a "many-to-many" topology, you create replication groups where multiple repositories can replicate to each other. You can define a many-to-many replication group where each repository assumes the responsibility of a destination repository and can receive local backups, replicate data to remote repositories, and receive replicated data from remote repositories.

---

## Chapter 2. Completing the ProtecTIER system setup for new installations

This chapter details the prerequisites for completing the ProtecTIER system setup for new installations. Configuring the node is described in the *IBM TS7620 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, and OpenStorage Systems, v3.3, GA32-0914*.

If you are upgrading the ProtecTIER system, refer to the *IBM TS7650 ProtecTIER Software Upgrade Guide, V3.3.6.1, SC27-3643*.

Use the ProtecTIER Service menu to complete the ProtecTIER configuration process that was started in manufacturing. If you are working on a TS7650G, some or all of these configurations may have already been done during the node configuration.

**Note:** Throughout this chapter the terms server and node are used interchangeably, depending upon the task being performed.

---

### Accessing the ProtecTIER Service menu

Complete this task to access the ProtecTIER Service menu.

#### Procedure

1. Connect a USB keyboard and graphics-capable monitor to the server.
2. Verify that the server is running:
  - If it is, go on to step 3.
  - If it is not running: power it on now, wait for the boot cycle to complete, and then go on to step 3.
3. At the localhost **Login** prompt, type **ptconfig** and press Enter.
4. At the **Password** prompt, type **ptconfig** and press Enter.

The **ProtecTIER Service Menu** displays:

```
-----  
ProtecTIER Service Menu running on rassmx  
-----  
1) ProtecTIER Configuration (...)  
2) Manage ProtecTIER services (...)  
3) Health Monitoring (...)  
4) Problem Alerting (...)  
5) Version Information (...)  
6) Generate a service report  
7) Generate a system view  
8) Update ProtecTIER code  
  
E) Exit  
-----  
>>> Your choice?
```

5. Go on to “Customizing the ProtecTIER server”

---

### Customizing the ProtecTIER server

Complete this task to customize the ProtecTIER server.

## About this task

Perform the following steps to configure the server by using the ProtecTIER Service menu:

### Procedure

1. On the server, if it is not already displayed, access the ProtecTIER Service menu. See “Accessing the ProtecTIER Service menu” on page 7.
2. Select the **ProtecTIER Configuration (...)** option. Type the corresponding number and press Enter. The **ProtecTIER Configuration (...)** menu appears.

```
-----  
ProtecTIER Service Menu running on rassmx  
ProtecTIER Configuration (...)  
-----  
1) Configure ProtecTIER node  
2) Recover Configuration for a replaced server  
3) Configure enclosure serial number for a replaced enclosure  
4) Update Time, Date, Timezone & Timeserver(s)  
5) Configure replication (...)  
6) IP Network configuration (...)  
7) Update Firmware  
8) Update the System's name  
9) Validate configuration  
10) Single node - code upgrade (For Support Use ONLY)  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

3. Select the **IP Network configuration (...)** option. Type the corresponding number and press Enter. The **IP Network configuration (...)** menu appears.

```
-----  
ProtecTIER Service Menu running on rassmx  
ProtecTIER Configuration (...)  
IP Network Configuration (...)  
-----  
1) Configure hostname  
2) Configure ProtecTIER's IP interfaces  
3) Configure Static Routes  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

4. Select the option **Configure ProtecTIER's IP interfaces** to configure external. Type the corresponding number and press Enter.

If asked if you would like to stop the vtfld service, type yes and press Enter.

The following status message displays as the system initiates shutdown:

```
Stopping VTFD [/]
```

The shutdown process may take a few minutes to complete.

When shutdown completes, the following status message appears:

```
Stopping RAS [ Done ]
```

```
Stopping VTFD [ Done ]
```

5. Change the server IP address, netmask, default gateway, and host name factory-set values, to the values specific to the customer environment.
  - a. You are prompted, one at a time to enter the following values. At each prompt, type the new value and then press <Enter>:
    - Customer Network IP address



- Customer Network netmask
- Customer Network default gateway
- Customer Network hostname (The fully qualified hostname of the server. For example: hostname.domain.com)

After you enter the hostname, the system automatically starts the network configuration process. The following status messages display:

```
Configuring network [ Done ]
Updated network configuration successfully
update updateNetwork ended successfully
```

The system automatically restarts the vtfd service, and you are returned to the command prompt.

6. Change the system name from the one assigned during manufacturing to one specific to the customer environment. To do so:
  - a. From the **ProtecTIER Configuration (...)** menu, select the **Update System Name** option. Type the number of your choice and press Enter.
  - b. When prompted, type the new system name of the server and press Enter.

**Note:** The system name that was assigned to the server in manufacturing appears in brackets after the prompt. For example: [PORTLAND]. After you enter the system name, the system automatically starts the **Update the System Name** process. The following status message appears:

```
Changing system name [ Done ]
Updated system name successfully
UpdateSystemName ended successfully
```

End Processing Procedure Successfully

Press Enter to continue and return to the command prompt.

7. When you are finished, go on to Chapter 4, “Installing ProtecTIER Manager,” on page 25.

---

## Configuring static routes

Complete this task to configure the static routes for replication.

### About this task

In this task you will provide information about your source server(s) and the target server(s), in order to define the static routes.

For assistance with this task, refer to the information on your completed **Configure Static Route for Replication** worksheet(s).

Run this procedure on the source server(s) to configure the addresses of all the destination systems and the node on which the ProtecTIER Replication Manager is activated. On the destination server(s), run this procedure to configure the addresses of the source system(s).

On the ProtecTIER Replication Manager node, all the systems (source and destination) must be configured.

### Procedure

1. Access the ProtecTIER Configuration Menu. See “Accessing the ProtecTIER Service menu” on page 7.

- From the ProtecTIER Service Menu, select **ProtectTIER Configuration (...)**. Type the corresponding number and press Enter. The **ProtectTIER Configuration (...)** menu is displayed.

```

-----
ProtectTIER Service Menu running on rassmx
ProtectTIER Configuration (...)
-----
1) Configure ProtecTIER node
2) Recover Configuration for a replaced server
3) Configure enclosure serial number for a replaced enclosure
4) Update Time, Date, Timezone & Timeserver(s)
5) Configure replication (...)
6) IP Network configuration (...)
7) Update Firmware
8) Update the System's name
9) Validate configuration
10) Single node - code upgrade (For Support Use ONLY)

B) Back
E) Exit
-----
>>> Your choice?

```

- Select **Configure replication (...)**. Type the corresponding number and press Enter. The **Configure replication (...)** menu is displayed.

```

-----
ProtectTIER Service Menu running on rassmx
ProtectTIER Configuration (...)
Configure Replication (...)
-----
1) Configure/Unconfigure ProtecTIER Replication Manager on this node
2) Configure Static Routes

B) Back
E) Exit
-----
>>> Your choice?

```

- Select **Configure Static routes**. Type the corresponding number and press Enter.

The message: Gathering System information [Done] displays, followed by a summary of the information that was retrieved for the server on which you are currently working. For example:

ID	Target Network Address	Target Netmask	Local Gateway Address
1	10.11.195.0	255.255.255.0	10.11.195.1
2	10.11.197.0	255.255.255.0	10.11.197.1

Following the summary, the **Available Options** prompt displays:

Available Options:

=====

- (a)dd a new record
- (e)dit a record
- (d)elete a record
- (c)ommit changes
- (q)uit

Please Choose (a,e,d,c,q):

5. Select **(a)dd a new record**. Type **a** and press Enter.  
You are prompted to enter information for the first destination (target) server and the local network.
6. At each prompt, type the requested information and then press Enter:  
Please provide the following information:  
Target Network Address:  
This is the starting network address of the Target (Hub) server. For example: *10.11.194.0*.  
Target Netmask:  
This is the network netmask address of the Target (Hub) server. For example: *255.255.255.0*.  
Local Gateway Address:  
This is the gateway IP address of the local server you are currently working on. For example: *10.11.195.1*.  
A summary of the information you provided, displays. For example:

ID	Target Network Address	Target Netmask	Local Gateway Address
1	10.11.194.0	255.255.255.0	10.11.195.1

**Note:** The addresses in the above summary are examples. Your actual values will vary.

The Available Options prompt displays a second time:

Available Options:

=====

(a)dd a new record

(e)dit a record

(d)etele a record

(c)ommit changes

(q)uit

Please Choose (a,e,d,c,q):

7. Type **a** and press Enter.  
You are prompted for the information for the second destination (target - ETH2) server and the local network.
8. At each prompt, type the requested information and then press Enter:  
Please provide the following information:  
Target Network Address:  
This is the starting network address of the Target (Hub) server. For example: *10.11.196.0*.  
Target Netmask:  
This is the network netmask address of the Target (Hub) server. For example: *255.255.255.0*.  
Local Gateway Address:  
This is the gateway IP address of the local server you are currently working on. For example: *10.11.197.1*  
An updated summary displays:

ID	Target Network Address	Target Netmask	Local Gateway Address
1	10.11.194.0	255.255.255.0	10.11.195.1
2	10.11.196.0	255.255.255.0	10.11.197.1

**Note:** The addresses in the above summary are examples. Your actual values will vary.

The Available Options prompt displays a third time:

Available Options:

=====

(a)dd a new record

(e)dit a record

(d)elete a record

(c)ommit changes

(q)uit

Please Choose (a,e,d,c,q):

9. Type: **q** <enter>

The Would you like to commit the changes performed to the routing table now? (yes|no) message, displays.

10. Type **yes** and press Enter.

The Successfully committed changes! message displays.

11. Press Enter to return to the **ProtectTIER Configuration Menu**.

12. Quit the menu to exit. Type **q** and press Enter. You are returned to the **login** prompt.

13. Configuration for one source server and the destination server, is now complete. Confirm that your replication configuration was successful. To do so, refer to the instructions in Chapter 9, "Native Replication Management (for VTL)," on page 89.

---

## Setting the timezone

Use the procedures in this task to change the time zone setting to match that of your location. *You must set the timezone to ensure accurate system timekeeping.*

### Procedure

1. On the **ProtectTIER Configuration (...)** menu (see "Setting the timezone"), select the **Update Time, Date, Timezone & Timeserver(s)** option. Type the corresponding number for this selection and press Enter.

The **Date, Time, Timezone & Timeserver(s) configuration** menu, displays:

```

-----
ProtectTIER Service Menu running on rassmx
      Date, Time, Timezone & Timeserver(s) configuration
-----
1. Set date & time
2. Set Timezone
3. Set Timeserver(s)

c. Commit changes and exit
q. Exit without committing changes
-----
>>> Please Choose:

```

Figure 3. Date, Time, Timezone & Timeserver(s) configuration menu

**Note:** To prevent selections from scrolling off the screen, consider setting the paging to show fewer lines of information.

2. Select the **Set Timezone** option. Type the corresponding number and press Enter.
3. If you are in the United States, when prompted for a country code, type: US and press Enter.

For locations outside the United States, you must enter an international country code. Refer to Appendix C, “Worldwide time zone codes,” on page 243 to locate your information, then return to this task and enter the appropriate country code in step “Setting the timezone” on page 12.

The time zones for the specified country display. A sample of the US time zones list is shown in “Setting the timezone” on page 12:

```

Time zones under US:
=====
1. America/New_York
2. America/Detroit
3. America/Kentucky/Louisville
4. America/Kentucky/Monticello
5. America/Indiana/Indianapolis
6. America/Indiana/Vincennes
7. America/Indiana/Winamac
8. America/Indiana/Marengo
9. America/Indiana/Petersburg
10. America/Indiana/Vevay
11. America/Chicago
12. America/Indiana/Tell_City
13. America/Indiana/Knox
14. America/Menominee
15. America/North_Dakota/Center
16. America/North_Dakota/New_Salem
17. America/Denver
18. America/Boise
19. America/Shiprock
20. America/Phoenix
21. America/Los_Angeles
22. America/Anchorage
23. America/Juneau
24. America/Yakutat
25. America/Nome
26. America/Adak

Press <Enter>

27. Pacific/Honolulu

Please choose a timezone:

```

Figure 4. Sample of US time zones

4. If the Press enter to continue prompt displays, the time zone list is too long to display on the screen at once. Press Enter to advance the list.
5. At the Please choose a timezone: prompt, type the number that corresponds to your timezone and press Enter to return to the **Date, Time, Timezone & Timeserver(s) configuration** menu. Type: c for commit and press Enter.  
The current time, date, and timezone settings display for review.
6. At the Do you wish to apply those settings? (yes|no) prompt, type: yes and press Enter.  
The following message appears: The cluster & VTFD services on all nodes must be stopped in order to continue. Do you wish to continue? (yes|no). Type: yes and press Enter.  
A series of status messages appears as the services are stopped and restarted. This process might take up to 10 minutes. When the service restart is complete, the Press the ENTER key to continue... message appears.
7. Press Enter to continue and return to the  **ProtecTIER Configuration (...)** menu.

---

## Setting the date and time

Each server contains a battery that must be calibrated.

### About this task

Use the procedures in this task to check the time and date on the server. If necessary, change the settings to match the time and date at your location.

**Important:** With Version 3.3.6 and later, you must apply each change you make to the timezone, date and time, and time server individually before proceeding to the next task.

### Procedure

1. On the  **ProtecTIER Configuration (...)** menu (see “Setting the date and time”), select the **Update Time, Date, Timezone & Timeserver(s)** option. Type the corresponding number for this selection and press Enter.  
The **Date, Time, Timezone & Timeserver(s) configuration** menu, displays:
2. On the **Date, Time, Timezone & Timeserver(s) configuration** menu (see “Setting the date and time”), select the **Set date & time** option. Type the corresponding number and press Enter.
3. When prompted for the date:
  - If the default date [displayed in brackets] is correct, press Enter.
  - If the default date is incorrect, type the current date in DD/MM/YYYY format and press Enter. For example, 09/01/2012.
4. When prompted for the time:
  - If the default time [displayed in brackets] is correct, press Enter.
  - If the default time is incorrect, type the current time in HH:MM:SS format and press Enter. For example:08:32:58.
5. At the Please choose: prompt, commit your date and time settings To commit, type: c and press Enter.  
The current time, date, and timezone settings display for review.
6. At the Do you wish to apply those settings? (yes|no) prompt, type: yes and press Enter.

You are notified as follows: The cluster & VTFD services on all nodes must be stopped in order to continue. Do you wish to continue? (yes|no). Type: yes and press Enter.

A series of status messages appears as the services are stopped and restarted. This process might take up to 10 minutes. When the service restart is complete, the Press the ENTER key to continue... message displays.

7. Press Enter to continue and return to the **ProtectTIER Configuration (...)** menu.

---

## ProtectTIER Network Performance Validation Utility

The objective of the `pt_net_perf_util` is to test maximal network performance in order to discover potential performance bottlenecks. On VTL systems, the utility tests maximal replication performance between two future ProtectTIER VTL repositories by emulating the network usage patterns of the ProtectTIER Native Replication component. On OpenStorage systems, the utility tests network performance between an OpenStorage host and a ProtectTIER server to identify possible bottlenecks in a backup and restore scenario.

---

## ProtectTIER Replication Network Performance Validation Utility for VTL Systems

The objective of the VTL `pt_net_perf_util` utility is to test maximal replication performance between two future ProtectTIER VTL repositories by emulating the network usage patterns of the ProtectTIER Native Replication component. This utility can not predict replication performance, but it can discover performance bottlenecks.

### Before you begin

The requirements of this utility are as follows:

- Red Hat Linux version 5.6 or Red Hat Linux version 5.4
- Standard external utilities expected to be in the current path: ping, netstat, getopt, echo.

The `pt_net_perf_util` utility and the iperf tool are part of the ProtectTIER software installation. To test the replication performance, use the following tool:

- iperf 2.0.4  
`/usr/local/bin/iperf`

This utility has two modes of operation, client and server. The server has to be started before the client. Before running the utility, shut down all other programs on both the client and server ProtectTIER systems. The **client** is the ProtectTIER system that transmits the test data and the **server** is the ProtectTIER system that receives the data (also known as the **target** server). Based on the data sent by the client and received by the server, the script outputs key network parameter values which indicate certain attributes of the network. The goal of these tests is to benchmark the throughput of the network. The most important benchmark is the direction that replication actually takes place, that is, test the target as the server since the flow of data will be **to** that server from the client. However, it is also important to also test the reverse direction to measure the bandwidth performance during disaster recovery failback. Network bandwidth is not always the same in both directions.

Before you can run the utility you must configure the replication ports on both the source and destination servers and define static routes between them in both directions.

## About this task

In the following procedure, the goal is to test network performance between two machines on a WAN, **server1** and **server2**. Each test runs for five minutes. Since there are five tests, the process takes a total of 25 minutes.

Repeat these tests for each server and for each replication port on the server (two tests total per server, one for each replication port).

## Procedure

1. At the login prompt, log in with user name `ptconfig` and password `ptconfig`. Press Enter. On the command line, type `menu` and press Enter. The ProtecTIER Service Menu is displayed.

```
-----  
ProtecTIER Service Menu running on rassmx  
-----  
1) ProtecTIER Configuration (...)  
2) Manage ProtecTIER services (...)  
3) Health Monitoring (...)  
4) Problem Alerting (...)  
5) Version Information (...)  
6) Generate a service report  
7) Generate a system view  
8) Update ProtecTIER code  
  
E) Exit  
-----  
>>> Your choice?
```

2. Stop the VTFD services.
  - a. Select the option to **Manage ProtecTIER services**.
  - b. The **Manage ProtecTIER services** menu is displayed.

```
-----  
ProtecTIER Service Menu running on rassmx  
Manage ProtecTIER Services (...)  
-----  
1) Display services status  
2) Start all services  
3) Stop all services  
4) Stop ProtecTIER services only (including GFS)  
5) Stop VTFD service only (including GFS)  
6) Poweroff This Node  
7) Reboot This Node  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

- c. Select the option to **Stop ProtecTIER services only (including GFS)**.

**Note:** You can also stop the VTFD services from the command line. From the command line on the server, type the following command and press Enter:  
`service vtfld stop`

3. Wait for the services to stop. A message similar to the following displays:



Shutting down vtfd: [ OK ]

Please wait .....  
[root@austin ~]#

4. Start the server mode of the utility on **server1** by entering the following commands on the command line:

```
cd /opt/dtc/app/sbin  
./pt_net_perf_util -s
```

5. Start the client mode of the utility on **server2** by entering the following command on the command line:

```
cd /opt/dtc/app/sbin  
./pt_net_perf_util -c <x.x.x.x> -t 300
```

Where <x.x.x.x> is the IP address of the server replication port.

6. The utility automatically performs the tests in sequence. The **client** output (**server2** in the example shown) looks similar to the following:

**Note:** In the sample output below the test ran for only 5 seconds instead of 300.

```
*** Latency  
PING 9.5.53.33 (9.5.53.33) 56(84) bytes of data.  
  
--- 9.5.53.33 ping statistics ---  
5 packets transmitted, 5 received, 0% packet loss, time 4001ms  
rtt min/avg/max/mdev = 0.257/0.406/0.484/0.079 ms  
  
*** Throughput - Default TCP  
[ 3] 0.0- 5.0 sec 56.6 MBytes 94.8 Mbits/sec  
  
*** Throughput - 1 TCP stream(s), 1MB send buffer  
[ 3] 0.0- 5.0 sec 57.0 MBytes 95.0 Mbits/sec  
  
*** Throughput - 16 TCP stream(s), 1MB send buffer  
[SUM] 0.0- 5.8 sec 65.0 MBytes 94.3 Mbits/sec  
  
*** Throughput - 127 TCP stream(s), 1MB send buffer  
[SUM] 0.0-11.3 sec 127 MBytes 94.1 Mbits/sec  
  
Number of TCP segments sent: 230536  
Number of TCP retransmissions detected: 21 (0%)  
  
Done.
```

See the next section for information about interpreting the results of the tests.

## Interpreting the results

The utility performs five foreground tests (Tests 1-5 below), and one background test (Test 6 below). The example outputs shown are from the client side. Each of the first five tests ran for 300 seconds (-t 300), while the last test monitored TCP performance during that time.

### Test 1: Latency

This test checks the nominal network link latency and packet loss. Example result:

```
*** Latency  
PING 10.0.13.194 (10.0.13.194) 56(84) bytes of data.
```

```
--- 10.0.13.194 ping statistics ---
120 packets transmitted, 120 received, 0% packet loss, time 119060ms
rtt min/avg/max/mdev = 57.403/78.491/104.451/9.872 ms
```

Interpreting the results:

- The average round-trip-time (rtt) was 78.4 ms and there was 0% packet loss.
- The latency in WAN topologies can vary, but should never exceed 200 ms. Contact your network administrator if latency reports more than 200 ms, as it can significantly decrease replication throughput.
- Higher latency values can cause a major deterioration in replication throughput.
- Packet loss should be 0%. Any other value indicates a major network problem.

### Test 2: Throughput - default settings

This test checks maximal TCP throughput of a single data stream with default TCP settings. Example result:

```
*** Throughput - Default TCP
[ 3] 0.0-120.1 sec 2.41 GBytes 173 Mbits/sec
```

Interpreting the results:

- The test ran for 120.1 seconds, transferred 2.41 GB (2.24 GiB), with an average throughput of 173 Mbits/sec.

**Note:** 1 MByte = 1,048,576 bytes. 1 Mbit/sec = 1,000,000 bits/sec.

### Test 3: Throughput - single stream, 1 MB send buffer

This test checks maximal TCP throughput of a single data stream with a 1 MB (0.95 MiB) send buffer. Example result:

```
*** Throughput - 1 TCP stream(s), 1MB send buffer
[ 3] 0.0-120.0 sec 2.51 GBytes 180 Mbits/sec
```

Interpreting the results:

- The test ran for 120.0 seconds, transferred 2.51 GB (2.34 GiB), with an average throughput of 180 Mbits/sec.
- There might be an improvement here on high-latency links.

### Test 4: Throughput - 16 streams, 1 MB send buffer

Example result:

```
*** Throughput - 16 TCP stream(s), 1MB send buffer
[SUM] 0.0-121.4 sec 5.91 GBytes 418 Mbits/sec
```

Interpreting the results:

- The test ran for 121.4 seconds, transferred 5.91 GB (5.5 GiB), with an average throughput of 418 Mbits/sec.
- The extra streams yielded higher utilization of the connection.
- The Mbits/sec reported in this test is the maximum replication performance your system will achieve if you are using up to 2-3 cartridges in parallel.

### Test 5: Throughput - 127 streams, 1 MB send buffer

Example result:

```
*** Throughput - 127 TCP stream(s), 1MB send buffer
[SUM] 0.0-126.1 sec 8.08 GBytes 550 Mbits/sec
```

Interpreting the results:

- The test ran for 126.1 seconds, transferred 8.08 GB (7.53 GiB), with an average throughput of 550 Mbits/sec.
- TCP takes a while to reach its maximal throughput. Longer testing times, 300 seconds or more, produces more accurate results.
- The throughput value given by this test is the potential physical replication throughput for this system. It is directly affected by the available bandwidth, latency, packet loss, and retransmission rate.
- The Mbits/sec reported in this test is the maximum replication performance your system might achieve. If this number is lower than anticipated, contact your network administrator.

### Test 6: TCP Retransmissions versus Total TCP segments sent

Example result:

```
Number of TCP segments sent: 1619061
Number of TCP retransmissions detected: 201038 (12%)
```

Interpreting the results:

- A total of 1619061 TCP segments were sent during the five tests, out of which, 201038 were lost and retransmitted.
- The retransmission rate imposes a direct penalty on the throughput, as the retransmission of these packets takes up bandwidth. The retransmission can be caused by the underlying network (for example, packet dropping by an overflowed router) or by the TCP layer itself (for example, retransmission due to packet reordering).
- Segment loss can be caused by each of the network layers.
- TCP retransmission larger than 2% can cause performance degradation and unstable network connectivity. Contact your network administrator to resolve this issue and reduce it to approximately 0%.

### What to do next

You might want to run these tests again to test the reverse throughput in the network. To run the tests in reverse, change **server1** to the client and **server2** to the server and repeat the procedures.



---

## Chapter 3. Configuring replication

Use the applicable options on the ProtecTIER Service Menu to configure your system for replication.

### About this task

Once basic system configuration is complete, you can perform the tasks required to configure your system for replication. To do so, you will need to complete the pre-configuration tasks outlined in “Before you begin,” as well as “Accessing the ProtecTIER Service Menu” through “Configuring static routes” on page 9, if necessary.

---

### Before you begin

This topic describes the prerequisites for configuring replication.

#### About this task

Replication configuration requires careful planning, decision-making, and coordination of effort. Before you get started, it is strongly recommended that you complete these tasks:

- Make sure that TCP ports 6520, 6530, 6540, 6550 are open in your firewall. Each ProtecTIER server being used for replication must allow TCP access through these ports.
- Ensure that the replication ports are on a different subnet than the external local area network (LAN) port. Having the replication ports and the external LAN port on the same subnet may cause replication errors.

In addition, IBM recommends that on all ProtecTIER nodes or servers involved in Native Replication, you configure all eth3 ports on one subnet, and you configure all eth4 ports on a different subnet.

- Identify the person (or persons) responsible for completing the planning worksheets.

It is strongly recommended that the worksheets be filled out in advance by someone with extensive knowledge of your organization's network and TCP/IP configuration. This will ensure that the information is technically accurate and readily available during replication setup.

- Identify the person (or persons) responsible for configuring the TARGET(S) and SOURCE(S) servers for replication, depending on the replication topology you are using.

This may or may not be the same person (or persons) who completed the worksheets.

After completing the above tasks, return to this page and go to “Accessing the ProtecTIER Service Menu.”

---

### Accessing the ProtecTIER Service Menu

Complete this task to access the ProtecTIER Service menu.

## Procedure

1. If necessary, power-on the server and the monitor, and wait for the **login** prompt to display.
2. At the **login** prompt, type: **ptconfig** and press Enter.
3. At the **Password** prompt, type: **ptconfig** and press Enter.

The **ProtectTIER Service Menu** displays:

```
-----  
ProtectTIER Service Menu running on rassmx  
-----
```

- ```
1) ProtectTIER Configuration (...)  
2) Manage ProtectTIER services (...)  
3) Health Monitoring (...)  
4) Problem Alerting (...)  
5) Version Information (...)  
6) Generate a service report  
7) Generate a system view  
8) Update ProtectTIER code
```

```
E) Exit
```

```
-----  
>>> Your choice?
```

4. Go on to “Configuring ProtectTIER Replication Manager.”

---

## Configuring ProtectTIER Replication Manager

Use this procedure to configure the ProtectTIER Replication Manager application on the designated server in your replication grid.

### About this task

You must configure the Replication Manager application on the server that remotely manages the replication grid or grids within your organization. IBM recommends configuring the ProtectTIER Replication Manager application on the TARGET server at the remote (destination) site. By doing so, the Replication Manager will remain available in a disaster recovery situation.

**Note:** This task may be completed at any time during the replication configuration process. However, creation of the replication grid and verification of the replication configuration, cannot take place until ProtectTIER Replication Manager is up and running on the designated server.

### Procedure

1. On the designated ProtectTIER Replication Manager server, if it is not already displayed, access the ProtectTIER Service Menu. See “Accessing the ProtectTIER Service Menu” on page 21.
2. From the ProtectTIER Service Menu, select **ProtectTIER Configuration (...)**. Type the corresponding number and press Enter. The **ProtectTIER Configuration (...)** menu is displayed.

```
-----  
ProtectTIER Service Menu running on rassmx  
ProtectTIER Configuration (...)  
-----
```

- 1) Configure ProtectTIER node
  - 2) Recover Configuration for a replaced server
  - 3) Configure enclosure serial number for a replaced enclosure
  - 4) Update Time, Date, Timezone & Timeserver(s)
  - 5) Configure replication (...)
  - 6) IP Network configuration (...)
  - 7) Update Firmware
  - 8) Update the System's name
  - 9) Validate configuration
  - 10) Single node - code upgrade (For Support Use ONLY)
- B) Back  
E) Exit

```
-----  
>>> Your choice?
```

3. Select **Configure replication (...)**. Type the corresponding number and press Enter. The **Configure replication (...)** menu is displayed.

```
-----  
ProtectTIER Service Menu running on rassmx  
ProtectTIER Configuration (...)  
Configure Replication (...)  
-----
```

- 1) Configure/Unconfigure ProtectTIER Replication Manager on this node
  - 2) Configure Static Routes
- B) Back  
E) Exit

```
-----  
>>> Your choice?
```

4. Select **Config/Unconfig ProtectTIER Replication Manager on this node**. Type the corresponding number and press Enter.
5. When the **Replication Manager is currently unconfigured, do you wish to configure it? (yes|no)** prompt displays, type: **yes** and press Enter.

The warning below displays:

Warning: You should not configure Replication Manager on more than one server in a grid, as doing so may cause conflicts within the grid. It is recommended that you designate the Target server (Hub) as the Replication Manager.

6. When the **Are you sure you want to configure the ProtectTIER Replication Manager on this node? (yes|no)** prompt displays, type: **yes** and press Enter. The status messages below, display:  
Gathering information [ Done ]  
The configurePTReplicationManager ended successfully message displays.
7. When the **Press the ENTER key to continue...** prompt displays, press Enter. You are returned to the **Configure replication (...)** menu.
8. If the static routes have not been previously configured, continue to "Configuring static routes" on page 9.
9. Type **E** and press Enter to exit.





---

## Chapter 4. Installing ProtecTIER Manager

The topics in this chapter describe how to install, configure, and uninstall the ProtecTIER Manager software.

The ProtecTIER system is managed with the ProtecTIER Manager software. It is recommended that you install the ProtecTIER Manager software on one or more workstations and not directly on the ProtecTIER TS7610 Appliance Express.

ProtecTIER Manager enables you to:

- Configure ProtecTIER
- Monitor the status of the TS7610 Appliance Express
- Manage file systems, repositories, and services
- Change the system configuration
- Manage Native Replication activities with the ProtecTIER Replication Manager software

---

### Prerequisites for the ProtecTIER Manager workstation

This topic describes the workstation prerequisites for installing and running the ProtecTIER Manager.

The ProtecTIER Manager workstation must meet the following prerequisites in order to install and run ProtecTIER Manager effectively:

- One of the following operating systems:
  - Windows 32/64 bit (XP Professional, 2003, Windows 7)
  - Linux Red Hat 32/64 bit (Red Hat Enterprise 4 or 5)
- At least 1.2 GB of available disk space
- At least 256 MB of RAM
- Workstation access to the ProtecTIER service nodes IP addresses (ports 3501 and 3503 are open on the firewall).

IBM recommends that you use the following settings to configure the monitor for ProtecTIER Manager:

- Resolution of 1024 x 768 pixels or higher (this resolution is the minimum supported, however, 1280 x 1024 is recommended).
- 24 bit color or higher

**Note:** If you are planning to run ProtecTIER Manager on a UNIX system, configure your graphics card and X Window System. You can perform this task either manually or by use of the Xconfigurator utility. For instructions, refer to the appropriate Linux documentation.

---

### Installing the ProtecTIER Manager software

Use the procedures in this chapter to install the latest version of ProtecTIER Manager software on the ProtecTIER Manager Workstation.

**Important:** Before starting the installation, make sure that the currently installed ProtecTIER Manager application is closed.

The ProtecTIER Manager installer is provided on your *IBM ProtecTIER Manager V3.3.6.1* DVD.

Different ProtecTIER Manager installers are used for Windows and Linux. Ensure that the installer that you are using is correct for the operating system running on your workstation.

- If you are installing ProtecTIER Manager on a workstation running Windows, see “Installing on Windows.”
- If you are installing ProtecTIER Manager on a workstation running Linux, see “Installing on Linux” on page 27.

If you are installing ProtecTIER Manager on a workstation on which an older version of ProtecTIER Manager is already installed, uninstall the older version first. For more information, see “Uninstalling the ProtecTIER Manager software” on page 28.

## Installing on Windows

Complete this task to install ProtecTIER Manager on a Windows system.

### About this task

Perform the following steps to install ProtecTIER Manager on a Windows system:

### Procedure

1. Insert the *IBM ProtecTIER Manager V3.3.6.1* DVD into the CD-ROM drive of the designated ProtecTIER Manager workstation.
  - If the ProtecTIER Manager installer launches and starts the installation, go on to step 2.
  - If the ProtecTIER Manager installer process does not launch automatically, do the following:
    - a. On the Windows task bar, click: **Start > Run**. The **Run** dialog box opens.
    - b. In the Open box, type: **D:** (where D: is the CD-ROM drive of the server).
    - c. Click **OK**.

The contents of the *IBM ProtecTIER Manager V3.3.6.1* DVD displays.
    - d. From the list of files, locate the ProtecTIER Manager for Windows installation file and double-click the file to start the installation.
2. Read the **Introduction** screen, and then click **Next**.
3. Read and accept the license agreement provided, and click **Next**.

The **Choose Install Folder** screen is displayed.
4. Specify the folder where the ProtecTIER Manager program files are to be installed, and click **Next**.

The **Choose Shortcut Folder** screen is displayed.
5. Select the location where the program icons are to be created:
  - **In a new Program Group** - Creates a program group in the Program list of the Start menu.
  - **In an existing Program Group** - Adds the shortcut to an existing program group in the Program list of the Start menu.
  - **In the Start Menu**
  - **On the Desktop**
  - **In the Quick Launch Bar**

- **Other** - Enables you to enter a path location for the shortcut, or to browse for a location by clicking Choose.
- **Don't create icons** - No shortcuts are created.

**Note:** When relevant, you can select **Create Icons for All Users** to create a shortcut in the defined location for all user accounts on the workstation.

6. Click **Next**.

The **Pre-Installation Summary** screen displays the Install and Shortcut folder locations and the disk space information of the target for installation.

7. Review the **Summary** screen, and click **Install** to start the installation.

The **Installing ProtecTIER Manager** screen is displayed.

8. When the installation is complete and ProtecTIER Manager has been successfully installed, click **Done**.

The ProtecTIER Installation wizard closes and the installation process is complete.

## What to do next

Go on to the next chapter.

## Installing on Linux

Complete this task to install ProtecTIER Manager on a Linux system.

### About this task

Perform the following steps to install ProtecTIER Manager on Linux:

### Procedure

1. Insert the *IBM ProtecTIER Manager V3.3.6.1* DVD into the CD-ROM drive of the designated ProtecTIER Manager workstation.
2. Run the ProtecTIER Manager installer.

**Note:** This procedure presumes that the workstation has a Linux graphical interface which is required for ProtecTIER Manager.

- a. From the Linux Desktop, select and open the CD drive icon.
- b. Select and open the folder for your Linux version: **Linux** for version **64** or **Linux32** for version **32**.
- c. When the folder opens, drag the **InstallLinuxXX.bin** file from the folder to the Desktop. (XX=either 32 or 64, depending on the Linux folder that you selected.)
- d. Close the open windows.
- e. Right-click on an open area of the Desktop, and from the menu options displayed, select **Open Terminal**.
- f. At the Terminal command prompt, use the following command to change to the Desktop directory (**Note:** Desktop is case-sensitive. Type it using a capital "D".):

```
cd Desktop
```

and press Enter.

- g. From the Desktop directory in the Terminal window, run the ProtecTIER Manager installer:

```
./InstallLinuxXX.bin
```

and press Enter.

(XX= either 32 or 64)

If the message: Permission Denied displays, enter the following commands:

```
chmod +x InstallLinuxXX.bin
./InstallLinuxXX.bin
```

after typing each command press Enter.

The **IBM ProtecTIER Manager** wizard **Introduction** screen is displayed.

3. Click **Next**. Two separate **Software License Agreement** screens display.
4. Read the terms for each license agreement, select **I accept both the IBM and non-IBM terms of the License Agreement** and click **Next**. The **Choose Install Folder** screen is displayed.
5. Enter the path to the location where you want the ProtecTIER Manager program files installed. Click **Choose** to browse for a location.

**Note:** Click **Restore Default Folder** to revert to the default installation path.

6. Click **Next**. The **Choose Link Folder** screen is displayed.
7. Select the location where you want the program links created:
  - **In your Home folder** – Creates the links in the directory where the user files are typically stored. For example: */home/bill*.
  - **Other** – Creates the links in the default location (*/opt/IBM/PTManager*). To specify a different location, click **Choose** and select a directory on the workstation hard disk drive.
  - **Don't create links** – No links are created.
8. Click **Next**. The **Pre-Installation Summary** screen is displayed.
9. Click **Install**. The **Installing ProtecTIER Manager** screen is displayed and ProtecTIER Manager is installed on your computer. When the installation is complete, the **Install Complete** screen is displayed.
10. Click **Done**. The **ProtecTIER Manager** wizard closes. When the command prompt returns in the Terminal window, type **exit** to close the window.

---

## Uninstalling the ProtecTIER Manager software

This topic describes how to uninstall the ProtecTIER Manager software.

### Procedure

To uninstall the ProtecTIER Manager software:

1. From the ProtecTIER Manager directory, run the ProtecTIER Manager uninstaller. The **Uninstall ProtecTIER Manager** wizard **Introduction** screen is displayed.
2. Click **Uninstall**. The **Uninstalling** screen is displayed and the ProtecTIER Manager software is removed from your computer. The **Uninstall Complete** screen is displayed.
3. Click **Done**. The **Uninstall ProtecTIER Manager** wizard closes.

---

## Chapter 5. Getting started with ProtecTIER Manager

Topics in this chapter provide an overview of common ProtecTIER Manager tasks.

After the ProtecTIER Manager software has been installed, familiarize yourself with these basic ProtecTIER Manager tasks.

---

### Running the ProtecTIER Manager application TS7600 ProtecTIER Deduplication Solutions, V3.3.6.1

This task describes how to run the ProtecTIER Manager software on the ProtecTIER Manager workstation.

#### About this task

The ProtecTIER Manager GUI can be run from either a Windows based, or a Linux based ProtecTIER Manager workstation.

#### Procedure

Run the ProtecTIER Manager application:

- On a Windows-based ProtecTIER Manager workstation, run the ProtecTIER Manager application:  
Click **Start > Programs > IBM > ProtecTIER Manager > IBM ProtecTIER Manager**.
- On a Linux-based ProtecTIER Manager workstation:
  1. Navigate to the directory where you installed ProtecTIER Manager. The default installation directory is: **/opt/IBM/PTManager**.
  2. Double-click the ProtecTIER Manager icon.

The **ProtecTIER Manager** window is displayed.

---

### Logging in and out of the ProtecTIER Manager application

Complete this task to log in to and log out of the ProtecTIER Manager application.

#### About this task

ProtecTIER Manager has default user accounts corresponding to three user permission levels: Administrator, Operator, and User. For more information, see "Permission levels" on page 31. The default username and password for each of these accounts are as follows:

*Table 2. Default usernames and passwords*

| Permission Level | Default Username | Default Password |
|------------------|------------------|------------------|
| Administrator    | ptadmin          | ptadmin          |
| Operator         | ptoper           | ptoper           |
| User             | ptuser           | ptuser           |

## Procedure

1. Click the **Login** button. The **Login** dialog box is displayed.
2. Enter your username and password.
3. Click **Ok**. The **Login** dialog box closes and ProtecTIER Manager displays the information for that node.

## Results

IBM recommends that you change or replace these default user accounts. For more information, see “Managing users” on page 31.

If you log in with Administrator level permission while another Administrator is already logged in, a message box is displayed with the following message:

Administrator is already logged in from host <host name>, at IP address: <IP address>.  
Would you like to login anyway?

Clicking **Yes** forces the other Administrator to logout.

---

## Customizing the network configuration of a node

This topic describes how to use the Network Configuration window in ProtecTIER Manager to customize the IP communication interfaces on a node.

### About this task

The Network Configuration window lets you reassign the IP communication interfaces to group several physical interfaces into a single virtual interface, and create a bond configuration of several physical interfaces.

## Procedure

1. From the Systems Management view, select **Node > Network configuration**. The **Network configuration** window is displayed:

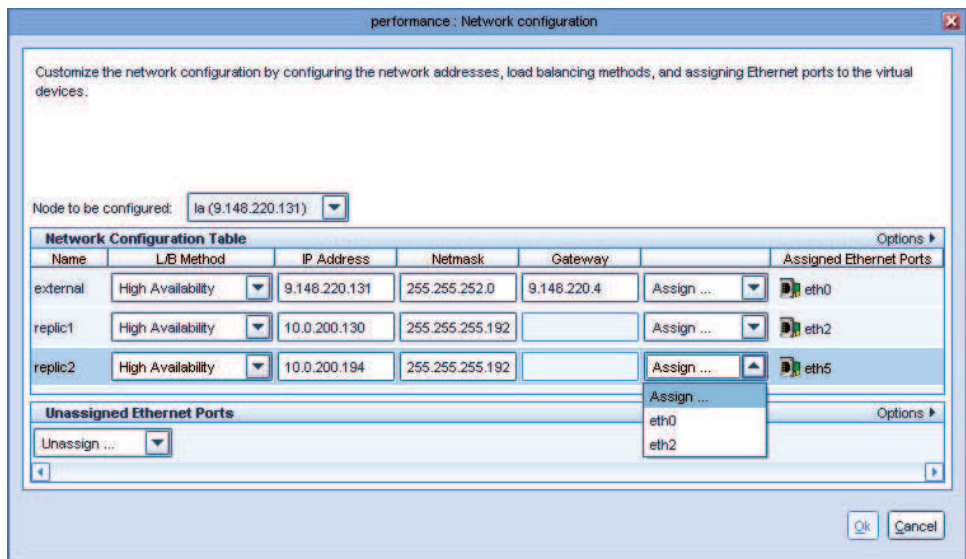


Figure 5. Configure IP interfaces window

2. Select a node from the **Node to be configured** field.
3. Highlight the virtual interface you wish to edit.
4. Click on the dropdown in the **L/B Method** column to select the load balancing method. The available load balancing methods are displayed:
  - RR (Round-robin)**  
Outgoing traffic is spread evenly across all of the adapter ports in the bond
  - L2** Outgoing traffic is spread using a default transmit hash policy of layer 2
  - L2L3**  
Outgoing traffic is spread using a transmit hash policy of MAC addresses and IP addresses of the source and the destination
  - L3L4**  
Outgoing traffic is spread using a transmit hash policy of IP addresses and ports of the source and the destination
  - HA** Active-backup policy: only one slave in the bond is active. A different slave becomes active if, and only if, the active slave fails.
5. Edit the **IP Address**, **Netmask** and **Gateway** addresses, as desired.
6. If you want to reassign a physical interface, select an Ethernet port from the ports available in the **Assign** field.
7. If you want to unassign a port, select the port to unassign from the **Unassigned Ethernet Ports** dropdown.
8. Click **Ok** to save the changes and exit the Network Configuration window.

---

## Managing users

The topics in this section describe how to manage users of the ProtecTIER Manager system.

ProtecTIER Manager enables you to create user accounts with different permission levels for accessing and configuring your ProtecTIER system.

### Permission levels

This topic describes the various user permission levels in the ProtecTIER Manager system.

The ProtecTIER system supports the following permission levels:

- **Administrator** has full access to the ProtecTIER system.

**Note:** Only one Administrator can be logged in to the ProtecTIER system at a time. If you log in as an administrator while another administrator is already logged in, the system displays a notification pane. The notification pane lists the other administrator who is logged in, and offers to force that administrator to log out.

- **Operator** can access ProtecTIER Manager monitoring screens and perform limited tasks.
- **User** can access only ProtecTIER Manager monitoring screens.

### Adding user accounts

This topic describes how to add a user account to ProtecTIER Manager.

## About this task

Complete this task to add a new user account to the ProtecTIER Manager system.

## Procedure

1. Log in to the ProtecTIER Manager system and choose **System > Manage Users**. The **Manage Users** dialog is displayed:

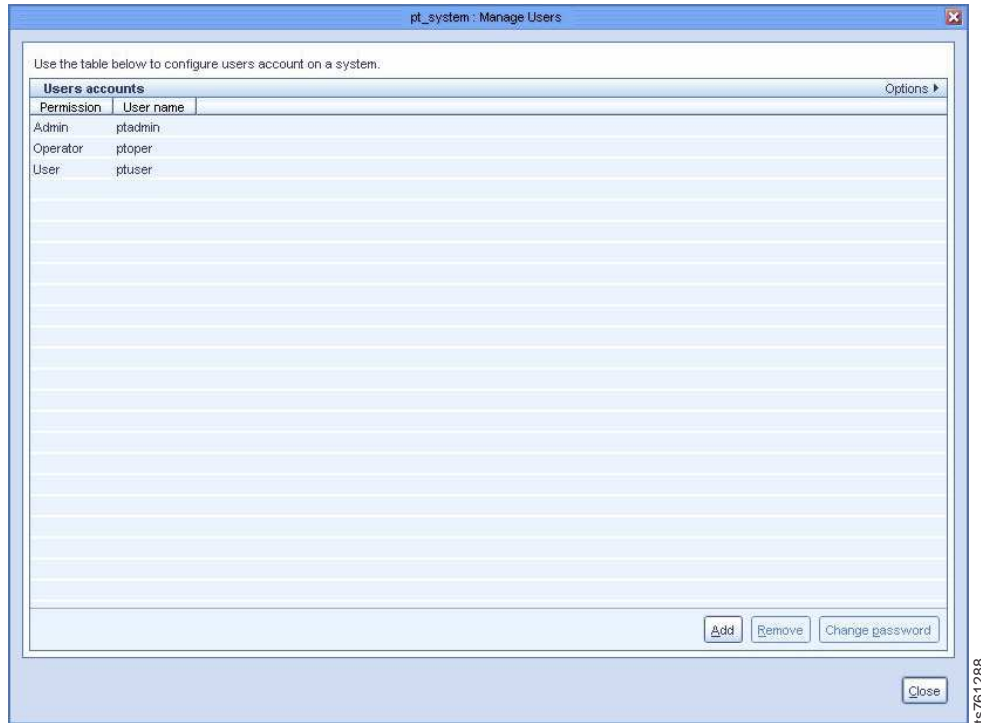


Figure 6. Manage Users dialog

2. Click **Add**. The **Add account** dialog is displayed.
3. In the **User name** field, enter a username for the account.
4. In the **New password** field, enter a password for the account.
5. In the **Verify password** field, reenter the password that you entered in the **New password** field.
6. In the **Permission** field, select a permission level (Administrator, Operator, or User) you want to assign to the user account.

**Note:** Before processing, record this information in a manner that allows you to notify the new user. Remind the new user to record the password because you nor the system stores the passwords for later use.

7. Click **Ok**. The **Add account** dialog closes and the account is added to the ProtecTIER Manager system.
8. Click **Close** to exit the **Manage Users** window.

## Changing the user account password

This topic describes how to change the password of a user account on the ProtecTIER Manager system.



## About this task

Complete this task to change the user password in the ProtecTIER Manager system.

### Procedure

1. Choose **System > Manage Users**. The **Manage Users** dialog is displayed.
2. Select a user account from the list and click **Change password**. The **Change password** dialog is displayed.
3. Type the current password in the **Password** field.
4. Type the new password in the **New password** field.
5. Type the new password again in the **Verify password** field.
6. Click **Ok**. The password for the selected user account is changed.
7. Click **Close** to exit the **Manage Users** window.

---

## Changing the Support System settings

This topic explains how to change the support system settings.

### About this task

The ProtecTIER Manager installation wizard and the ProtecTIER Manager application are fully compatible with the JAWS screen-reader software. ProtecTIER Manager also allows you to change other accessibility settings, such as the contrast resolution mode and color palette. Instructions for installing JAWS and the Java-based accessibility tools, and for setting the contrast resolution mode and color palette are available in “Accessibility” on page 257.

---

## Saving and printing data

This task describes how to save or print the data displayed in informational ProtecTIER Manager windows.

### About this task

Follow these steps to save or print data in ProtecTIER Manager informational windows and panes:

### Procedure

1. Select **Options** in the upper right-hand corner of the window.

**Note:** The **Options** menu may not be available on all windows.

2. Select **Save** to save the information or **Print** to print the information. Use the standard saving or printing procedures for your operating system.

---

## Refreshing information displayed by the ProtecTIER Manager software

This task describes how to refresh windows, screens, and panes in the ProtecTIER Manager application.

Many windows, screens, and panes of ProtecTIER Manager automatically refresh to display the most current information. However, you need to refresh some windows manually. Because you can have multiple ProtecTIER Manager

workstations on the same system, changes made on another workstation are not automatically reflected on your workstation. To ensure that you have the most up to date information, you should periodically refresh the ProtecTIER Manager Navigation pane and View pane.

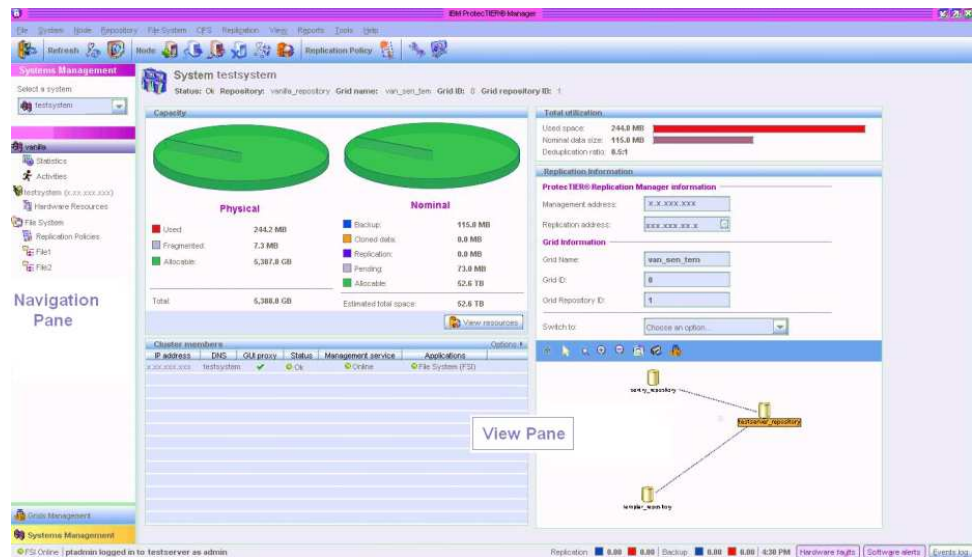


Figure 7. ProtecTIER Manager

Select the **Refresh navigation pane** button to refresh the Navigation pane.

Select the **Refresh current view** button to refresh the View pane.

## Running operations in the background

This topic describes enabling operations to run in the background while you are run another operation.

You can use the same instance of ProtecTIER Manager to work with multiple ProtecTIER systems while a specific ProtecTIER Manager operation runs in the background. You cannot, however, run multiple operations in the same ProtecTIER system.

For instance, if you are running a **Delete library** operation, the wizard prompts you to wait while the system goes offline to run the required operation. That system will be busy until it completes, thereby not allowing further administration of other operations.

By selecting **Run in background**, you return control to the user. If additional systems are configured in ProtecTIER Manager, those systems are accessible and can be worked on, even while the required operation is running.

---

## Chapter 6. Managing repositories

The topics in this chapter describe how to use the ProtecTIER Manager software to create and manage repositories in TS7600 ProtecTIER Deduplication Solutions, V3.3.6.1.

The Appliance Express server has one repository on which data is stored.

Use the ProtecTIER Manager software for repository management tasks, including:

- Enabling replication
- Increasing the capacity of repositories
- Configuring the virtual libraries in VTL systems on the ProtecTIER server
- Creating and configuring CIFS shares in FSI systems
- Defragmenting a repository
- Reserving space on a repository

---

### Enabling replication

Perform the following procedure on ProtecTIER Manager to enable replication on systems that have not already been configured for replication.

#### Before you begin

**Note:** It is possible that replication has already been enabled on your system. For example, if you performed the **Increase Capacity** operation with ProtecTIER v2.3 or above, replication was automatically enabled.

By default, replication is enabled on new repositories created with ProtecTIER v2.3 and above. Replication is disabled on repositories upgraded from v2.2 (and below) versions. When you enable replication, you must assign file systems, set the estimated factoring ratio, MD raid configuration, and disk size. The procedure allocates metadata for replication and then you can add file systems to the repository as needed. If more storage is required, you can select additional file systems (if they exist) to add to the metadata.

#### About this task

Enabling replication on the Appliance Express might require additional metadata, pending the actual metadata deployment on the specific repository.

To enable replication:

#### Procedure

1. From the Systems management view, select **Replication > Enable replication**. The **Enable replication** wizard welcome screen is displayed.
2. Click Next. The **Properties** dialog is displayed.
3. Select the Estimated factoring ratio, the MD raid configuration, and the Disk size (in GB) of the metadata disks.

**Note:** The size of the repository cannot be changed when enabling replication.

4. Click **Next**. The **Repository resources** dialog displays the total amount of metadata and user data (in GB) allocated for the repository.
5. If more storage is required, click **Advanced**. The **Repository resources** window is displayed with a list of available file systems (if they exist).
6. Select what file systems to use for metadata or user data. Click **Ok**. The resources window closes.
7. Click **Finish**. The summary report is displayed and replication is enabled on ProtecTIER Manager.

---

## Expanding repositories

Complete the tasks in this topic to increase the capacity of a repository.

### About this task

**Attention:** This section provides instructions for increasing the capacity of a repository.

After the repository is created, the ProtecTIER system enables you to increase the capacity of the repository. Much like creating the repository, expanding the repository requires the guidance of a trained ProtecTIER specialist and use of a wizard for planning repository expansions. You might need to expand the repository if:

- Your factoring ratio is higher than originally expected and you are running out of meta data space.
- Your repository needs have expanded beyond the original growth projections and you are running out of user data space.

The increase capacity steps described in this task appear in the order in which they should be performed:

1. Plan the expansion using ProtecTIER Manager.
2. Create new file systems or extend existing ones on the backend storage using the ProtecTIER Service menu and verify that the devices are displayed.
3. Run the Increase Capacity wizard.
4. Complete the operation .

## Guidelines for increasing the repository and the virtual capacity of a cartridge

Increasing the capacity of a repository impacts the virtual capacity of cartridges.

Increasing the capacity of a repository has a direct impact on the way the ProtecTIER system calculates the logical maximum size of the defined virtual cartridges. When you increase the repository, the maximum size of the cartridges is updated and recalculated based on the new repository size (that is, the size of the cartridges is increased).

When you create a repository, the **nominal size** of the repository is equal to the **factoring and compression ratios** multiplied by its **physical size**. The following calculation is used:

$$[\text{nominal size}] = [\text{factoring and compression ratio}] * [\text{physical size}]$$

ProtecTIER emulates real cartridges with a given virtual capacity. When adding cartridges to the repository, the **virtual capacity of the cartridge** is equal to the **nominal size of the repository** divided by the **number of cartridges** in the system, as shown in the following calculation:

$$[\text{cartridge virtual capacity}] = [\text{nominal size}] / [\text{number of cartridges in the system}]$$

The resulting value of the **virtual capacity of the cartridge** is dynamic, such that:

- If you add more cartridges to the system, the virtual capacity of the cartridge decreases.
- If you delete cartridges from the system, the virtual capacity of the cartridge increases.
- If the factoring ratio decreases, the nominal size of the repository decreases, therefore causing the virtual capacity of the cartridge to decrease.
- If more capacity is added to the repository, the nominal size of the repository increases, therefore causing the virtual capacity of the cartridge to increase.

When the virtual capacity size of the cartridge is full, the backup application receives an Early Warning (EW) message, and the cartridge is marked **full** in ProtecTIER Manager. If the capacity of the cartridge increases, the cartridges stay marked as **full**. You must expire cartridges that have reached EW to use the remaining capacity.

If the full cartridges cannot be expired, you must add cartridges after increasing the capacity so that the virtual capacity of each cartridge is less than, or equal to the previous capacity.

## Planning an expansion

Complete this task to plan for a repository expansion.

### About this task

With the guidance of a trained ProtecTIER specialist, run the **Plan repository increase** wizard to determine the optimum repository size and meta data file system arrangement for your expanded repository.

To plan a repository expansion:

### Procedure

1. Choose **Repository > Increase capacity planning**. The **Increase capacity planning** window opens.
2. In the **Repository size** field, select the total physical size, in TB, for the repository.

**Note:** If you are expanding the repository only to increase the amount of meta data space, increase the estimated factoring ratio value, but leave the repository physical size value unchanged.

3. In the **Estimated factoring ratio** field, enter the updated factoring ratio estimate for the repository.
4. In the **MD Raid configuration** field, select a configuration option from the drop-down list.
5. In the **Disk size** field, select the physical disk size, in GB, from the drop-down list.

6. Click **Ok**. The **Increase capacity planning** dialog closes and the **Repository meta data storage requirements** window is displayed listing the minimum meta data file system expansion options that are suitable for your expansion needs.
7. Click **Options** to print or save as a *.csv* file the information in the Repository meta data storage requirements dialog using the standard procedures for your operating system.
8. Click **Plan again** to go back to the **Increase capacity planning** window and change the configuration options, or click **Close**. The **Repository meta data storage requirements** dialog closes.

---

## Defragmentation on a repository

Defragmentation is the process to allocate fragmented space on a repository as defragmented so that this space can be used to write new data.

**Important:** Contact a trained ProtecTIER specialist before performing this operation.

A ProtecTIER repository becomes fragmented over time. The **Defragmentation control** operation gathers the fragmented (i.e. free, but unusable) space together in order to improve the speed of reading and writing new data to the repository.

---

## Reserve space for backup for VTL

This topic describes the **Reserve space for backup** feature for a VTL which provides the ability to exclusively assign a portion of a repository's capacity for local backups.

In some situations, the replication process may fill, or nearly fill, all the space in the hub repository, leaving insufficient space for backup data. Since the assumption is that backup has precedence over replication, this feature ensures that the designated capacity is reserved only for local backup during replication, so that replication cannot be written to the reserved portion of the storage capacity. Error notifications will appear in the event that the capacity reserved on the repository is running out of space for the local backup, or for replication.

- If there is no replication, backup data can stream into the repository and fill the entire storage capacity.
- If there is replication going on, backup data can stream into the repository and fill the entire reserved space for backup, while replication data streams into the repository and fills the remainder of the storage capacity. Keep in mind that replication and backup data compete for this space.

To reserve space for backup on a repository:

1. From the System's Management view, choose the repository from the navigation pane.
2. Select **Reserve space for backup** from the **Repository** menu. The **Reserve space for backup** window displays the minimum amount of nominal space that is currently reserved for backup.

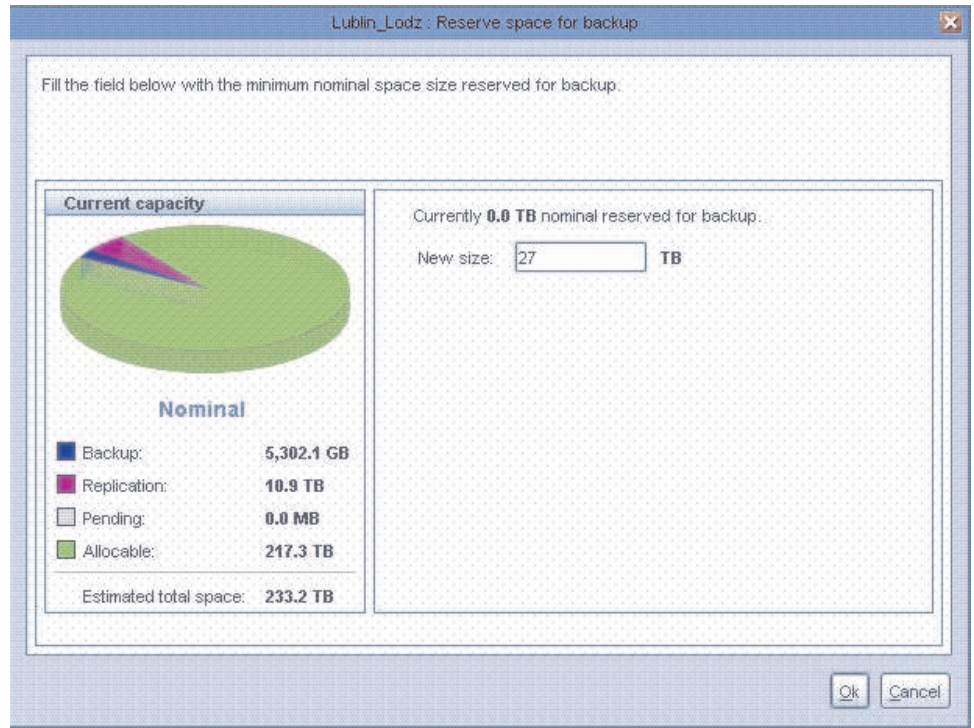


Figure 8. Reserve space for backup window

3. Enter the new minimum nominal space size and click **Ok**. The operation is complete and space for backup is reserved on the repository.

Go on to Chapter 8, “Managing the ProtecTIER Virtual Tape service,” on page 61.

## Deleting repositories

Complete this task to delete a repository.

### About this task

In general, it is not necessary to delete a repository. Using ProtecTIER Manager, follow the task to delete a repository. To recreate the repository on the existing storage, you must reinstall the operating system and the ProtecTIER code. For further instructions, refer to Chapter 15, “ProtecTIER system recovery procedures,” on page 197.

For more information, contact a trained ProtecTIER specialist.

**Attention:** Deleting the repository results in the loss of all the data contained in the repository.

Perform the following steps to delete a repository:

### Procedure

1. Select the repository.
2. Choose **Repository > Delete repository**. A confirmation message box is displayed.
3. Click **Yes**. The **Data Loss Confirmation** dialog box is displayed.

4. In the field, type **data loss** and click **Ok**. A confirmation message box is displayed.
5. Click **Yes**. The ProtecTIER system temporarily goes offline to delete the repository.
6. When the system comes back online, you can resume use of your ProtecTIER system.

| **Note:** Before you can recreate a repository on the existing storage, contact a  
| trained ProtecTIER specialist for assistance.



---

## Chapter 7. Managing and monitoring ProtecTIER through the CLI

This chapter describes how to query and configure the system via the command line interface (CLI), and to receive various statistics about the ProtecTIER system. This information can provide valuable insight to the administrator on the performance, capacity, configuration and operation of the system, and can be accessed by other management applications.

---

### Understanding the syntax diagrams

A syntax diagram uses symbols to represent the elements of a command and to specify the rules for using these elements.

#### Syntax diagrams

##### Main path line



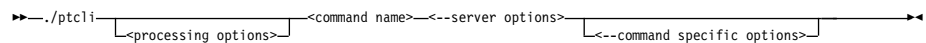
Begins on the left with double arrowheads (>>) and ends on the right with two arrowheads facing each other (><). If a diagram is longer than one line, each line to be continued ends with a single arrowhead (>) and the next line begins with a single arrowhead. Read the diagrams from left-to-right, top-to-bottom, following the main path line.

##### Keyword



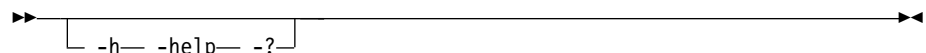
Represents the name of a command, flag, parameter, or argument. A keyword is not in italics. Spell a keyword exactly as it is shown in the syntax diagram.

##### Required keywords



Indicate the parameters or arguments you must specify for the command. Required keywords appear on the main path line. Mutually exclusive required keywords are stacked vertically.

##### Optional keywords



Indicate the parameters or arguments you can choose to specify for the command. Optional keywords appear below the main path line. Mutually exclusive optional keywords are stacked vertically.

##### Variable

▶▶ *variable* ◀◀

Represents the value you need to supply for a parameter or argument, such as a file name, user name, or password. Variables are in italics.

## Special characters

### - (minus) or -- (double minus)

Flags are prefixed with a - (minus) sign. Flags define the action of a command or modify the operation of a command. You can use multiple flags, followed by parameters, when you issue a command.

### [ ] square brackets

Optional values are enclosed in square brackets.

### | vertical bar

A vertical bar indicates that you have a choice between two or more options or arguments.

For example, [ a | b ] indicates that you can choose a, b, or nothing. Similarly, { a | b } indicates that you must choose either a or b.

---

## ptcli

This topic describes how to use `ptcli` through the command-line interface (CLI) . The `ptcli` is loaded during the installation of ProtecTIER software and ProtecTIER Manager software.

## Usage

When `ptcli` is running, the available `ptcli` commands are listed according to the version of ProtecTIER that is installed. If the `ptcli` for version 3.3.6.1 is running on older versions of ProtecTIER, several operations might not be supported.

Use `ptcli` to do any of the following tasks:

- Configure ProtecTIER (including configuration of a ProtecTIER repository and configuration of ProtecTIER virtual tape [VT] libraries).
- Monitor ProtecTIER (including statistics of ProtecTIER VT and statistics about the ProtecTIER repository).
- Snapshot and filter ProtecTIER VT cartridges (mostly used for DR (disaster recovery)\_, scenerios) For more information, see “`ptcli` Inventory commands” on page 49.

To run `ptcli` on a ProtecTIER node, move into the following directory:  
`/opt/dtc/ptcli`.

To run `ptcli` on a host running ProtecTIER Manager, move into the ProtecTIER Manager directory (in Windows, `C:\Program Files\IBM\ProtecTIER Manager`).

The `ptcli` command is issued from the command line as follows:

▶▶ `./ptcli` ◀◀

└─<processing options>─┘ <command name> ─<--server options>─┘ └─<--command specific options>─┘

For more information, see:

- “Processing options” on page 43

- “Server options” on page 44

## Creating a profile

This topic describes how to create a profile in order to query the ProtecTIER server through the command line interface (CLI) using `ptcli`.

### About this task

Creating a profile is an optional task that can be completed prior to accessing the `ptcli`. Creating a profile provides for the user name and password to be saved in a file. You can always enter the user name and password manually if you choose not to create a profile. For more information on using `ptcli`, see “`ptcli`” on page 42.

### Procedure

1. Activate `ptcli` with `-p` followed by a file name with full path.
2. Once prompted, enter the desired user name and password. This step creates the user-specified file with the user name and password that is needed for login.

### Example

**Note:** In the following example, `\ptcli` is the root directory. Keep in mind that running the command does not create the directory path. Therefore, for the command to work, the root directory (in this case `\ptcli`) must be created before activating the command.

```
ptcli -p h:\ptcli\ptuser
User name: ptuser
Password:
<?xml version="1.0" encoding="UTF-8"?
<response command="createprofile" status="success"/>
```

---

## Processing options

This topic describes how to use the processing options to query the ProtecTIER server through the command line interface (CLI).

### Usage

You can specify the following processing options at the beginning of the command string:

Table 3. Processing options

| Processing options                       | Explanation                                                                                                                                                                                            |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>--debug &lt;debug level&gt;</code> | Specify the debug level to print log messages to the console. Choices for the debug level are as follows: <ul style="list-style-type: none"> <li>• SEVERE</li> <li>• WARNING</li> <li>• ALL</li> </ul> |
| <code>[-h (--help)]</code>               | Prints the Help message to the console and exits.                                                                                                                                                      |
| <code>[-v (--version)]</code>            | Prints the version information and exits.                                                                                                                                                              |
| <code>[-p (--createprofile) FILE]</code> | Creates or modifies the user profile file. This file is used for logging into the management server.                                                                                                   |

---

## Server options

This topic describes the server options to use when querying the ProtecTIER server through the command line interface (CLI). Server options are used for connection to the management server. They should appear with each query/action - except for the arguments `-h` or `-v`.

### Usage

**Note:** Administrator privileges are required for configuration operations.

You can specify the following server options at the beginning of the command string:

Table 4. Server options

| Server options                                         | Explanation                                                                                                                                                                                                                                        |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>--ip &lt;IP&gt;</code>                           | Specify the IP address of the management server.<br><br>This field is required if you are running <code>ptcli</code> from a server or PC that is not the ProtecTIER server to which you want to connect.                                           |
| <code>[--port &lt;PORT&gt;]</code>                     | Specify the port of the management server. The default is: 3501.<br><b>Note:</b> This is optional.                                                                                                                                                 |
| <code>[--loginFile &lt;FILE&gt;]</code>                | Specify a user profile file for login.<br><b>Notes:</b> <ul style="list-style-type: none"><li>• This is optional.</li><li>• When specifying <code>--loginFile</code>, using <code>--loginInline</code> is mutually exclusive.</li></ul>            |
| <code>[--loginInline &lt;USERNAME,PASSWORD&gt;]</code> | Specify a login using the user name and password.<br><b>Notes:</b> <ul style="list-style-type: none"><li>• This is optional.</li><li>• When specifying <code>--loginInline</code>, using <code>--loginFile</code> is mutually exclusive.</li></ul> |
| <code>[--force]</code>                                 | Force the login if another administrator is already logged in.<br><b>Note:</b> This is optional.                                                                                                                                                   |

---

## Commands

The following tables contain lists of commands to invoke on the management server.

For information about ProtecTIER VT commands, see “ProtecTIER VT commands” on page 46.

For information about ProtecTIER Repository commands, see “ProtecTIER repository commands.”

### ProtecTIER repository commands

The following tables contain lists of commands to invoke on the ProtecTIER repository.

Table 5. CreateRepository Command

| Command                     | Explanation                                                                    | Command Specific Options    |                                                                                                                                                     |
|-----------------------------|--------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
|                             |                                                                                | Name                        | Explanation                                                                                                                                         |
| CreateRepository            | Create a repository                                                            | --name <NAME>               | Repository name                                                                                                                                     |
|                             |                                                                                | --system <NAME>             | System name                                                                                                                                         |
|                             |                                                                                | --size <SIZE>               | Repository physical maximum size in TB                                                                                                              |
|                             |                                                                                | --peak <NUM>                | Peak throughput in MB                                                                                                                               |
|                             |                                                                                | --ratio <NUM>               | Deduplication ratio                                                                                                                                 |
|                             |                                                                                | --raid <X,Y,Z>              | Metadata raid configuration in the form of [X,Y,Z] where (X = Type), (Y = Members) and (Z = Disk size in GB) taken from "RaidConfigurations" output |
|                             |                                                                                | [--metadata <MOUNT_POINTS>] | List of GFS (global file system) mounted file systems used to store ProtecTIER repository metadata                                                  |
| [--userdata <MOUNT_POINTS>] | List of GFS mounted file systems used to store ProtecTIER repository user data |                             |                                                                                                                                                     |

Example:

**CreateRepository**

```
▶▶ . /ptcli—CreateRepository—ip 9.148.220.101—loginFile—h:\ptcli\ptadmin— Command Specific Options ▶▶
```

**Command Specific Options:**

```
|---name—PTCLI_REP---system—PTCLI_SYS---size—2---peak—300---ratio—13---raid—FC-10K,4+4,120— Command specific options |
```

**Command specific options:**

```
| [---metadata—<MOUNT_POINTS>] [---userdata—<MOUNT_POINTS>] |
```

Table 6. RaidConfigurations Command

| Command            | Explanation                                                |
|--------------------|------------------------------------------------------------|
| RaidConfigurations | Prints information about the supported raid configurations |

Example:

**RaidConfigurations**

```
▶▶ . /ptcli—RaidConfigurations—ip 9.148.220.101—loginFile—h:\ptcli\ptadmin—▶▶
```

Table 7. RepositoryStatistics Command

| Command                                                                                                                                            | Explanation                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| RepositoryStatistics                                                                                                                               | Prints the repository statistics |
| <b>Example:</b><br><b>RepositoryStatistics</b><br><pre>▶—. /ptcli—RepositoryStatistics---ip 9.148.220.101---loginFile—h:\ptcli\ptadmin—————▶</pre> |                                  |

Table 8. ServerVersion Command

| Command                                                                                                                              | Explanation               |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| ServerVersion                                                                                                                        | Prints the server version |
| <b>Example:</b><br><b>ServerVersion</b><br><pre>▶—. /ptcli—ServerVersion---ip 9.148.220.101---loginFile—h:\ptcli\ptadmin—————▶</pre> |                           |

## ProtectTIER VT commands

The following tables contain lists of commands to invoke on the virtual tape library.

### ptcli Configuration commands

This topic describes how to configure the ProtecTIER server through the command line interface (CLI) using Configuration commands.

Table 9. AddCartridges command

| Command                                                                                                                                                          | Explanation    | Command Specific Options |                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------|----------------------------------------------------------------------------|
|                                                                                                                                                                  |                | Name                     | Explanation                                                                |
| AddCartridges                                                                                                                                                    | Add Cartridges | --name <NAME>            | Library name (taken from "Libraries" output)                               |
|                                                                                                                                                                  |                | --cartridges <NUM>       | Number of cartridges                                                       |
|                                                                                                                                                                  |                | [--maxcartsize <NUM>]    | Maximum cartridge growth in MB. If not specified, the size is not limited. |
|                                                                                                                                                                  |                | --seed <SEED>            | Bar code seed                                                              |
|                                                                                                                                                                  |                |                          |                                                                            |
| <b>Example:</b><br><b>AddCartridges</b><br><pre>▶—. /ptcli—AddCartridges---ip 9.148.220.45---loginFile—h:\ptcli\ptadmin—  Command Specific Options  —————▶</pre> |                |                          |                                                                            |
| <b>Command Specific Options:</b><br><pre> ---name—Lib---cartridges—200---seed—TS0000— <br/> ---maxcartsize—NUM— </pre>                                           |                |                          |                                                                            |

Table 10. AddLibrary Command

| Command    | Explanation    | Command Specific Options |                                                                                                                       |
|------------|----------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------|
|            |                | Name                     | Explanation                                                                                                           |
| AddLibrary | Create library | --name <NAME>            | New library name defined when creating a library                                                                      |
|            |                | [--slots <NUM>]          | Number of slots (defaults to 0)                                                                                       |
|            |                | --impexp <NUM>           | Number of import/export (defaults to 8)                                                                               |
|            |                | --libtype <NAME>         | Library type (taken from "LibraryTypes" output)                                                                       |
|            |                | --robot X,Y              | List of robot assignments in the form of [X,Y] where (X = Node external IP), (Y = Port)                               |
|            |                | --drivemodel <NAME>      | Tape drive model (taken from "DriveModels" output)                                                                    |
|            |                | [--drives X,Y,Z]         | List of drive assignments in the form of [X,Y,Z] where (X = Number of drives), (Y = Node external IP), and (Z = Port) |

**Example:**

**AddLibrary**

```
▶ ./ptcli AddLibrary --ip 9.148.220.45 --loginFile h:\ptcli\ptadmin | Command Specific Options | ▶
```

**Command Specific Options:**

```
| --name Lib1 | [ --slots ] 30 | --impexp 5 | --libtype TS3500 | --drivemodel ULT3580-TD3 |
| --robot 9.148.220.45,0 | --robot 7,168.159.150.33,0 | [ --drives ] 5,9.148.220.45,0 | [ --drives ] 7,168.159.150.33,0 |
```

**ptcli Throughput statistics**

This topic describes how to view the ProtecTIER server statistics history through the command-line interface (CLI).

Table 11. NodeVtlStatistics Command

| Command           | Explanation                                     | Command Specific Options |                                                                                                                                                           |
|-------------------|-------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   |                                                 | Name                     | Explanation                                                                                                                                               |
| NodeVtlStatistics | Prints the statistics history on the local host | --hours <NUM>            | The number of statistics hours included in the output. By default, the output includes four chronicles (statistic records) per hour (if uptime >= hours). |

Table 11. NodeVtlStatistics Command (continued)

| Command                                                                                                 | Explanation | Command Specific Options |
|---------------------------------------------------------------------------------------------------------|-------------|--------------------------|
| <b>Example:</b><br><b>NodeVtlStatistics</b>                                                             |             |                          |
| <pre>▶▶ ./ptcli—NodeVtlStatistics—--ip 9.148.220.101—--loginFile—h:\ptcli\ptadmin—--hours—1————▶▶</pre> |             |                          |

### ptcli Library information

The tables in this topic contain lists of commands to invoke on libraries of the ProtecTIER repository.

Table 12. CartridgeInfo Command

| Command                                                                                                               | Explanation                                                                                               | Command Specific Options |                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                       |                                                                                                           | Name                     | Explanation                                                                                                                                                    |
| CartridgeInfo                                                                                                         | Print information about specific cartridges in the library<br><b>Note:</b> The list is sorted by barcode. | --name <NAME>            | Library name (taken from "Libraries" output)                                                                                                                   |
|                                                                                                                       |                                                                                                           | --from <NUM>             | The number of cartridges before the first printed cartridge in the list of cartridges (the number of cartridges can be taken from "NumberOfCartridges" output) |
|                                                                                                                       |                                                                                                           | --count <NUM>            | The maximum number of cartridges in the output                                                                                                                 |
| <b>Example:</b><br><b>CartridgeInfo</b>                                                                               |                                                                                                           |                          |                                                                                                                                                                |
| <pre>▶▶ ./ptcli—CartridgeInfo—--ip 9.148.220.45—--loginFile—h:\ptcli\ptadmin—  Command Specific Options  ————▶▶</pre> |                                                                                                           |                          |                                                                                                                                                                |
| <b>Command Specific Options:</b>                                                                                      |                                                                                                           |                          |                                                                                                                                                                |
| <pre> —--name—Lib—--from—0—--count—400———— </pre>                                                                     |                                                                                                           |                          |                                                                                                                                                                |

Table 13. DriveModels Command

| Command                                                                                                  | Explanation                                              | Command Specific Options |                                                 |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------|-------------------------------------------------|
|                                                                                                          |                                                          | Name                     | Explanation                                     |
| DriveModels                                                                                              | Prints information about the supported tape drive models | --libtype <NAME>         | Library type (taken from "LibraryTypes" output) |
|                                                                                                          |                                                          |                          |                                                 |
| <b>Example:</b><br><b>DriveModels</b>                                                                    |                                                          |                          |                                                 |
| <pre>▶▶ ./ptcli—DriveModels—--ip 9.148.220.101—--loginFile—h:\ptcli\ptadmin—--libtype—TS3500————▶▶</pre> |                                                          |                          |                                                 |



Table 14. Libraries Command

| Command                                                                                                                    | Explanation                                    |
|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Libraries                                                                                                                  | Prints the list of libraries on the repository |
| <b>Example:</b><br><b>Libraries</b><br><pre>▶ . /ptcli—Libraries—--ip 9.148.220.101—--loginInline—h:\ptcli\ptadmin—▶</pre> |                                                |

Table 15. LibraryInformation Command

| Command                                                                                                                                          | Explanation                                                   | Command Specific Options |                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------|----------------------------------------------|
|                                                                                                                                                  |                                                               | Name                     | Explanation                                  |
| LibraryInfo                                                                                                                                      | Prints information about a specific library in the repository | --name <NAME>            | Library name (taken from "Libraries" output) |
| <b>Example:</b><br><b>LibraryInformation</b><br><pre>▶ . /ptcli—LibraryInfo—--ip 9.148.220.101—--loginInline—h:\ptcli\ptadmin—--name—Lib—▶</pre> |                                                               |                          |                                              |

Table 16. LibraryTypes Command

| Command                                                                                                                        | Explanation                                                   |
|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| LibraryTypes                                                                                                                   | Prints information about a specific library in the repository |
| <b>Example:</b><br><b>LibraryTypes</b><br><pre>▶ . /ptcli—LibraryTypes—--ip 9.148.220.101—--loginFile—h:\ptcli\ptadmin—▶</pre> |                                                               |

Table 17. NumberOfCartridges Command

| Command                                                                                                                                               | Explanation                                    | Command Specific Options |                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------|----------------------------------------------|
|                                                                                                                                                       |                                                | Name                     | Explanation                                  |
| NumberOfCartridges                                                                                                                                    | Prints the number of cartridges in the library | --name <NAME>            | Library name (taken from "Libraries" output) |
| <b>Example:</b><br><b>NumberOfCartridges</b><br><pre>▶ . /ptcli—NumberOfCartridges—--ip 9.148.220.101—--loginFile—h:\ptcli\ptadmin—--name—Lib—▶</pre> |                                                |                          |                                              |

## ptcli Inventory commands

This topic describes how to query the ProtecTIER server through the command line interface (CLI) using **Inventory** commands.

## Usage

The Inventory command options are used to filter cartridges in a ProtecTIER repository using a variety of criteria. Also, these options can be used to move cartridges that match a certain criteria. Before beginning to filter the cartridges, and/or moving cartridges using the CLI, you must first create a snapshot of the cartridges using the InventoryRefresh command. (See Table 18.) The snapshot will include the most updated properties of the cartridges at the time it is created.

**Note:** Any filter/move operation is executed using the snapshot's contents. Running such a command without a previous refresh is considered an error. Also, for larger repositories, a refresh operation may take considerable time and reduce ProtecTIER's performance during that time.

Moving a cartridge using the CLI may fail if the snapshot is not up to date for the cartridge (for instance, if the cartridge is moved or deleted after a snapshot is taken). Operations on libraries for which the snapshot is not up to date may have undesirable consequences.

Table 18. InventoryRefresh command

| Command                                                                                                                                   | Explanation                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| InventoryRefresh                                                                                                                          | Refresh the cartridges inventory snapshot on the server. |
| <p><b>Example:</b></p> <p><b>InventoryRefresh</b></p> <p>▶—./ptcli—InventoryRefresh—--ip 9.148.220.101—--loginFile—h:\ptcli\ptadmin—▶</p> |                                                          |

Table 19. InventoryFilter command

| Command         | Explanation                                                                        | Command Specific Options |                                                                                                                                                                                                                                                                                                                                                 |
|-----------------|------------------------------------------------------------------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |                                                                                    | Name                     | Explanation                                                                                                                                                                                                                                                                                                                                     |
| InventoryFilter | Queries the cartridges inventory snapshot created by the InventoryRefresh command. | --querytype <QUERYTYPE>  | Type of query to be used by the command: <ul style="list-style-type: none"> <li>• <b>All</b> - All cartridges in the ProtecTIER repository.</li> <li>• <b>Replica</b> - All cartridges that were replicated <i>into</i> this repository.</li> <li>• <b>Origin</b> - All cartridges that were replicated <i>from</i> this repository.</li> </ul> |
|                 |                                                                                    | --query <QUERY>          | Query to be used by the filter command. See "Query" on page 54 for more information.                                                                                                                                                                                                                                                            |
|                 |                                                                                    | [--output <PATH>]        | The output file path for the query results.                                                                                                                                                                                                                                                                                                     |
|                 |                                                                                    | [--limit <NUM>]          | The limit for the maximal number of cartridges the query may return.                                                                                                                                                                                                                                                                            |

Table 19. InventoryFilter command (continued)

| Command                                                                                                                                                                                                                                                                                                                                      | Explanation | Command Specific Options |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|
| <p><b>Example:</b></p> <p><b>InventoryFilter</b></p> <pre>▶ ./.ptcli—InventoryFilter---ip 9.148.220.101---loginFile—h:\ptcli\ptadmin—  Command Specific Options  ————▶</pre> <p><b>Command Specific Options:</b></p> <pre> ---querytype—replica---query—"in_sync = true"—   _  [---output]—&lt;PATH&gt;—   _  [---limit]—&lt;NUM&gt;— </pre> |             |                          |

Table 20. InventoryGetQueryFields command

| Command                                                                                                                                                                         | Explanation                                               | Command Specific Options |                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                 |                                                           | Name                     | Explanation                                                                                                                                                                                                                                                                                                                                                                                  |
| InventoryGetQueryFields                                                                                                                                                         | Returns the fields available for the specified query type | --querytype <QUERYTYPE>  | Type of query to be used by the command: <ul style="list-style-type: none"> <li>• <b>All</b> - All cartridges in the ProtecTIER repository.</li> <li>• <b>Replica</b> - All cartridges that were replicated <i>into</i> this repository.</li> <li>• <b>Origin</b> - All cartridges that were replicated <i>from</i> this repository.</li> </ul> See "Query" on page 54 for more information. |
| <p><b>Example:</b></p> <p><b>InventoryGetQueryFields</b></p> <pre>▶ ./.ptcli—InventoryGetQueryFields---ip 9.148.220.101---loginFile—h:\ptcli\ptadmin---querytype—all————▶</pre> |                                                           |                          |                                                                                                                                                                                                                                                                                                                                                                                              |

Table 21. InventoryMoveFile command

| Command                                                                                                                                                                                                                                                                                      | Explanation                                                                                             | Command Specific Options |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                              |                                                                                                         | Name                     | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| InventoryMoveFile                                                                                                                                                                                                                                                                            | Move a group of cartridges expressed as a file (created manually or using the InventoryFilter command). | --filetype <TYPE>        | The type of the file to be used by the command: <ul style="list-style-type: none"> <li>• <b>All</b> - All cartridges in the ProtecTIER repository.</li> <li>• <b>Replica</b> - All cartridges that were replicated <i>into</i> this repository.</li> <li>• <b>Origin</b> - All cartridges that were replicated <i>from</i> this repository.</li> <li>• <b>barcode</b> - Lists the barcodes of cartridges in the repository to be moved.</li> </ul> |
|                                                                                                                                                                                                                                                                                              |                                                                                                         | --file <PATH>            | The path to a file containing a list of cartridges to be moved                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                              |                                                                                                         | --destination <NAME>     | The destination library (or shelf) of the move command                                                                                                                                                                                                                                                                                                                                                                                             |
| <p><b>Example:</b></p> <p><b>InventoryMoveFile</b></p> <pre>▶ ./ptcli—InventoryMoveFile—ip 9.148.220.45—loginFile—h:\ptcli\ptadmin—  Command Specific Options  </pre> <p><b>Command Specific Options:</b></p> <pre> —filetype—replica—file—/temp/inventory/if2.csv—destination—shelf— </pre> |                                                                                                         |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Table 22. InventoryMoveFilter command

| Command             | Explanation                                           | Command Specific Options |                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |                                                       | Name                     | Explanation                                                                                                                                                                                                                                                                                                                                             |
| InventoryMoveFilter | Move a group of cartridges (that match a given query) | --querytype <QUERYTYPE>  | The type of the query to be used by the command: <ul style="list-style-type: none"> <li>• <b>All</b> - All cartridges in the ProtecTIER repository.</li> <li>• <b>Replica</b> - All cartridges that were replicated <i>into</i> this repository.</li> <li>• <b>Origin</b> - All cartridges that were replicated <i>from</i> this repository.</li> </ul> |
|                     |                                                       | --query <QUERY>          | The query to be used by the filter command See "Query" on page 54 for more information.                                                                                                                                                                                                                                                                 |
|                     |                                                       | --destination <NAME>     | The destination library of the move command.                                                                                                                                                                                                                                                                                                            |

Table 22. InventoryMoveFilter command (continued)

| Command                                                                                                                                                                                                                                                                                                        | Explanation | Command Specific Options |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|
| <p><b>Example:</b></p> <p><b>InventoryMoveFilter</b></p> <pre>▶—./ptcli—InventoryMoveFilter—--ip 9.148.220.45—--loginFile—h:\ptcli\ptadmin—  Command Specific Options  ————▶</pre> <p><b>Command Specific Options:</b></p> <pre> —--querytype—replica—--query—"in_synch = true"—--destination—shelf———— </pre> |             |                          |

Table 23. InventoryStatistics command

| Command                                                                                                                                                | Explanation                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| InventoryStatistics                                                                                                                                    | Display the latest information about the cartridges inventory snapshot |
| <p><b>Example:</b></p> <p><b>InventoryStatistics</b></p> <pre>▶—./ptcli—InventoryStatistics—--ip 9.148.220.101—--loginFile—h:\ptcli\ptadmin————▶</pre> |                                                                        |

Table 24. InventoryDeleteFile command

| Command             | Explanation                                         | Command Specific Options |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------|-----------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |                                                     | Name                     | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| InventoryDeleteFile | Delete a group of cartridges (expressed as a file). | --filetype <TYPE>        | The type of the file to be used by the command: <ul style="list-style-type: none"> <li>• <b>All</b> - All cartridges in the ProtecTIER repository.</li> <li>• <b>Replica</b> - All cartridges that were replicated <i>into</i> this repository.</li> <li>• <b>Origin</b> - All cartridges that were replicated <i>from</i> this repository.</li> <li>• <b>barcode</b> - Lists the barcodes of cartridges in the repository to be deleted.</li> </ul> |
|                     |                                                     | --file <PATH>            | The path to a file containing a list of cartridges to be deleted                                                                                                                                                                                                                                                                                                                                                                                     |
|                     |                                                     | --shelf                  | Flag indicating that the cartridges are located in Shelf. Choose this option or Library option.                                                                                                                                                                                                                                                                                                                                                      |
|                     |                                                     | --library <NAME>         | Flag indicating that the cartridges located in the library <NAME>. Choose this option or Shelf option.                                                                                                                                                                                                                                                                                                                                               |

Table 24. InventoryDeleteFile command (continued)

| Command                                                                                                                                                                                                                                                                                             | Explanation | Command Specific Options |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|
| <p><b>Example:</b></p> <p><b>InventoryDeleteFile</b></p> <p>▶ <code>./ptcli—InventoryDeleteFile—ip 9.148.220.88—loginFile—h:\ptcli\ptadmin—</code> Command Specific Options ▶</p> <p><b>Command Specific Options:</b></p> <p>  <code>—filetype—all—file—/temp/inventory/if2.csv—shelf—</code>  </p> |             |                          |

Table 25. InventoryDeleteFilter command

| Command                                                                                                                                                                                                                                                                                                                           | Explanation                                           | Command Specific Options                   |                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                   |                                                       | Name                                       | Explanation                                                                                                                                                                                                                                                                                                                                            |
| InventoryDeleteFilter                                                                                                                                                                                                                                                                                                             | Delete a group of cartridges (expressed as a filter). | <code>--querytype &lt;QUERYTYPE&gt;</code> | The type of the file to be used by the command: <ul style="list-style-type: none"> <li>• <b>All</b> - All cartridges in the ProtecTIER repository.</li> <li>• <b>Replica</b> - All cartridges that were replicated <i>into</i> this repository.</li> <li>• <b>Origin</b> - All cartridges that were replicated <i>from</i> this repository.</li> </ul> |
|                                                                                                                                                                                                                                                                                                                                   |                                                       | <code>--query &lt;QUERY&gt;</code>         | The query to be used by the filter command. See "Query"                                                                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                                                   |                                                       | <code>--shelf</code>                       | Flag indicating that the cartridges are located in Shelf. Choose this option or Library option.                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                   |                                                       | <code>--library &lt;NAME&gt;</code>        | Flag indicating that the cartridges located in the library <NAME>. Choose this option or Shelf option.                                                                                                                                                                                                                                                 |
| <p><b>Example:</b></p> <p><b>InventoryDeleteFilter</b></p> <p>▶ <code>./ptcli—InventoryDeleteFilter—ip 9.148.220.88—loginFile—h:\ptcli\ptadmin—</code> Command Specific Options ▶</p> <p><b>Command Specific Options:</b></p> <p>  <code>—querytype—all—query—"barcode&gt;='000811' AND barcode&lt;='000830'"—shelf—</code>  </p> |                                                       |                                            |                                                                                                                                                                                                                                                                                                                                                        |

## Query

This topic describes what a query is and how to use it in Inventory commands.

A query is a statement in which the user can put one of the following:

- White spaces
- Numbers

- Tokens: and/or/not/is/in/between
- String literals (within single quotes): 'AB0000'
- Boolean: TRUE/FALSE/true/false
- Column names as defined by the column names of the query type
- Date: the date format in a query is as follows: datetime('2009-12-27' 08:23:00)

Results can be saved in a .csv file using the --output command switch.

The .csv file can be used as an input to a CLI move command. This .csv file can be partially edited by the user by removing lines (each line represents a cartridge).

User can also create his own barcodes file, and to use this as an input to a move command.

### Cartridges set and query type

A filter is always working on the specified set of cartridges:

- *All: All cartridges in the ProtecTIER repository.*

**cart\_unique\_id**

An internal unique id for a cartridge.

**barcode**

Barcode number.

**nominal\_size\_in\_bytes**

Nominal size measured in bytes.

**last\_access\_time**

Last access time.

**media\_type**

The media type could be L3 for LTO3, L2 for LTO2 or none for DLT.

**read-only**

An indication of the write protection status of the cartridge. True means it is read only and can't be written on. False means it can be written on.

**principality\_grid\_id**

The Grid ID of the repository that owns the cartridge.

**principality\_repository\_id**

The ID of the repository within the Grid that owns the cartridge.

**container\_name**

Could be only in a single container in a point in time.

**Note:** Grid ID will be common to all repositories within a Grid. Repository ID is unique within a Grid.

- *Replica: All cartridges that were replicated into this repository.*

**Note:** This is relevant from the stand point of a *Hub*, or in 3.1 a *Target* cartridge

**cart\_unique\_id**

An internal unique id for a cartridge.

**barcode**

Barcode number.

**nominal\_size\_in\_bytes**

Nominal size measured in bytes.

**last\_access\_time**

Last access time.

**media type**

The media type could be L3 for LTO3, L2 for LTO2 or none for DLT.

**read-only**

An indication of the write protection status of the cartridge. True means it is read only and can't be written on. False means it can be written on.

**principality\_grid\_id**

The Grid ID of the repository that owns the cartridge

**principality\_repository\_id**

The ID of the repository within the Grid that owns the cartridge

**container\_name**

Shelf or library name. Could be only in a single container in a point in time.

**last\_update\_time**

The last time the nominal size was updated - either by backup (in the source) or by replication (at the destination).

**source\_repository\_id\_for\_last\_sync\_point**

The ID of the repository this cartridge was replicated from.

**source\_grid\_id\_for\_last\_sync\_point**

The ID of the grid this cartridge was replicated from.

**source\_time\_for\_last\_sync\_point**

The time this cartridge was last synchronized with the source, in source clock. For example if the last replication ended at 09:23 according to source clock, and 11:23 according to destination clock, then this will show 09:23.

**destination\_time\_for\_last\_sync\_point**

The time this cartridge was last synchronized with the source, in destination clock. For example if the last replication ended at 09:23 according to source clock, and 11:23 according to destination clock, then this will show 11:23.

**in\_sync**

Shows if this cartridge is the same as in the source or not. When starting backup at the source this will turn to false. When the replication for this cartridge ends, it will turn to true. Note: this is synchronized only if there is a connection between the source and the destination. To know what is the time this flag is true, look at the "last sync point" fields above.

- *Origin: All cartridges that were replicated from this repository.*

**Note:** This is relevant from the stand point of a Spoke, or in 3.1, an Origin cartridge.

**cart\_unique\_id**

This is an internal unique id for a cartridge

**barcode**

Barcode number.



**nominal\_size\_in\_bytes**

Nominal size measure in bytes.

**last\_access\_time**

Last access time.

**media\_type**

The media type could be L3 for LTO3, L2 for LTO2 or none for DLT.

**read-only**

An indication of the write protection status of the cartridge. True means it is read only and can't be written on. False means it can be written on.

**principality\_grid\_id**

The Grid ID of the repository that owns the cartridge

**principality\_repository\_id**

The ID of the repository within the Grid that owns the cartridge

**container\_name**

Shelf or library name where the cartridge exists.

**destination\_repository\_id**

The ID of the repository within the Grid that this cartridge was replicated into.

**destination\_grid\_id**

The Grid ID of the repository that this cartridge was replicated into.

**last\_replication\_time**

This is the time when the last DFS file (last data unit) was replicated to the destination.

**last\_sync\_time**

The recent time that the cartridge was being synced with the destination.

**replicated\_size**

The nominal size (in bytes) replicated to that destination for this cartridge.

**backlog\_size**

The nominal size of the backlog for this cartridge relative to the destination. This is how much left to replicate for this cartridge to the destination - only for cartridges that have triggers (need to replicate or being replicated).

The set of cartridges is stated in the CLI command as 'querytype'. So the query type can be: 'all', 'replica', 'origin'.



---

## **Part 2. Working with ProtecTIER for VTL**

This section of the guide describes how to work with ProtecTIER for VTL.



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## Chapter 8. Managing the ProtecTIER Virtual Tape service

The ProtecTIER system provides many functions to managing the ProtecTIER Virtual Tape (VT) service.

### About this task

A virtual tape library emulates a physical tape library. The ProtecTIER system emulates the library installation, library expansion, cartridge management, drive addition, and drive allocation.

---

### Setting the ProtecTIER VT host connections

This topic describes how the ProtecTIER front-end ports are connected.

Connect the ProtecTIER front-end ports to your backup environment. ProtecTIER front-end ports can be connected either in FC loop topology or through fibre channel switches.

**Important:** When modifying the front-end connectivity, it is recommended that Loop topology be used for direct connection and P2P when fibre channel switches are being used. If the topology is set to Loop in a fibre channel switch connection, the link will go down.

If fibre channel switches are used, you must create zones to set up the appropriate fibre channel connectivity between the ProtecTIER front-end ports and the fibre channel ports in your backup environment.

**Attention:** The switch should be installed and correctly cabled before beginning the configuration. For details, see the documentation provided with the switch.

### Creating the zones

A ProtecTIER server front-end port shares zones with only backup server FC ports. Each zone contains only one ProtecTIER front-end port.

Zoning can be defined by switch ports or by worldwide Names (WWNs).

---

### Creating libraries

Complete this task to create a library for your ProtecTIER system.

#### Before you begin

Ensure that the following items are performed before proceeding with this task:

- Check with your administrator about the number of drives and cartridges supported by your application.
- The virtual devices of the library are assigned to ProtecTIER server ports. Use the Scan button of the Port attributes pane to verify that the ProtecTIER server ports are connected to the correct host.

## About this task

**Note:** Check with your backup application administrator to ensure the number of drives and cartridges supported by your application.

|                                  | TS7610 or TS7620<br>Appliance Express | TS7650G             | TS7650 Appliance    |
|----------------------------------|---------------------------------------|---------------------|---------------------|
| Maximum number of libraries      | 4                                     | 16                  | 12                  |
| Maximum number of virtual drives | 256                                   | 256 (dual-node 512) | 256 (dual-node 512) |

**Note:** The ProtecTIER server ports to which the virtual devices of the library are assigned must be connected to the correct host. Use the Scan button of the Port attributes pane to verify the port connections to the correct host. For more information, see “Fibre Channel port attributes of a node” on page 126.

If your ProtecTIER node has ports connected to a host that is running HP-UX, you must verify that the ports are configured as HP-UX ports. Use the **Flat addressing mode** function from the **Host Initiators Management** screen to verify port configuration. For more information, see “Managing host initiators” on page 81 and “Manually adding host initiators” on page 82. If these conditions are not met, the host might not be able to detect all of the virtual tape drives.

Perform the following steps to create the library:

### Procedure

1. From the toolbar, click the **Create new library** button. The **Create new library** wizard **Welcome** screen is displayed.
2. Click **Next**. The **Library details** screen is displayed.
3. In the **VT name** field, enter a name for the library.
4. Click **Next**. The **Library type** screen is displayed.

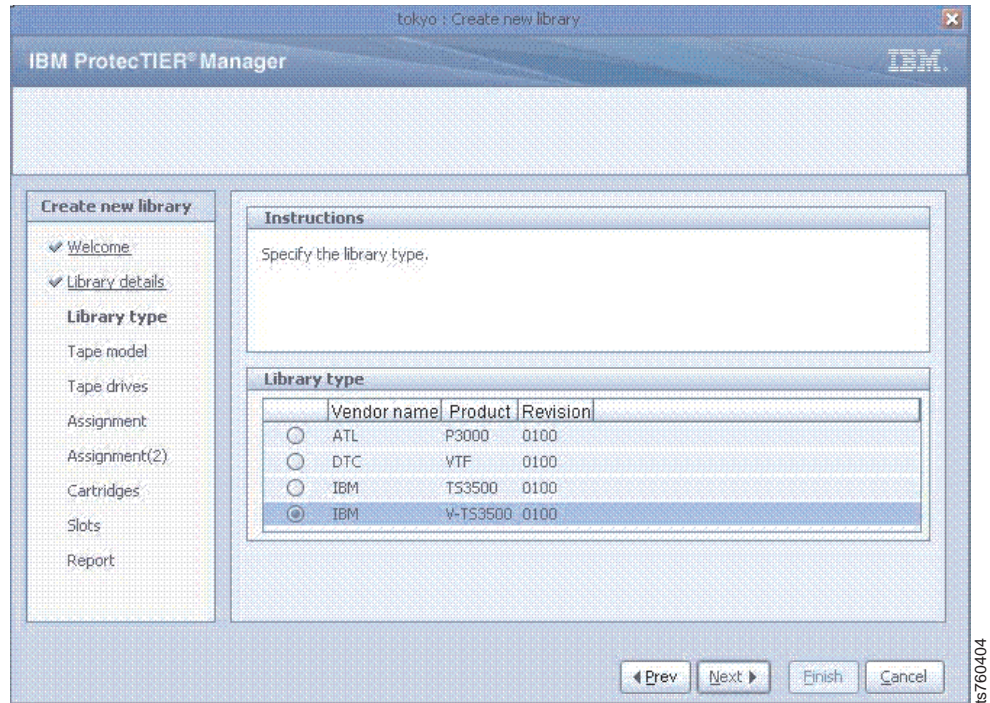


Figure 9. Library type screen

5. Select **IBM TS3500 0100** as the type of physical library model that you want the virtual library to emulate:

**Note:** For more information, see “Setting the library type” on page 68.

- ATL P3000 0100
- IBM TS3500 0100

You can also configure the virtual library models:

- DTC VTF 0100
- IBM V-TS3500 0100

**Note:** Verify that the backup application that you are using supports the type of library model that you select. For more information, refer to the *TS7650 Support Matrix* at: [http://www-03.ibm.com/systems/resources/TS7650\\_Support\\_Matrix.pdf](http://www-03.ibm.com/systems/resources/TS7650_Support_Matrix.pdf).

6. Click **Next**. The **Tape model** screen is displayed.

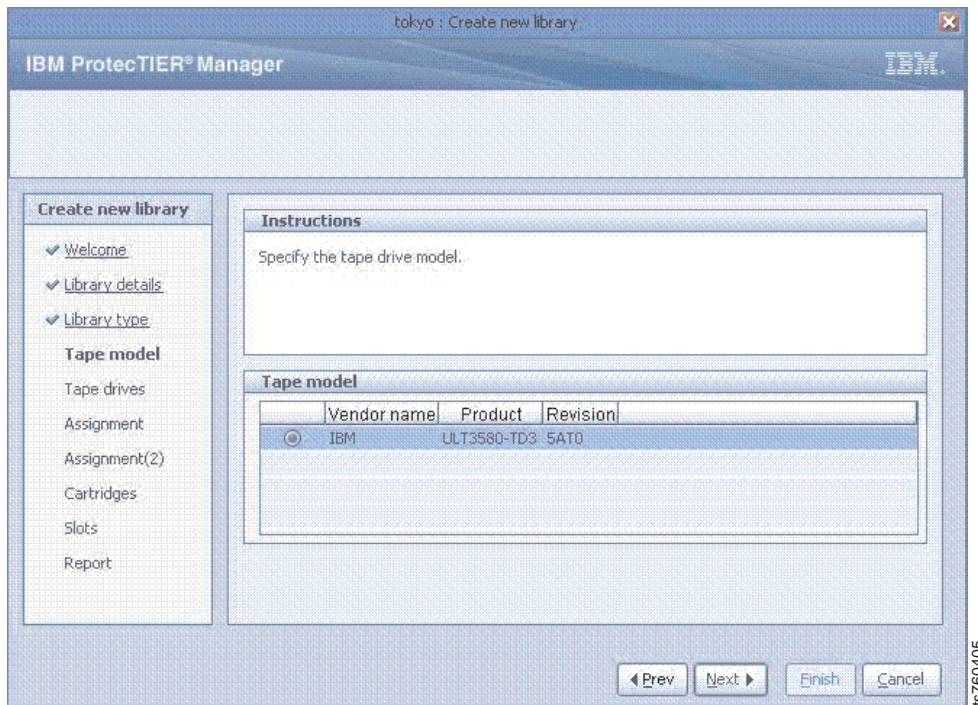


Figure 10. Tape model screen

7. Select the type of tape drive model that you want the virtual library to emulate. The type of tape drive depends on the library type chosen:
  - IBM ULT3580-TD3 (IBM LTO3)

**Note:** All tape drives in the library are of this type after your selection, including tape drives added at a later time.

8. Click **Next**. The **Tape drives** screen is displayed.



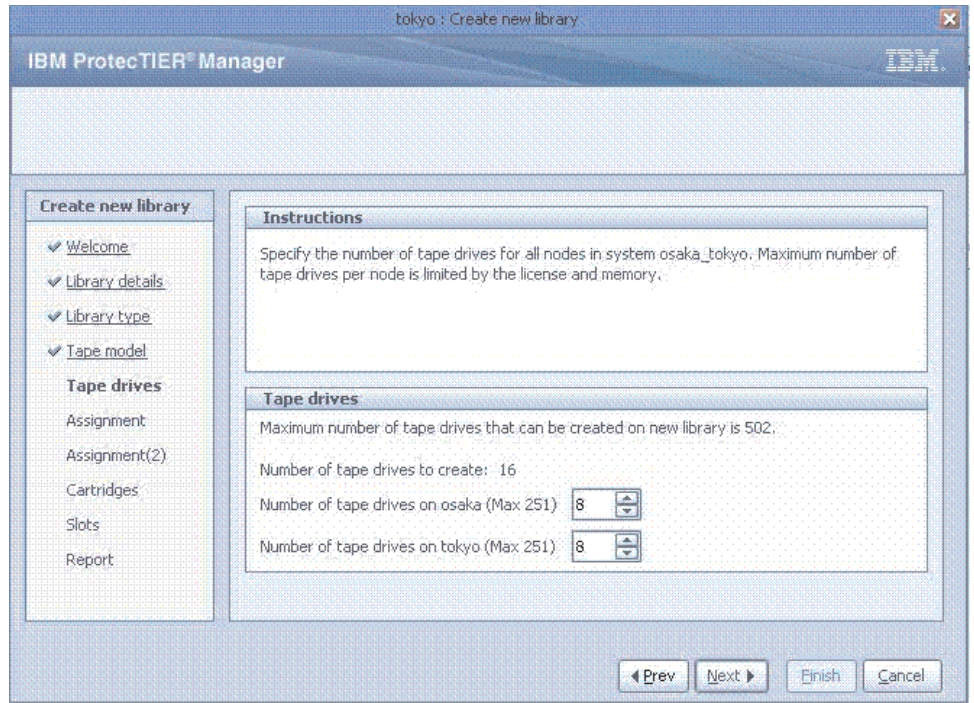


Figure 11. Tape drives screen

9. In the **Number of tape drives** field for each node, enter the number of tape drives to assign to the node. To maximize load balancing, IBM recommends that you distribute tape drives across the nodes based on the relative power of the node servers.
10. Click **Next**. The **Assignment** screen is displayed.

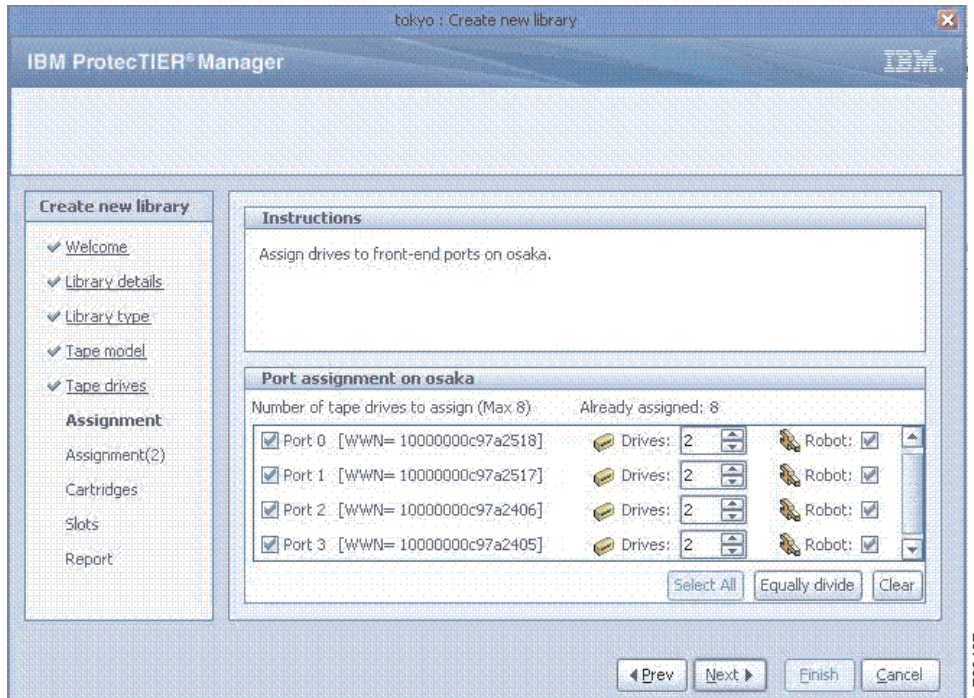


Figure 12. Port assignment screen

11. Select or clear the check boxes next to each port to define which of the node ports are assigned virtual devices.

**Note:** If you have chosen an IBM library model, all the ports are selected and enabled. If you have chosen a library model other than IBM, the ports are not checked. In either case, you **must** select at least **one** port assignment that will have a robot.

12. In the **Drives** fields corresponding to each selected port, select the number of virtual tape drives that are assigned to each port.

**Note:** Optionally, click **Select All** to automatically select both ports. Click **Equally divide** to evenly divide the number of drives between the ports.

13. Check the **Robot** check box if you want the library virtual robot to be accessible through this port.

**Note:** For high-availability purposes, ProtecTIER supports the assignment of the virtual robot to multiple ports.

14. Click **Next**.
15. Click **Next**. The **Cartridges** screen is displayed.

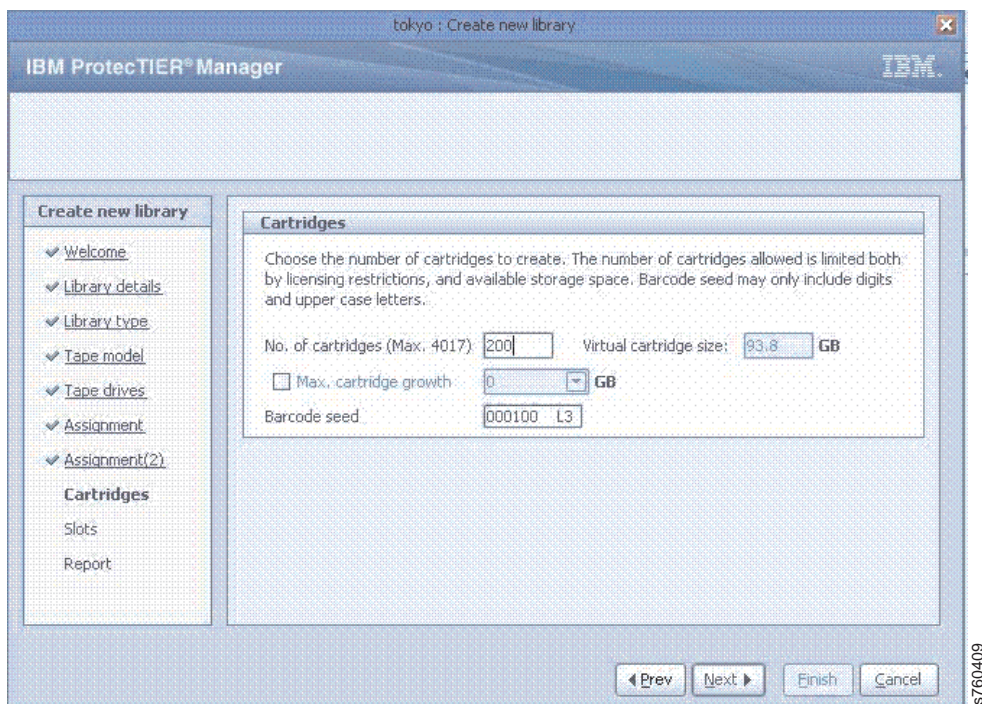


Figure 13. Cartridges screen

16. In the **No. of cartridges** field, enter the number of cartridges that you want to have in the library. The **Virtual cartridge size** field automatically displays the system for virtual cartridges. Capacity is based on the number of cartridges entered, the total amount of available storage space in your repository, and the current HyperFactor ratio.

**Note:** Optionally, select the **Max. cartridge growth** check box. When selected, you can limit the maximum amount of nominal data that a cartridge can contain.

The value of the maximum number of cartridges possible on a system depends on the amount of storage space available on your system. The maximum possible cartridge limit is 62,000, but many systems will have a lower maximum limit because of the storage space available.

17. In the **Barcode seed** field, enter a value for the barcode seed. The barcode seed is the barcode that is assigned to the first cartridge created. Every cartridge added after the first cartridge is assigned a barcode following the initial barcode seed.

**Note:** The barcode seed must contain only numbers and capital letters.

18. Click **Next**. The **Slots** screen is displayed.

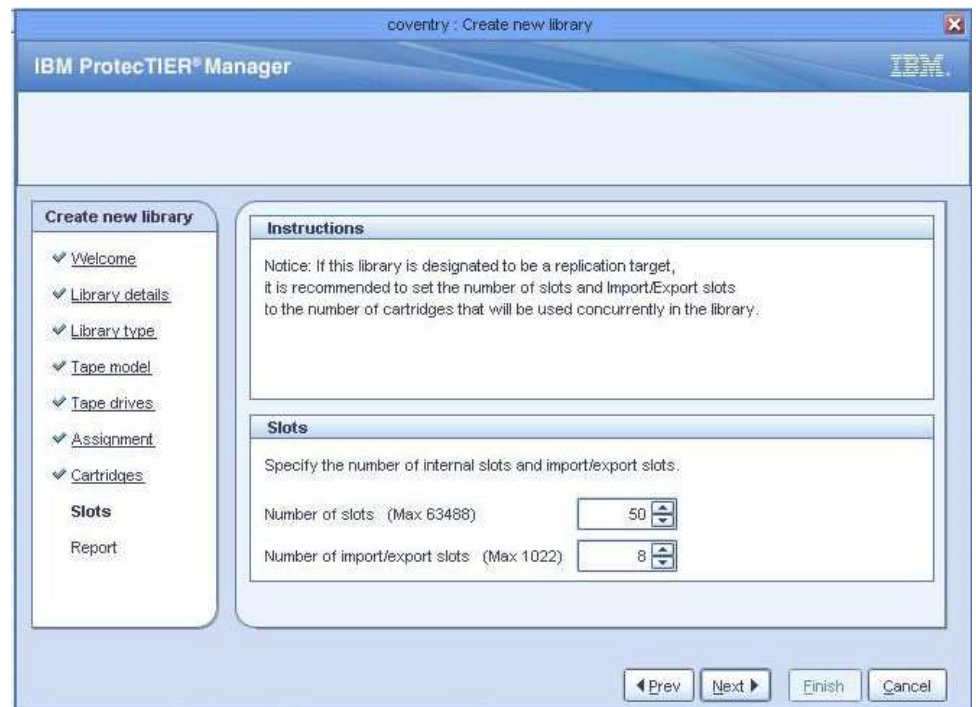


Figure 14. Slots screen

19. In the **Number of slots** field, enter the number of cartridge slots that you want to have in the library.

**Note:** The number of cartridge slots must not be less than the number of cartridges that you are creating. If you expect to increase the number of cartridges at a later time, it is recommended that you create additional slots.

20. In the **Number of import/export slots** field, enter the number of import/export slots that you want to have in the library. You can define up to a maximum of 1022 import/export slots for each library.
21. Click **Next** and **Finish**. The **Create new library** wizard closes.
22. Click **Yes** to continue. The ProtecTIER system temporarily goes offline to create the library. The library is displayed in the **Systems Management** pane.

## Renaming libraries

Complete this task to rename an existing ProtecTIER library.

## About this task

The ProtecTIER system enables you to rename libraries after they have been created.

Perform the following steps to rename an existing library.

### Procedure

To rename an existing library:

1. Log in to the ProtecTIER Manager software.
2. Select a library from the navigation pane.
3. Choose **VT > VT Library > Rename library**. The **Rename library** dialog is displayed.
4. Enter a new name for the selected library and click **Ok**. The **Rename library** dialog closes and the library's name is changed.

---

## Setting the library type

**Note:** Verify that the backup application that you are using supports the type of library model that you select for a virtual tape system. Refer to the *TS7620 Support Matrix* at: <http://www.indabook.org/preview/wyXeKaF5oviNlchFeGbhQAG3rhfjYA7IQYIN0pDoGWM,/IBM-System-Storage-TS7650-TS7650G-TS7620.html?query=IBM-Support-Drivers-Download>.

When you set the library type, you can select the type of physical library model that you want the virtual library to emulate:

- ATL P3000 0100
- IBM TS3500 0100

You can also configure the virtual library models:

- DTC VTF 0100
- IBM V-TS3500 0100

If you chose the TS3500 (or P3000) during the creation of the library and your backup application does not support that library model type as a virtual tape system, the **Set library type** window allows you to change the library type to V-TS3500 (or VTF). Conversely, if you chose the V-TS3500 (or VTF) during library creation, and your backup application supports the TS3500 library, use **Set library type** to change the library type. (You can interchange between the TS3500 and V-TS3500 library models and between the P3000 and VTF library models.)

### Example

To set the library type:

1. Select the library in the **Systems Management** pane.
2. Choose **VT > VT Library > Set library type**. The **Set library type** window is displayed.
3. Specify the library type accordingly:

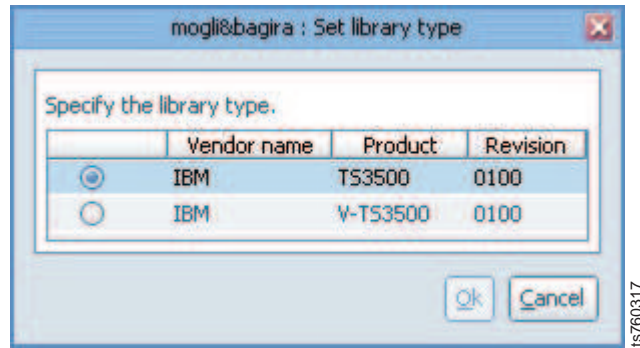


Figure 15. Set library type dialog

4. Click **Ok**.

---

## Editing library parameters

Complete this task to change the parameters of an existing library.

### About this task

The ProtecTIER system enables you to change the parameters of libraries, including the assignment of virtual devices, adding virtual tape drives, and increasing library capacity.

**Note:** The **Change dimensions wizard** does not enable you to assign existing unassigned tape drives. Use the Re-assign devices wizard to assign unassigned tape drives. For more information, see “Reassigning devices” on page 72.

Perform the following steps to change the parameters of an existing library:

### Procedure

1. Select a library from the **Systems Management** navigation pane.
2. Choose **VT > VT Library > Change dimensions**. The **Change dimensions wizard Welcome** screen is displayed.
3. Click **Next**. The **Tape drives** screen is displayed.

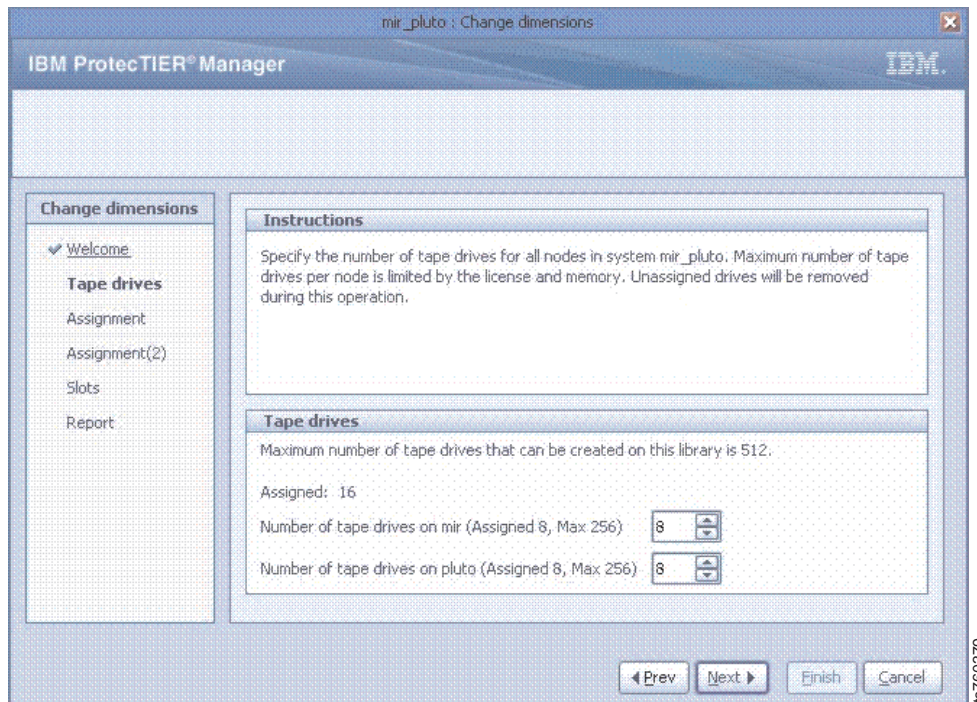


Figure 16. Tape drives screen

4. In the **Number of tape drives** field enter the number of tape drives that you want to have in the node.
5. Click **Next**. The **Assignment** screen is displayed.

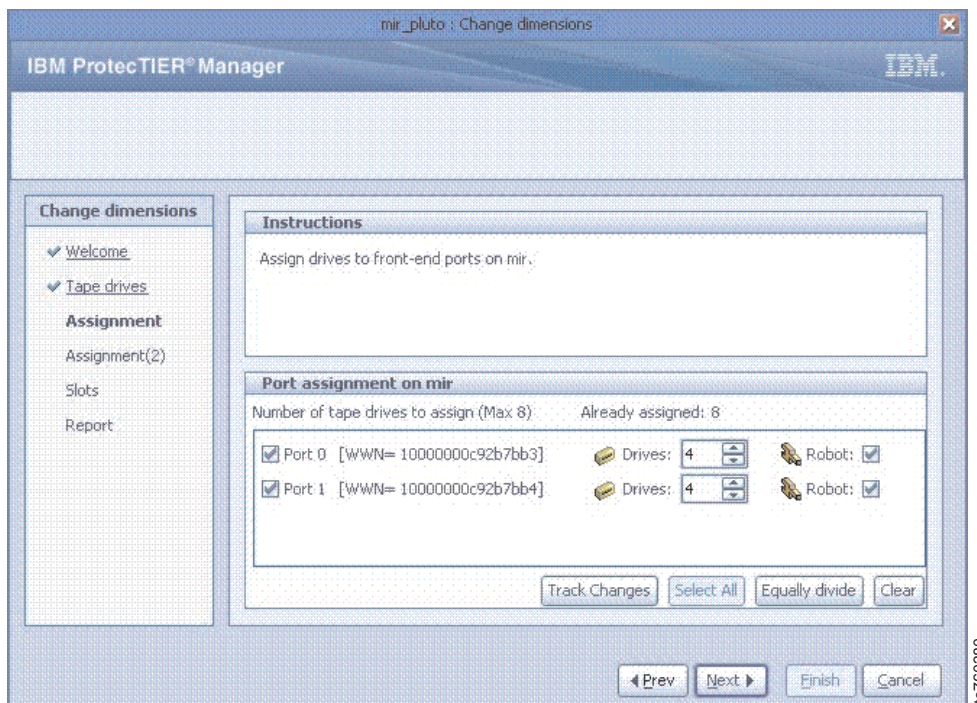


Figure 17. Assignment screen

6. Select or clear the check boxes next to each port to define which of the node ports are assigned virtual tape drives.

7. In the **Drives** fields corresponding to each selected port, select the number of virtual tape drives that are assigned to each port.

**Note:** Optionally, click **Select All** to automatically select both ports. Click **Equally divide** to evenly divide the number of drives between the ports.

8. Optionally, click **Track Changes** to display the modifications that the ProtecTIER system might need to make in response to the changes you defined. Then, click **Re-assign ports** to return to the Assignment screen and continue assigning virtual tape drives.
9. Check the **Robot** check box if you want the library virtual robot to be accessible through this port.

**Note:** For high-availability purposes, ProtecTIER supports the assignment of the virtual robot to multiple ports.

10. Repeat steps 6 on page 70 through 9 for the **Assignment (2)** screen.
11. Click **Next**. The **Slots** screen is displayed.

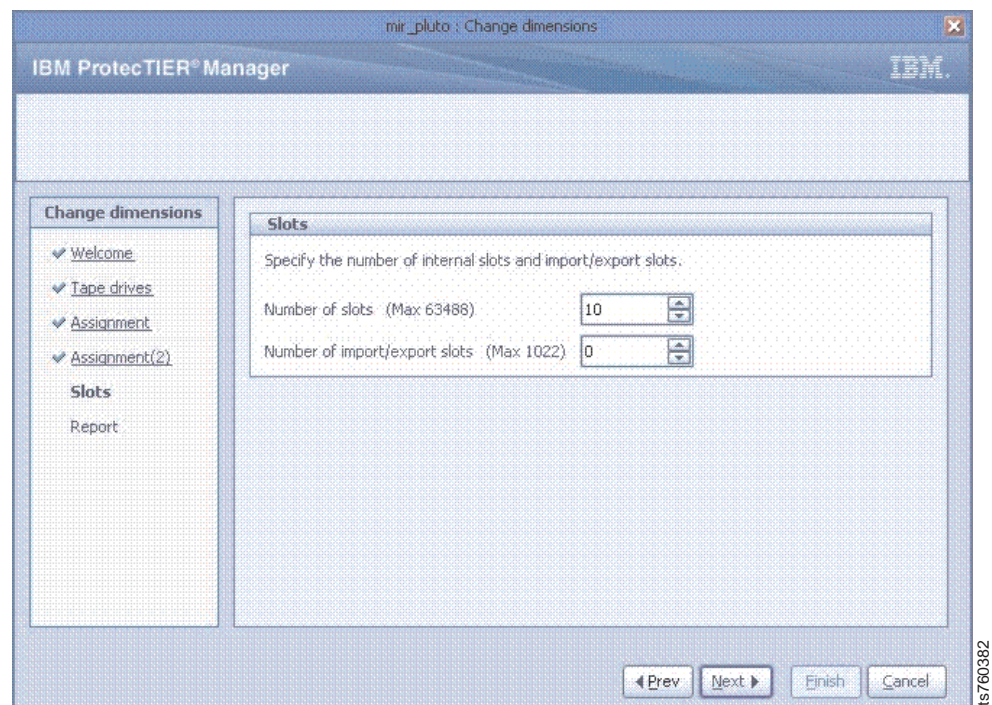


Figure 18. Slots screen

12. In the **Number of slots** field, enter the number of slots that you want in the library.

**Note:** The number of slots must be at least equal to the number of cartridges in the library.

13. In the **Number of import/export slots** field, enter the number of import/export slots that you want in the library.
14. Click **Next** and **Finish**. The **Change dimensions** wizard closes.
15. Click **Yes** to continue. The ProtecTIER system temporarily goes offline to update the library.

## Reassigning devices

Complete this task to reassign the virtual robot and cartridge drives within the ProtecTIER system.

### About this task

The ProtecTIER system enables you to relocate the virtual robot and cartridge drives between nodes or node ports.

Perform the following steps to reassign the virtual robot or cartridge drives:

### Procedure

1. Select a library from the **Systems Management** navigation pane.
2. Choose **VT > VT Library > Re-assign devices**. The **Re-assign devices** wizard **Welcome** screen is displayed.
3. Click **Next**. The **Tape drives** screen is displayed.

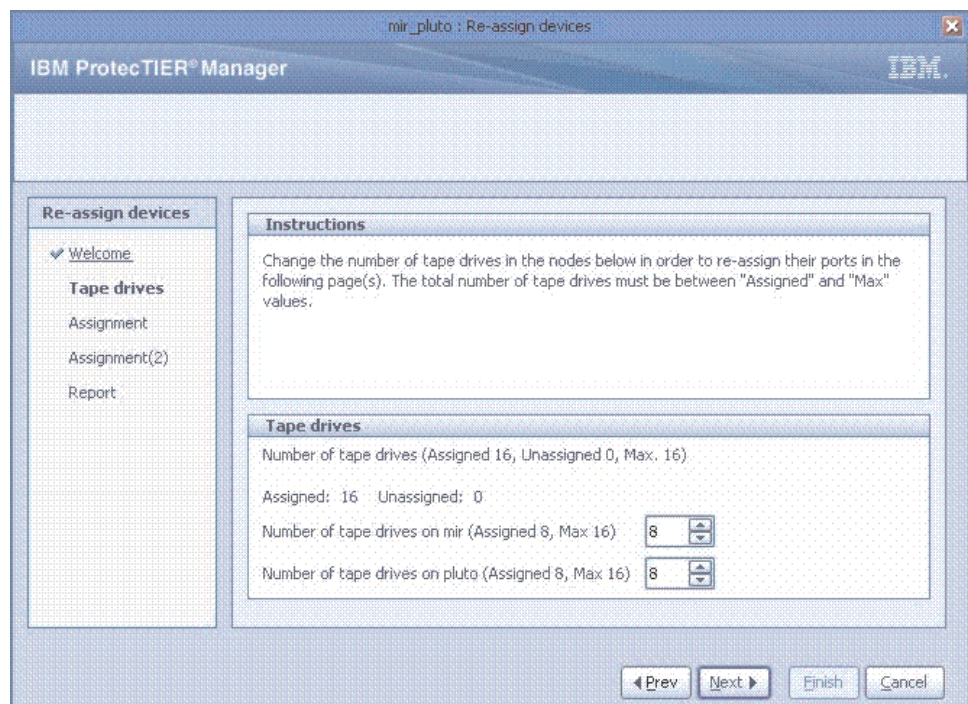


Figure 19. Tape drives screen

4. In the **Number of tape drives** field, select the number of tape drives to assign to the node.

**Note:** If a node is currently down, you can only remove drives from that node.

5. Click **Next**. The **Assignment** screen is displayed.



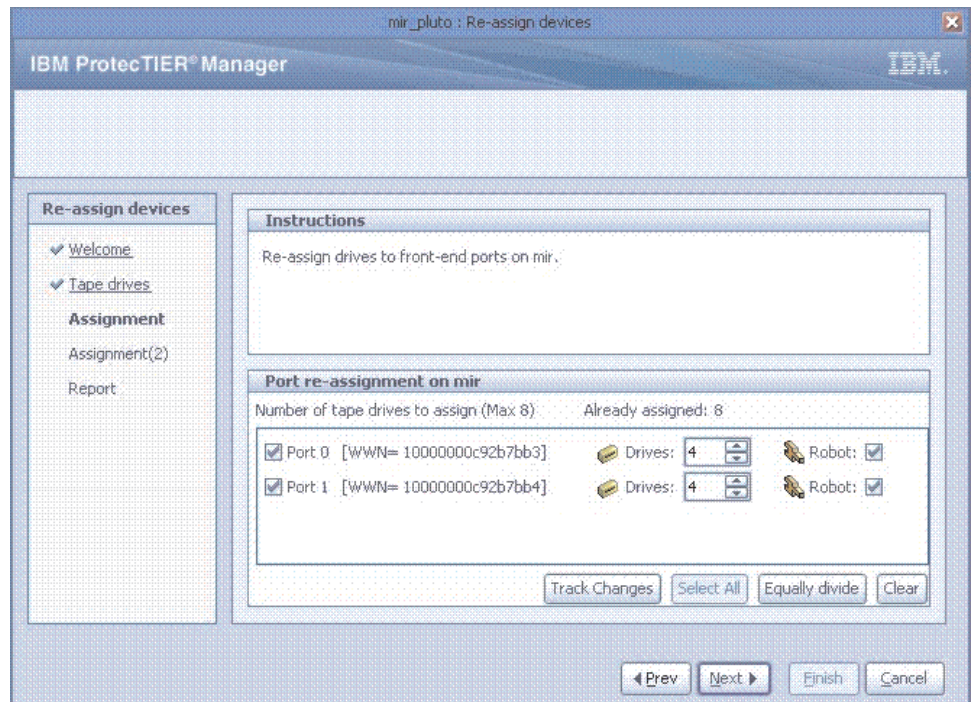


Figure 20. Assignment screen

6. Select or deselect the check boxes next to each port to define which of the node's ports are assigned virtual tape drives.
7. In the **Drives** fields corresponding to each selected port, select the number of virtual tape drives that are assigned to each port.

**Note:** Optionally, click **Select All** to automatically select both ports. Click **Equally divide** to evenly divide the number of drives between the ports.

8. Optionally, click **Track Changes** to display the modifications that the ProtecTIER system might need to make in response to the changes that you defined. Then, click **Re-assign ports** to return to the Assignment screen and continue assigning virtual tape drives.
9. Check the **Robot** checkbox if you want the library virtual robot to be accessible through this port.

**Note:** For high-availability purposes, ProtecTIER supports the assignment of the virtual robot to multiple ports.

10. Click **Next**. The **Summary report** is displayed.

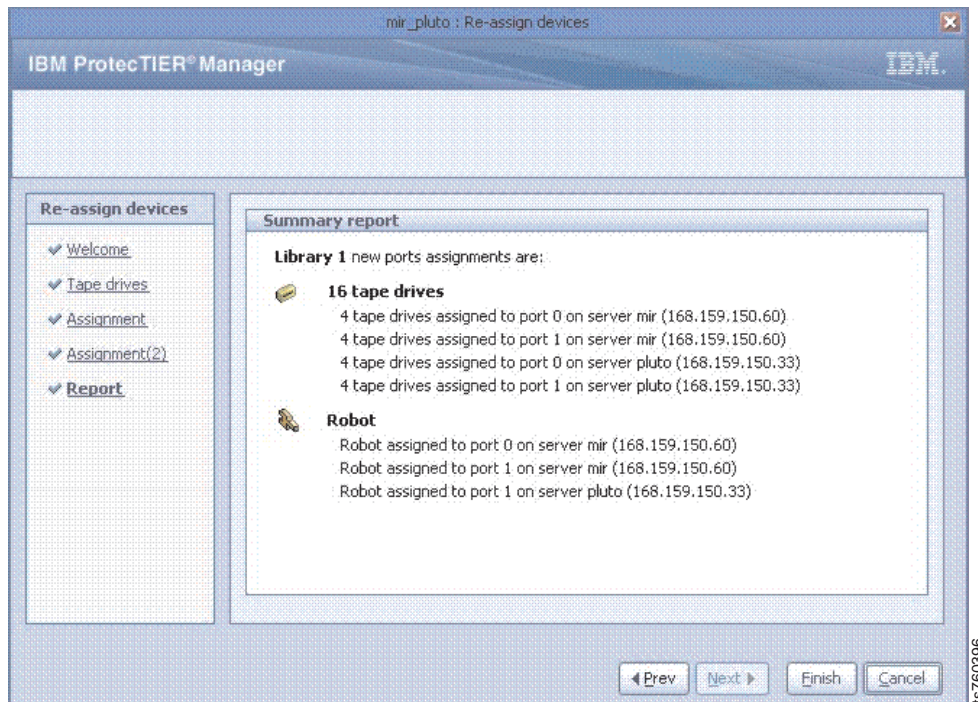


Figure 21. Summary report screen

11. Click **Finish**. The **Re-assign devices** wizard closes.
12. Click **Yes** to continue. The ProtecTIER system temporarily goes offline to reassign the devices.

## Control Path Failover (CPF) and Data Path Failover (DPF) support

This topic details the Control Path Failover (CPF) and Data Patch Failover (DPF) that are supported by the emulated IBM library models.

### Before you begin

Setting CPF/DPF within the IBM tape device driver is described in the *IBM Tape Device Drivers Installation and User's Guide* located on the following Web site: <https://www-304.ibm.com/support/docview.wss?rs=577&uid=ssg1S7002972>.

By default, Data Path Failover is always enabled on the emulated IBM library models and requires no feature code.

By default, CPF is also enabled on the emulated IBM library models. However, when troubleshooting host connectivity issues, you might be asked to disable CPF.

### About this task

This task describes how to disable CPF:

#### Procedure

1. Select a library from the **Systems Management** navigation pane.
2. Select **VT > VT Library > Set control path failover mode**. The **Set control path failover mode** dialog is displayed.
3. Set the CPF mode to **Control path failover disabled**. CPF is now disabled.

## What to do next

For further details on CPF and DPF support, refer to the TS7650 Support Matrix at the following Web site: [http://www-03.ibm.com/systems/resources/TS7650\\_Support\\_Matrix.pdf](http://www-03.ibm.com/systems/resources/TS7650_Support_Matrix.pdf).

---

## Deleting libraries

Complete this task to delete a ProtecTIER library.

### About this task

**Attention:** Deleting a library results in the loss of all data contained in that library. Only a person with administrator authority can perform this task.

Perform the following steps to delete a ProtecTIER library.

### Procedure

To delete a library:

1. Log in to the ProtecTIER Manager software.
2. Select a library from the **Systems Management** navigation pane.
3. Choose **VT > VT Library > Delete library**. A confirmation message box is displayed.
4. Click **Yes**. The Data Loss Confirmation dialog is displayed.
5. In the field, type **data loss** and click **Ok**. A confirmation message box is displayed.
6. Click **Yes** to continue. The ProtecTIER system temporarily goes offline to delete the library.

---

## Managing cartridges

The topics in this section describe how to manage cartridges from your libraries within the ProtecTIER system.

### Adding cartridges

Complete this task to add cartridges to your ProtecTIER system.

### About this task

If your virtual library has enough empty slots to accommodate the additional cartridges, the adding cartridges process occurs online without disrupting backup. If the virtual library does not have enough empty slots, adding cartridges causes the ProtecTIER system to temporarily go offline to create more slots for the cartridges.

Perform the following steps to add cartridges:

### Procedure

1. Select a library from the **Systems Management** navigation pane.
2. Click the **Add cartridges** button. The **Add cartridges** wizard **Welcome** screen is displayed.

3. Click **Next**. The **Cartridges** screen is displayed:

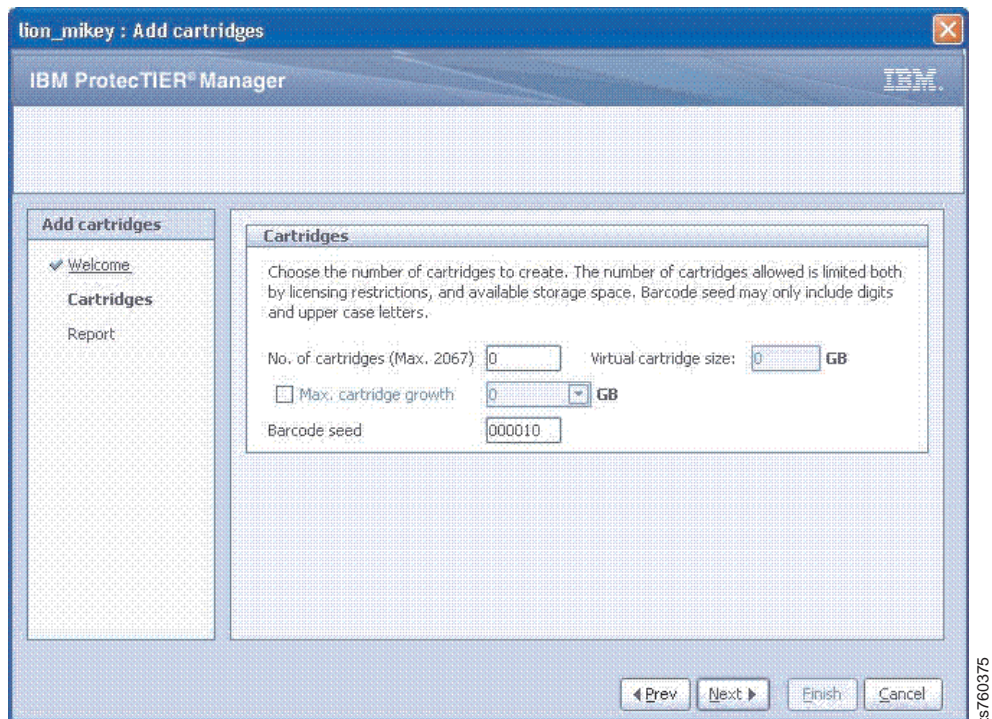


Figure 22. Cartridges screen

4. In the **No. of cartridges** field, enter the number of cartridges that you want to have in the library. The **Virtual cartridge size** field automatically displays the maximum possible size for virtual cartridges for your system. This number is based on the number of cartridges entered, the total amount of available storage space in your repository, and the current HyperFactor ratio.

**Note:** Optionally select the **Max. cartridge growth** checkbox. When selected, you can limit the maximum amount of nominal data that a cartridge can contain.

The value of the maximum number of cartridges possible on a system depends on the amount of storage space available on your system.

5. In the **Barcode seed** field, enter a value for the barcode seed. The default barcode seed is the continuation of the initial barcode seed assigned when the library was created.

**Note:** The barcode seed must contain only numbers and capital letters.

6. Click **Next** and **Finish**. The **Add cartridges** wizard closes.
7. Click **Yes** to continue and add the cartridges to the library. If the necessary number of cartridge slots are not already available, the ProtecTIER system temporarily goes offline to create them. When the system returns online, the cartridges are added to the library.
8. Continue working with the ProtecTIER system.

## Deleting cartridges

Complete this task to delete a cartridge within the ProtecTIER VT system.

## About this task

Deleting a cartridge results in the loss of all data contained in the cartridge.

**Note:** Deleting cartridges from an existing library increases the capacity size of cartridges in all libraries in the repository by a percentage proportional to the percent decrease in the number of cartridges. The change affects future backups. The Data Size of full cartridges does not change.

Perform the following steps to delete a cartridge:

**Note:** Alternatively, you can delete a cartridge from the shelf. Deleting a cartridge from the shelf is a nondisruptive operation (i.e. the VTL stays online). Thus, it is recommended that you eject the cartridges you want to delete to the local shelf on the repository, and then delete the cartridge.

### Procedure

1. Select the library that contains the cartridge you want to delete. The **VT** window is displayed.
2. Click the **Cartridges** tab. The **Cartridges** window is displayed.
3. Select a cartridge from the list of the cartridges displayed.
4. Choose **VT > VT Cartridge > Delete Cartridges**. A confirmation message box is displayed.
5. Click **Yes**. The **Data Loss Confirmation** dialog is displayed.
6. In the field, type **data loss** and click **Ok**. A confirmation message box is displayed.
7. Click **Yes**. The cartridge is deleted from the list.

**Note:** If the cartridges are deleted directly from the library (and not the shelf), a confirmation message will display for the system to go offline.

## Switching cartridges to read-only mode

Complete this task to change the cartridge mode to read-only.

### About this task

Perform the following steps to change the cartridge mode to read-only:

### Procedure

1. From the **Systems Management** view, select a library from the navigation pane..
2. Click on the **Slots** tab.
3. Select a cartridge.
4. Choose **VT > VT Cartridge > Read/Write cartridge**. A confirmation message box is displayed.
5. Click **Yes**. The cartridge switches to read-only mode.

**Note:** Clicking Read/Write cartridge for a read-only cartridge switches the cartridge to the read/write mode.

---

## Verifying cartridge metadata

This task describes how to verify a cartridge's metadata.

### About this task

Cartridge metadata is verified by reading the cartridge metadata to ensure that it is intact and the cartridge is usable.

Follow the procedure to verify cartridge metadata:

### Procedure

1. From the Systems Management view, select a library from the navigation pane.
2. Click on the **Slots** tab.
3. Highlight the cartridges to check.
4. Choose **VT > VT Cartridge > Meta-data verification**.
5. Click **Yes** to proceed with the operation. The **Verification results** display the status of the selected cartridges, the barcode numbers and file marks.
6. Click **Ok** to close the window.

---

## Verifying cartridge integrity

This task describes how to verify a cartridge's integrity.

### About this task

Cartridge integrity is verified by reading the cartridge actual data while performing CRC comparisons to ensure that the data is intact and the cartridge is usable.

Follow the procedure to verify cartridge integrity:

### Procedure

1. From the Systems Management view, select a library from the navigation pane.
2. Click on the **Slots** tab.
3. Highlight the cartridges to check.
4. Choose **VT > VT Cartridge > Cartridges integrity verification**.
5. Click **Yes** to proceed with the operation. The **Verification results** display the status of the selected cartridges and the barcode numbers.
6. Click **Ok** to close the window.

---

## Changing cartridge ownership (Principality)

Complete this task to change the ownership of a cartridge.

### Before you begin

Using ProtecTIER Manager, you can change the principality of synchronized cartridges to a different repository in the same replication group (without entering DR mode). The following conditions must be true:

Both repositories must be available

Both cartridges (source cartridge and its replica cartridge) must exist (have not been deleted) on relevant repositories.

**Note:** When you run a VTL repository takeover, the principality of the cartridges from the destroyed repository is automatically changed to the replacing repository. Refer to “Replacing a destroyed VTL repository ” on page 146 for more information.

### About this task

Cartridge ownership, or "principality", is the privilege to write to a cartridge (set it to read/write mode). The principality of each cartridge belongs only to one repository in the grid, and, by default, principality belongs to the source repository.

Follow the procedure below to change the cartridge principality:

### Procedure

1. In the Systems Management view, select a VT library from the navigation pane.
2. Click the **Cartridges** tab to display detailed information about the virtual tape cartridges in the library.
3. Highlight the synched cartridges from the VT library on which you want to change principality and right-click.

**Note:** Additionally, you can use the **Principality Cartridge Query Tool** to select cartridges for principality change by filtering the cartridges that are "in-sync".

To access the **Principality Cartridge Query Tool**, choose one of the following options:

- Right-click and select **Cartridge principality change > Principality Cartridge Query Tool** , or
- Select **VT > VT Cartridges > Principality Cartridge Query Tool** from the menu.

Refer to “Using the cartridge query tool (for VTL)” on page 164 for more information.

4. Select **Cartridge principality change > Mark selected cartridges to be processed** from the popup menu.

The following message is displayed:

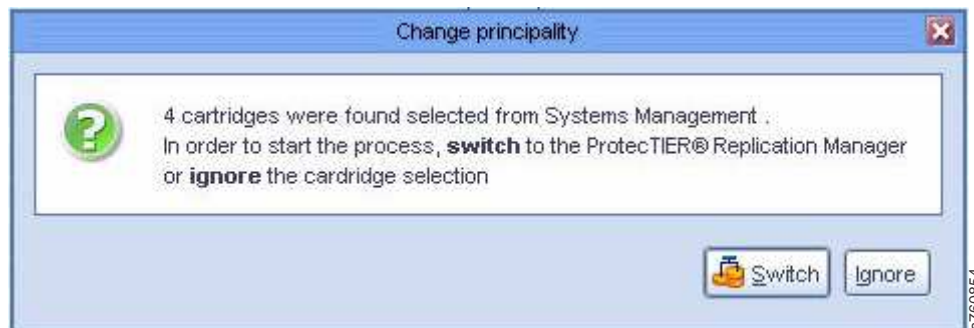


Figure 23. Cartridge selection details message

5. Click **Switch**. You are automatically switched to the ProtecTIER Replication Manager and the **Change principality** window is displayed:

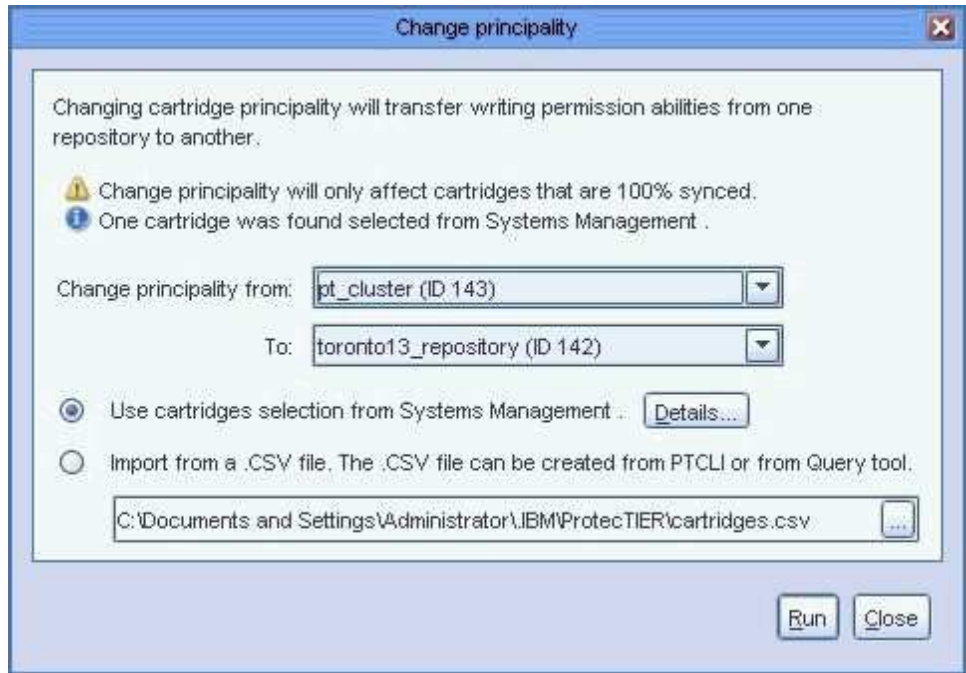


Figure 24. Change principality window

**Note:** Additionally, you can display the Change principality window by selecting **Group > Change principality**.

6. From the drop-down lists, select the repository from the **Change principality from:** field from which to change the cartridge principality.

**Tip:** If this window was displayed immediately after selecting cartridges in the System Management view, the repository displayed in the **Change principality from:** field should be correctly displayed by the system. Choosing a different repository from the drop-down list forces you to use the **Import from a .CSV file** option.

7. Select the repository from the **To** field to which to change the cartridge principality.
8. Click **Run**.
9. Click **Yes** to confirm running the operation.

If the change principality operation is successful, a message will display that the operation succeeded, how many cartridges were sent for processing, and how many of the cartridges were valid for principality change.
10. Click **Yes** to download a summary report.
11. If cartridges were marked for change principality in the Systems Management view, then the **Use cartridges selection** button is enabled. Click **Details...** to view the cartridges selected.

**Note:** If no cartridges were marked for change principality in the Systems Management view, then the only option offered is to import the cartridge selection from a *.csv* file created from either the PTCLI, or Cartridge query tool.



## Results

Once the change principality operation has succeeded, the **Principal** column in the cartridge view will show to which repository the principality has been changed.

## What to do next

Go to “Backup properties” on page 134.

---

## About LUN Masking

Use LUN Masking to monitor device visibility. LUN Masking "masks" specific devices (tape drives or robots) from the view of host initiators while allowing a selected host initiator group to view them.

LUN Masking allows you to assign specific devices to a specific host running backup application modules. It enables multiple initiators to share the same target FC port without having conflicts on the devices being emulated.

The LUN Masking setup can be monitored and modified at all times during system operation. LUN Masking in ProtecTIER influences the visibility of the devices by the hosts systems. Keep in mind that every modification in the LUN Masking in ProtecTIER might affect the host configuration and might require rescanning by the hosts.

## Enabling or disabling LUN Masking

The LUN Masking settings are disabled, by default, but can be either enabled or disabled. Configuration operations can be done in either mode, but the relevant changes are applied only when LUN Masking is enabled.

### About this task

If LUN Masking is enabled, devices are seen only by the hosts that are defined with them in the same LUN Masking group. If LUN Masking is disabled, all devices are seen by all hosts. Follow the steps below to enable or disable LUN Masking:

### Procedure

1. Select **VT > LUN Masking > Set LUN Masking enablement**.
2. Select **Enable LUN masking** to turn *on* LUN Masking, or **Disable LUN masking** to turn *off* LUN Masking.
3. Click **Ok**.

### What to do next

Once you have enabled or disabled the LUN Masking option, IBM recommends that you re-scan the devices from the host systems. Re-scanning sends the updated information for the list of visible devices and their associated LUN numbers.

Go on to “Managing host initiators.”

## Managing host initiators

The **Host Initiators Management** option is used to add, modify, or delete host initiators from the list of host initiators known to ProtecTIER.

**Note:** A host initiator must be defined before it can be a part of a LUN Masking group. Up to 1024 host initiators can be defined on a system. See “Working with LUN Masking groups” on page 85.

To add, modify or delete host initiators, select **VT > Host Initiators Management** to access the Host Initiators Management functions. The **Host Initiators Management** screen displays the following details of the host initiator:

- WWN
- Alias – a name that is defined other than the WWN
- Group associated – the LUN Masking group to which the host initiator belongs
- Flat addressing mode - a technique used by HP-UX to work around certain SCSI addressing limitations when accessing many devices over a Fibre Channel
- Link up – displays whether there is an active link between ProtecTIER and the host initiator

From this screen, go on to adding or scanning host initiators, modifying host initiator configurations, or deleting host initiators.

### **Adding Host Initiators**

This section describes how to add host initiators with the Host Initiators Management window.

Host initiators can be added to the host initiators list either manually, or by scanning the system for new host initiators. Follow either one of the following procedures below for adding host initiators:

- “Manually adding host initiators”
- “Scanning host initiators” on page 83

#### **Manually adding host initiators:**

Host initiators can be added manually by entering the host WWN, alias, and addressing mode. A host initiator can be added either by accessing the Host Initiator Management window from the VT menu, or from the LUN Masking group configuration window.

#### **About this task**

Manually adding host initiators is primarily done when hosts are not yet connected to ProtecTIER.

**Note:** A host initiator must first be defined before it can be a part of a LUN Masking group.

#### **Procedure**

To add a new host initiator:

1. Select **VT > Host initiators management**. The **Host initiator management** window displays.

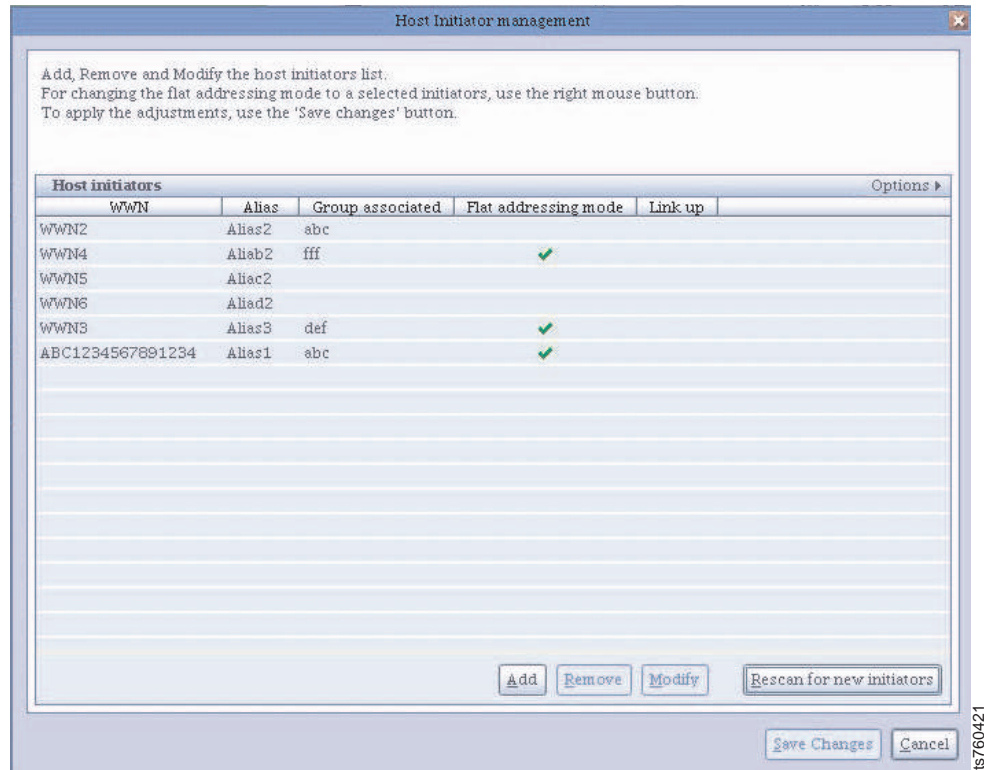


Figure 25. Host Initiator management window

2. Click **Add**. The **Add host initiator** screen is displayed.
3. Select a WWN from the WWN dropdown box or type in a new WWN.
4. Enter an alternative name for the WWN in the **Alias** field.
5. Select the **Flat addressing mode** check box if the flat addressing technique is to be used.
6. Click **Ok**. The new host initiator is listed on the Host initiators management screen.

### What to do next

Go on to add more new host initiators or to modify or delete existing host initiators. Once you have defined a host initiator, you can create LUN Masking groups. See “Working with LUN Masking groups” on page 85.

### Scanning host initiators:

Host initiators can be added to the configured host initiators list after scanning the system. Scanning for new host initiators is recommended when the host initiators are already physically connected, but you have not yet added them to the **Host Initiators** list.

### About this task

Use the following procedure to scan for new host initiators.

### Procedure

To scan for new host initiators:

1. Select **VT > Host initiators management**. The **Host initiator management** window displays.
2. Click **Re-scan for new initiators** to scan for new host initiators. If new host initiators are found that are not already configured in the Host Initiators list, a dialog with the available host initiators appears.
3. Select the Host Initiators you want to add.
4. Click **Yes** to add the new host initiators to the list, or click **Cancel** to exit without adding.

### What to do next

Go on to “Working with LUN Masking groups” on page 85.

## Modifying Host Initiators

You can change the host initiator alias or addressing mode or both.

### About this task

Use the following procedure to change the host initiator alias or addressing mode or both:

#### Procedure

1. Select **Host initiators management** from the **VT** menu. The **Host initiators management** screen is displayed.
2. Select a host initiator from the list and click **Modify**. The **Modify host initiator** dialog is displayed.
3. Change the host initiator alias by typing a new name in the **Alias** field.
4. Change the addressing mode by selecting or clearing the **Flat addressing mode** check box.
5. Click **Ok** to save and close the **Modify host initiator** dialog, or select a different host initiator to modify from the drop-down list in the **WWN** field.

### What to do next

Continue working with the options available from the **Host Initiators Management** screen to add, remove, modify, or rescan for new initiators.

If you have finished working with the **Host Initiators Management** screen, click **Save Changes** to save your changes and exit, or click **Cancel** to exit without saving your changes.

## Removing Host Initiators

Configured host initiators cannot be deleted if they act as members of a LUN Masking group. See *Removing a LUN Masking group* for more information.

### About this task

Use the following procedure to remove a host initiator that is not a member of a LUN Masking group:

#### Procedure

1. Select **Host initiators management** from the **VT** menu. The **Host initiators management** screen is displayed.

2. Select a host initiator from the list and click **Remove**. The **Remove host initiator** dialog is displayed.
3. Click **Yes** to remove.

### What to do next

Continue working with the options available from the **Host Initiators Management** screen to add, remove, modify, or rescan for new initiators. If you have finished working with the Host Initiators Management screen, click **Save Changes** to save your changes and exit, or click **Cancel** to exit without saving your changes.

---

## Working with LUN Masking groups

LUN Masking groups define the connection between the host initiators and the VT library devices (robots or tape drives). Devices which belong to a certain group can be seen by the host initiators of the group. A device can belong to multiple LUN Masking groups, but a host initiator can belong to only one LUN Masking group.

Select the **Configure LUN Masking groups** option from the **VT > LUN Masking** menu to begin configuring LUN Masking groups.

You can add LUN Masking groups. If a group exists, configure the group by adding Host Initiators, adding or modifying libraries, or adding or modifying the devices within the libraries.

**Note:** Keep in mind that changes you make in the LUN Masking configuration requires scanning by the host and by the backup application.

### Creating LUN Masking groups

Begin working with LUN Masking groups by adding a group via the **LUN Masking** window. A maximum of 512 groups can be configured per system and a maximum of 512 drives can be configured per group. (A maximum of 1024 host initiators can be defined on a system.) Each group needs to contain at least one host initiator and one device (tape drive or robot). Robots can be added as required.

To add a LUN Masking group:

1. On the left side of the LUN Masking window, click **Add** at the bottom of the **LUN Masking Groups** pane. The group details appear to the right of the window.

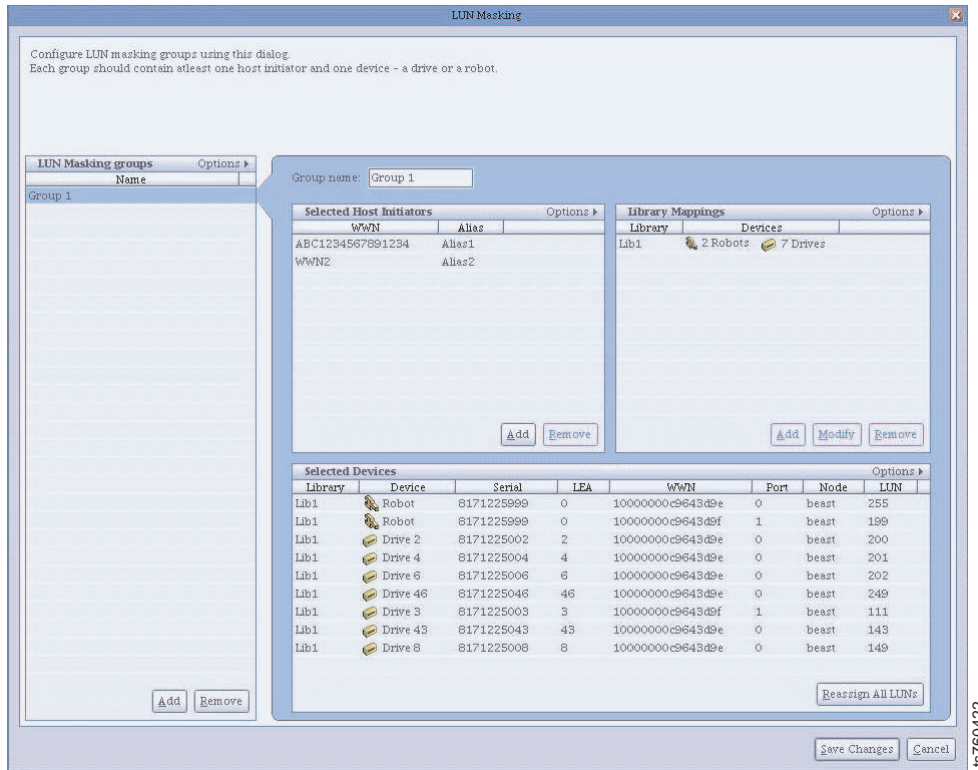


Figure 26. LUN Masking window

2. Type a new name for the group in the **Group name** field.
3. Add host initiators by clicking **Add** in the **Selected Host Initiators** pane. The **Add Host Initiators** dialog is displayed.
4. Select the Host Initiators to add to the LUN Masking group from the list displayed and click **Ok**.
5. Continue adding more host initiators, or go on to add the library devices.

From the **Library Mappings** pane, you can add the library devices you want to be visible to the host initiators in the group.

1. To define the devices, click **Add** at the bottom of the **Library Mappings** pane in the LUN Masking group details view. A list of libraries in the system is displayed.
2. Select the relevant libraries from the list and click **Ok**

Continue selecting the library devices to be viewed by the host initiators in the group.

## Modifying a LUN Masking group

From the **Selected Devices** pane, modify the libraries and devices defined in the LUN Masking group. Once you have finished, click **Save changes** to save your modifications and exit the LUN Masking configuration.

After modifying a LUN Masking group, undesired holes might occur within the LUN numbering sequence. For example, removing a device from an existing group causes holes in the LUN numbering if this device does not have the highest LUN number. As a result, the backup application might have trouble scanning the

devices. If your backup application has trouble scanning the devices, it is recommended that you reassign or renumber the LUN.

1. Reassign the LUNs by clicking **Reassign All LUNs** at the bottom of the Selected Devices pane.

The system displays the Reassign LUNs dialog, which states "You are about to renumerate the LUN values of the available devices in the group. All the connected hosts must be rescanned."

2. Click **Yes** to renumerate.

The LUN values are renumbered and all the devices in the Selected Devices pane are assigned new LUN numbers, sequentially, starting with "0" (zero).

3. Click **Save changes** to keep the modifications or **Cancel** to close the wizard.

**Remember:** As noted in the dialog opened in step 1, you must rescan drives from all affected Host Initiators in the specific group.

Continue to the next section.

## Removing a LUN Masking group

If a LUN Masking group is removed while LUN Masking is enabled, the host initiators of that group become ineffective. They are unable to "see" any devices on this system. The host initiators must be reassigned to a different group to be reconnected.

To remove a LUN Masking group, click **Remove** at the bottom of the LUN Masking groups pane. The LUN Masking group is removed from the list.

Continue configuring the LUN Masking groups as appropriate. Click **Save changes** to save your modifications and exit the LUN Masking configuration.

## Library-related operations

Some library configuration operations might affect the LUN masking groups. Most of these operations are blocked by the system, with the exception of operations where the removal of the devices might directly affect the relevant LUN Masking group. The **Delete library** operation and the **Change library dimensions** operation to reduce the number of drives are not blocked by the system.

### Deleting a library

If devices from a deleted library are members of LUN Masking groups, a warning is issued to the log file and to the user. If the user proceeds with the operation, the devices are removed from the relevant LUN Masking groups, and the configuration file data is updated accordingly.

Removing a library can cause "holes" in the LUN Masking numbering and, therefore, the backup application might have trouble scanning the devices. In this case, you must reassign the LUN.

### Modifying the dimensions or reassigning devices of a library

The following rules apply when you modify the dimensions of a library or reassign library devices that belong to a LUN masking group:

- The device cannot be deleted or reassigned to another FE port. To reassign the device to a different port, you must remove the device from all of its related groupings.
- The number of drives in the library cannot be reduced.

Continue to the next chapter.



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## Chapter 9. Native Replication Management (for VTL)

This chapter provides the information needed to manage Native Replication configuration and monitoring of ProtecTIER VTL systems.

Native Replication lets you replicate data objects between ProtecTIER repositories. In order for a logical set of repositories to replicate from one to another, you must create a replication grid. The replication grid is remotely created and managed by the Replication Manager.

The ProtecTIER Replication Manager is a server that remotely manages the replication grids within an organization. ProtecTIER Manager connects to the ProtecTIER Replication Manager using the IP address of the ProtecTIER Replication Manager server. The ProtecTIER Replication Manager is installed on a ProtecTIER node and can manage up to one grid with 24 repositories.

Each ProtecTIER Replication Manager has a unique identity. A repository, once it has joined a replication manager cannot join a replication grid managed by a different replication manager, even if it has left the grid. This restriction prevents data collision.

In a VTL environment, replication groups are created where multiple source repositories can replicate to a single target. This target can then act as a Disaster Recovery site for any number of the sources, while still allowing local backups, as well as replication, from the active source repositories.

Go on to “Working with ProtecTIER Replication Manager.”

---

### Working with ProtecTIER Replication Manager

This section describes how to manage Native Replication by working with ProtecTIER Replication Manager.

The ProtecTIER Replication Manager tasks include:

- Managing the repositories in the replication grid that can be replicated to
- Maintaining the IP addresses of all repositories
- Updating of repositories leaving and joining the grid
- High-level monitoring and statistics of traffic in the replication grids

#### Connecting to a ProtecTIER Replication Manager

To begin adding and working with a replication grid, click the **Grids Management** button at the bottom of the navigation pane of ProtecTIER Manager.

Use the following procedure to connect to a new ProtecTIER Replication Manager:

1. Select **Replication Manager > Add Replication Manager**. The **Add ProtecTIER Replication Manager** dialog is displayed.
2. Enter the **IP address** of the ProtecTIER Replication Manager you want to add and click **Ok**. The **ProtecTIER Replication Manager Login** is displayed.

## Logging in to a ProtecTIER Replication Manager

Log in to a ProtecTIER Replication Manager:

1. Select **Replication Manager > Login**. The login screen is displayed.
2. Enter the Username: **gadmin** and Password: **gadmin**.
3. Click **Ok**. The **Replication Manager** view is displayed.

## Removing a ProtecTIER Replication Manager

Before you remove a ProtecTIER Replication Manager, you must first log out of the Replication Manager you want to remove.

1. Select the **Replication Manager** for removal from the **Grids Management** navigation pane.
2. Select **Replication Manager > Logout**. You are now logged out.
3. Select **Replication Manager > Remove Replication Manager**. The **Remove Replication Manager** dialog is displayed asking if you want to remove the connection to the Replication Manager you selected.
4. Click **Yes**. The Replication Manager is removed from the list in the Grids Management navigation pane.

Go on to “Managing the replication grid.”

---

## Managing the replication grid

The topics in this section define tasks used when working with the replication grid in a VTL environment.

Management and configuration of a replication grid is done through the ProtecTIER Replication Manager **Grids Management** view of ProtecTIER Manager. A replication grid is composed of a set of repositories that share a common ID and can potentially transmit and receive logical objects through replication. Repositories do not need physical connections between them. However, all repositories do need a network connection to the ProtecTIER Replication Manager server. ProtecTIER Replication Manager is installed on a ProtecTIER node and can manage up to one grid with a total of 24 repositories.

In a many-to-one environment, a single replication grid can include up to eight target repositories and, therefore, up to 8 "topology groups". A "topology group" is a replication group of one target repository with up to 12 source repositories connected to it.

In a many-to-many environment, a replication grid can have up to 2 groups of 4 target/source repositories replicating to each other per group. So, it can have up to two "topology groups" for a total of 8 members.

## Creating a replication grid

Use the following procedure to create a replication grid:

**Note:** Grid IDs and repository IDs are numbers that are never recycled. Even if a repository “leaves” the grid and “re-enters” the grid, it does not receive the same ID. Thus, actions like leaving a grid are expected to be rare and are not a part of the normal flow of work.

1. Click **Create new grid**. The **Create new grid** dialog is displayed.

- Complete the fields to define a grid. Type a unique **Grid ID** or select a unique **Grid ID** number (0 - 63) from the drop-down list and enter a name in the **Name** field.

**Note:** ProtecTIER does not allow you to choose an ID that has already been used.

- Click **Ok**. The new grid is added to the **Grids** list in the navigation pane of the Grids Management view.

## Deleting a replication grid

Deleting a grid is only allowed if the grid is empty. In addition, once you have deleted a grid, the Grid ID cannot be reused. Being that there are only 64 grid numbers (0 - 63), deleting a grid means that you 'lose' one grid ID.

## Taking over a VTL repository

If the repository at the production site (source) has been destroyed and cannot be repaired, you can replace it with a new repository. See “Replacing a destroyed VTL repository ” on page 146.

## Displaying removed repositories

To display a list of removed (unrecoverable) repositories and their replacements, click **Grid > Show removed repositories**. A table is displayed showing the list of removed repositories and their replacements according to their ID numbers and names.

The table below show the list of removed repositories and their replacements:

| Removed repositories |                   | Replacing repositories |                           |
|----------------------|-------------------|------------------------|---------------------------|
| ID                   | Name              | ID                     | Name                      |
| 16                   | pt_cluster        | 14                     | dakiri_repository         |
|                      |                   | 12                     | Denver/Detroit_repository |
|                      |                   | 12                     | Denver/Detroit_repository |
|                      |                   | 15                     | corfu_rep                 |
|                      |                   | 14                     | dakiri_repository         |
|                      |                   | 19                     | piraeus_rep               |
|                      |                   | 12                     | Denver/Detroit_repository |
|                      |                   | 14                     | dakiri_repository         |
| 17                   | pt_cluster        | 12                     | Denver/Detroit_repository |
|                      |                   | 14                     | dakiri_repository         |
|                      |                   | 14                     | dakiri_repository         |
|                      |                   | 14                     | dakiri_repository         |
| 19                   | piraeus_rep       |                        |                           |
| 22                   | corfu_rep         | 23                     | piraeus_rep               |
|                      |                   | 14                     | dakiri_repository         |
| 23                   | piraeus_rep       |                        |                           |
| 25                   | dakiri_repository |                        |                           |
| 26                   | piraeus_rep       | 24                     | corfu_rep                 |

Figure 27. Show removed repositories window

Go on to “Working with repositories in a replication grid” on page 92.

---

## Working with repositories in a replication grid

The topics in this section explain how to manage and work with repositories in a replication grid.

**Note:** Repositories can replicate to each other only if they are part of the same grid. In addition, a repository cannot be a member of more than one grid.

### Adding a repository to a replication grid

This task explains how to add a repository to a grid.

#### About this task

When you add a repository to a replication grid, the repository can be defined as a source or a destination.

To add a repository to a replication grid:

#### Procedure

1. From the Grids Management view, select **Repository > Add repository to grid**. The **Add repository to grid** window is displayed.

**Note:** A repository cannot be a grid member of more than one grid.

2. Type the network replication IP address of the repository in the **Replication IP address** field.
3. Enter the username and password of the repository (User name: **ptadmin** and Password: **ptadmin**).
4. Click **Ok**. The repository is added to the replication grid.
5. If you have additional repositories to add to the replication grid, repeat this procedure for each one.

#### What to do next

Go on to “Working with Replication Groups in VTL” on page 93.

### Removing a repository from a grid

You can use the **ProtecTIER Replication Manager** to remove a repository from a grid.

#### About this task

**Note:** Before removing a repository from a grid, carefully consider the potential effects on the system configuration. Once the repository is removed from the grid, all the bandwidth reduction and replication deduplication information is deleted. The relationship between the original and replicated cartridge pair is lost and they cannot be updated in the same pair. If the repository rejoins the same grid, it looks like a new repository in the grid with a new ID, and all data should be replicated from beginning by new policies. Therefore, removing a repository from a grid is an operation you should plan with a PT specialist.

A repository can be removed from a grid only if it is a stand-alone repository. See “Modifying a Replication Group for VTL” on page 97.

To remove a repository from a grid:

## Procedure

1. From the Grids Management view, click the repository you want to remove.
2. Select **Repository > Remove repository from grid**. The **Remove repository from grid** window is displayed.
3. Complete the login information by typing the **User name** and **Password** of the repository.
4. Click **Ok**. The repository is removed from the grid.

## What to do next

**Note:** Remove a repository from a grid, without coordination with the Replication Manager, only if the ProtecTIER Replication Manager thinks that the repository is not a part of the grid already, or the Replication Manager was destroyed and is not meant to be restored. To remove a repository from a grid without coordination, see "Forcing a repository to leave a grid" on page 208.

## Updating the replication IP address of a grid member

Complete this task to update the Replication Manager about a change in the replication IP address of a grid member.

If the replication IP address of a grid member is changed, you need to update the ProtecTIER Replication manager with the new IP address.

To update the replication manager about a change in the IP address of a repository, select **Repository > Update repository address**. The **Update repository address** screen appears. Enter the updated IP address and click **Ok**.

---

## Working with Replication Groups in VTL

This section describes how to work with replication groups in "many-to-one" and "many-to-many" VTL environments.

In a "many-to-one" VTL environment, replication groups are created where up to 12 source repositories ("spokes") can receive local backups and replicate to a single destination ("hub"). The destination repository can, then act as a Disaster Recovery site for any number of the source repositories, and still allowing local backups, as well as replication, from the active source repositories.

In a "many-to-many" VTL environment, replication groups are created where multiple repositories can replicate to each other. A many-to-many replication group can be defined with up to four repositories, where each repository assumes the responsibility of a hub repository and can receive local backups, replicate data to remote hub repositories, as well as receive replicated data from remote hub repositories.

The same cartridge can be replicated from its principal repository to up to three destination repositories. Different cartridges can be replicated between multiple hub repositories in a bidirectional manner.

**Note:** Source repositories are not supported in a four-way many-to-many replication grid.

## Creating a Replication Group for VTL

This task explains how to create a replication group in a replication grid for VTL.

## About this task

Before defining any replication policy, you must create a replication group with a physical connection between the repositories. Different steps are followed for creating a replication group in "many-to-one" and "many-to-many" topologies.

- If you are creating a replication group in a many-to-one topology, see "Many-to-one topology."
- If you are creating a replication group in a many-to-many topology, see "Many-to-many topology" on page 95.

## Many-to-one topology

Follow this procedure to connect a source and destination repository in a many-to-one replication group.

### Procedure

1. From the Grids Management view, click a stand-alone repository.
2. Select **Group > Replication group management**. The **Replication group management** wizard is displayed. Click **Next**.

**Tip:** The **Replication group management** wizard can be accessed in a number of ways, either: right-click on a repository and select **Replication group management**, click the **Replication group management** icon on the toolbar, or select **Group > Replication group management**.

The following window is displayed:

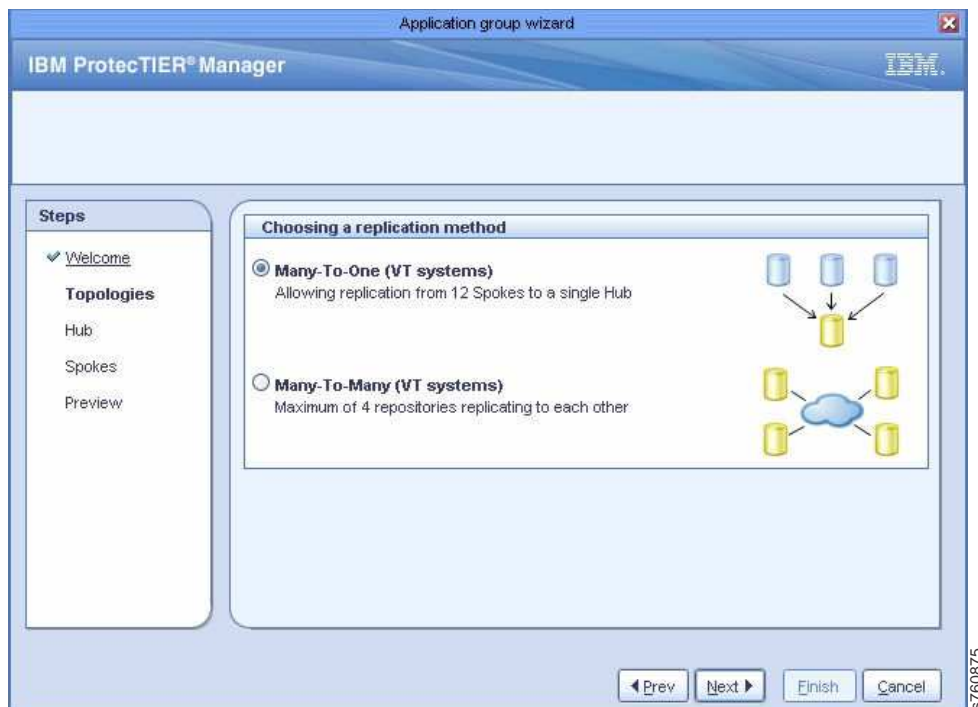


Figure 28. Many-to-one replication method topology window

3. Select the **Many-To-One (VT systems)** topology and click **Next**. The **Hub selection** window is displayed.
4. Select a repository to set as the destination from the **Hub repository** drop-down list and click **Next**. The **Repositories selection** window is displayed.

5. Select the repositories to connect as spokes for the selected hub and click **Next**. The **Preview** window of the replication group is displayed.
6. Type a **Group name** in the **Replication group settings** window and click **Finish**. The **Replication group management** wizard closes and the replication group is displayed in the Replication Manager.

### What to do next

Repeat this procedure or run the “Many-to-many topology” procedure to create additional replication groups, or go on to define and create replication policies (see “Replication policies” on page 98). To continue modifying the replication group (see “Modifying a Replication Group for VTL” on page 97).

### Many-to-many topology

Follow this procedure to connect up to 4 destination repositories in a many-to-many replication group.

#### Procedure

1. From the Grids Management view, click a stand-alone repository.
2. Select **Group > Replication group management**. The **Replication group management** wizard is displayed. Click **Next**.

**Tip:** The **Replication group management** wizard can be accessed in a number of ways, either: right-click on a repository and select **Replication group management**, click the **Replication group management** icon on the toolbar, or select **Group > Replication group management**.

3. Select the **Many-To-Many (VT systems)** topology as shown:



Figure 29. Many-to-many replication method topology window

4. Click **Next**. The **Repositories** selection window is displayed.

5. Select the destination repositories from the list that appears to be part of the replication group.
6. Click **Next**. The **Preview** window of the Replication Group is displayed.
7. Type a **Group name** in the **Replication group settings** window and click **Finish**. The **Replication group management** wizard closes and the replication group is displayed in the Replication Manager.

### What to do next

Repeat this procedure or run the “Many-to-one topology” on page 94 to create additional replication groups, or go on to define and create replication policies (see “Replication policies” on page 98). To continue modifying the replication group (see “Modifying a Replication Group for VTL” on page 97).

## Adding a stand-alone repository to a replication group

This task explains how to add a stand-alone repository to a replication group.

### About this task

Use the **Replication group management** wizard to add and remove stand-alone repositories from a replication group.

### Procedure

1. From the Grids Management view, click a stand-alone repository.
2. Select **Group > Replication group management**. The **Replication group management** wizard is displayed.

**Tip:** The **Replication group management** wizard can be accessed in one of the following ways:

- Right-click on a repository
- Click the **Replication group management** icon on the toolbar
- Select **Group > Replication group management**

3. Click **Next**. The following options appear:
  - Creating a new replication group
  - Join an existing replication group

**Note:** In order to create a replication group, there must be at least two stand-alone repositories in the grid.

To join an existing replication group, go on to “Adding a stand-alone repository to an Existing Replication Group” on page 97. If you are adding a repository to a new replication group, continue with step 4

4. Select **Creating a new replication group**.
5. Click **Next**. The **Repositories selection** window is displayed.
6. Select the repositories to be added to the replication group.
7. Click **Next**. A preview of the replication group is displayed.
8. Type the appropriate name of the replication group and click **Finish**. The **Replication group management** wizard closes and a new replication group is created.



## What to do next

Once the operation is complete, go on to define and create replication policies (see “Replication policies” on page 98), or continue working with replication groups.

## Adding a stand-alone repository to an Existing Replication Group

### Procedure

1. From the Grids Management view, click a stand-alone repository.
2. Select **Repository > Replication group management**. The **Replication group management** wizard is displayed.
3. Click Next. The following options appear:
  - Creating a new replication group
  - Join an existing replication group
4. Select **Join an existing replication group**.
5. Click Next. The **Group selection** window is displayed.
6. Choose an existing replication group to join from the **Existing replication group** drop-down list. A preview of the existing replication group selected is displayed.
7. Click Finish. The wizard closed and the repository is added to the existing replication group.

## What to do next

Once the operation is complete, go on to define and create replication policies (see “Replication policies” on page 98), or continue working with replication groups.

## Modifying a Replication Group for VTL

This task explains how to modify an existing replication group by adding or removing members.

### About this task

Use the **Replication group management** wizard to add and remove repositories from an existing replication group.

### Procedure

1. From the Grids Management view, click a repository in an existing replication group.
2. Select **Group > Replication group management**. The **Replication group management** wizard is displayed.

**Tip:** The **Replication group management** wizard can be accessed in one of the following ways:

- Right-click on a repository
  - Click the **Replication group management** icon on the toolbar
  - Select **Group > Replication group management**
3. Click **Next**. The **Repositories selection** window is displayed. Repositories that are already members of the replication group are checked and standalone grid members appear cleared.

**Note:** In a many-to-one topology, this window will appear as **Spokes selection**.

4. Select or clear the repositories to add or remove from the replication group. Alternatively, **Select all** adds all the repositories in the selection list to the replication group. **Select none** removes all the repositories from the replication group.  
  
**Note:** When you clear a check box for a repository, the **Group status** appears as **Deleted**. If you select a repository to add, the **Group status** appears as **New**.
5. Click **Next**. The **Preview** window of the replication group is displayed.
6. Click **Finish**. The **Replication group management** wizard closes. A **Confirm operation** window is displayed with a notification that all running and pending replications will be aborted from the deleted members and that unreachable repositories will not be updated with the changes.
7. Click **Yes** to continue with the operation, or **No** to cancel the operation.

### What to do next

Once the operation is complete, go on to define and create replication policies (see “Replication policies”), or continue working with replication groups.

---

## Replication policies

The topics in this section describe how to manage replication policies in a VTL environment.

Defined and managed through the Systems Management view of ProtecTIER Manager, a replication policy can only be created on a repository that is a member of a replication group and applies only to the repository on which it's defined. A replication policy defines a set of objects (for example, cartridges) from a repository that need to be replicated to a remote repository. A replication policy serves as the only means to transfer de-duplicated data from a source repository to a destination repository.

Using a set of rules, an event occurs, for example, which indicates that the data segment on a cartridge has changed and that replication may be needed for the specific cartridge. Once the event matches with a policy, a "trigger" is created for replication activity and a job occurs.

In a many-to-many environment, up to 256 policies may be defined per repository and up to 1023 ranges of cartridges may be defined per replication policy. A source repository can replicate a range of cartridges to up to three different destination repositories with different priorities. "Visibility switching" can be enabled on one of the destination repositories. See “Creating a replication policy” on page 99 for more information.

Select **Replication Policies** in the navigation pane to view the policies defined. Select a policy from the list to view the policy details and replication statistics per destination.

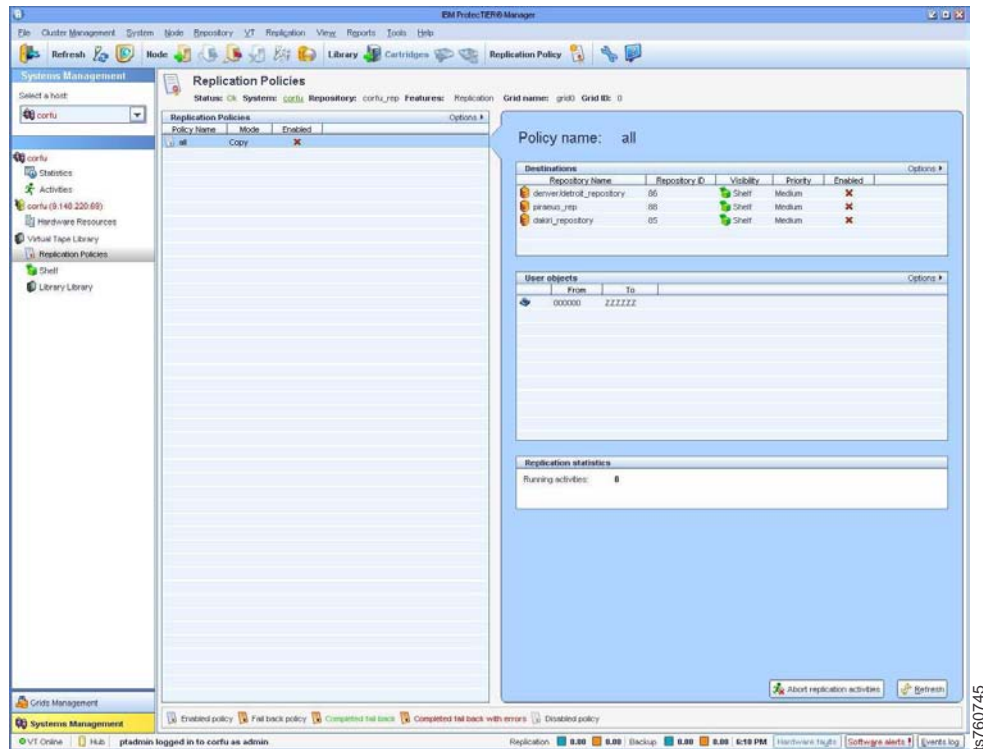


Figure 30. View of replication policy

The following sections describe how to create and work with replication policies:

- “Setting the weekly replication timeframe” on page 103
- “Setting the replication rate limit” on page 105
- “Limiting the network interface bandwidth” on page 107
- “Creating a replication policy”
- “Enabling and disabling a policy” on page 101
- “Running a policy” on page 101
- “Modifying a policy” on page 102
- “Deleting a policy” on page 103

## Creating a replication policy

This section describes how to create a replication policy using the **Create policy** wizard in the ProtecTIER Manager software.

When creating a replication policy, the following parameters are defined:

- Replication policy name
- Barcode ranges
- Replication destination
- Visibility change

“Visibility change” is the means by which you can determine “where” cartridges actually exist. From a backup application standpoint, a specific cartridge or barcode can “exist” in only one location at a given time. Once exported by the backup application, cartridges can be placed on a virtual *shelf* that is visible via ProtecTIER, providing more flexibility in managing tapes/cartridges and where they are kept – similar to keeping physical tapes on an actual shelf outside of the tape library.

## About this task

To create a replication policy, complete the following steps:

### Procedure

1. Choose **Replication > Replication Policy > Create policy**. The Welcome window of the **Create policy** wizard is displayed.
2. Click **Next**. The **Properties** window is displayed. Type a unique policy name in the Policy name field. You cannot have the same policy name twice. If you do define the same policy name, an error message is displayed.
3. Select the **Policy enabled** checkbox to run the policy within the timeframe defined. All incoming replication events will look to apply their rules to the policy's definition. If the **Policy enabled** checkbox is not selected, no replication activities will take place.
4. Click **Next**, the **Destinations** window is displayed.
5. From the **Destinations** option, select the repositories on which to run the defined policy.

**Note:** If a member has left the replication group, the policy destination will be removed from the list and a warning will display that the member will be removed from the policy.

6. Select a **Priority** per destination.  
Policies have 3 options of priority: High, Medium, Low. Define the policy's **Priority** according to the importance and/or urgency of the data that needs to be transferred. For example, a policy with a high priority is transferred first, then a policy with medium priority, followed by low priority. The default is Low for every policy.
7. Click **Next**. The **Visibility** window is displayed.  
**Visibility** controls the location of replicated cartridges at the destination repository. Destination replica cartridges can be "invisible" (if you choose shelf) or "visible" (if you choose a library).
  - If **Visibility enabled** is not activated, the destination will be shelf for all of the repository destinations.
  - If **Visibility enabled** is activated, you can choose a library for one of the destination repositories. The other destination repository targets will be shelf.  
Upon ejecting a cartridge, it is first moved to the shelf on the local repository. On the remote repository, the cartridge is moved to the import/export slot of a library so that the backup application on the remote site can see it.
8. Select a repository from the **Repository** dropdown list and the target on the destination repository, either the shelf or a library, from the **Library** dropdown list.
9. Click **Next**. The **Ranges** window is displayed. The policy objects, i.e. cartridges, are defined as barcode ranges. There can be up to 256 ranges in a single policy.
10. Type the **From** and **To** barcodes for a range of cartridges to be replicated.
11. Click **Add** to view the range in the **Ranges** table. If a barcode number or barcode range appears more than once, an error message is displayed with the conflict.
12. To delete the barcode ranges from the table, click **Select all and Remove**, or click **Select none** to deselect.

13. Click **Next** and **Finish** to commit and save the policy on the server. The **Summary report** is displayed with the policy name and the number of barcode ranges that were defined.

## What to do next

Go on to “Enabling and disabling a policy.”

## Enabling and disabling a policy

You can enable or disable a policy from ProtecTIER Manager.

A policy can be enabled or disabled per destination. In the detailed view of a policy, an indication displays whether the policy is enabled, disabled, or enabled with some of its destinations disabled.

### Enabling a policy

Upon successfully creating a policy, by default, the policy is enabled. This means that all incoming replication events will look to apply their rules to the policy's definition. If a policy is disabled, you can enable it from ProtecTIER Manager. This does not affect current running activities. Selecting **Policy enabled** automatically runs the policy within the timeframe defined. If **Policy enabled** is not selected, no activities will take place.

To enable a policy:

1. From the Systems Management view, select a policy from the **Replication Policies** pane.
2. Select **Replication > Replication policy > Enable policy**. The policy is enabled.
3. Go on to “Running a policy.”

**Important:** After you enable a policy, it is best to run the new policy quickly to ensure that all the pending replication activities are included in the replication. Otherwise, only further backups will be triggered for a replication

### Disabling a policy

A policy can be disabled at any time from ProtecTIER Manager. If a policy is disabled, all incoming replication events will “ignore” the policy from the moment it is disabled. This does not affect current running and pending activities.

To disable a policy:

1. From the Systems Management view, select a policy from the **Replication Policies** pane.
2. Select **Replication > Replication policy > Disable policy**. The policy is disabled.
3. Go on to “Running a policy.”

## Running a policy

Complete this task to run a policy.

Policies can be run either manually or automatically. Whenever replication events are received, policies are continuously run. The most common types of triggers for automatic replication are:

- backup
- eject
- unload cartridge

Manually run policies create replication jobs for all the valid cartridges in their list, whether or not they need to be replicated.

Running a policy leads to lining up replication jobs in their respective priority queues where they wait for resources and the replication timeframe to start replicating.

To run a policy:

1. Select **Replication > Replication Policy > Run replication policy**.
2. Select the destination repositories on which to run the repository.
3. Click **Run**. The replication policy will begin to run.

**Note:** If you run a policy with a single destination, no destinations need to be selected. Or, if you select multiple policies to run, no destinations are chosen.

## Running a policy on a cartridge

You can also replicate a specific cartridge that is within the range of cartridges in a specific policy. To manually run the policy on the specific cartridge, select the **Cartridges** tab view of the library. Right-click on the cartridge and choose **Cartridge replication**. The policy will run on the selected cartridge.

## Modifying a policy

You can modify a policy to change the parameters originally defined during policy creation.

### About this task

Complete the following steps to modify a policy:

### Procedure

1. Select **Replication > Replication Policy > Modify policy**. The **Modify policy** welcome screen is displayed.
2. Click **Next**. The **Properties** window is displayed. Type a unique policy name in the Policy name field. You cannot have the same policy name twice. If you do define the same policy name, an error message is displayed.
3. Select the **Policy enabled** checkbox to run the policy within the timeframe defined. All incoming replication events will look to apply their rules to the policy's definition. If the **Policy enabled** checkbox is not selected, no replication activities will take place.
4. Click **Next**, the **Destinations** window is displayed.
5. From the **Destinations** option, select the repositories on which to run the defined policy.

**Note:** If a member has left the replication group, the policy destination will be removed from the list and a warning will display that the member will be removed from the policy.

6. Select a **Priority** per destination.

Policies have 3 options of priority: High, Medium, Low. Define the policy's **Priority** according to the importance and/or urgency of the data that needs to be transferred. For example, a policy with a high priority is transferred first, then a policy with medium priority, followed by low priority. The default is *Low* for every policy.

7. Click **Next**. The **Visibility** window is displayed.

**Visibility** controls the location of replicated cartridges at the destination repository. Destination replica cartridges can be "invisible" (if you choose shelf) or "visible" (if you choose a library).

- If **Visibility enabled** is not activated, the destination will be shelf for all of the repository destinations.
- If **Visibility enabled** is activated, you can choose a library for one of the destination repositories. The other destination repository targets will be shelf.

Upon ejecting a cartridge, it is first moved to the shelf on the local repository. On the remote repository, the cartridge is moved to the import/export slot of a library so that the backup application on the remote site can see it.

8. Select a repository from the **Repository** dropdown list and the target on the destination repository, either the shelf or a library, from the **Library** dropdown list.
9. Click **Next**. The **Ranges** window is displayed. The policy objects, i.e. cartridges, are defined as barcode ranges. There can be up to 256 ranges in a single policy.
10. Type the **From** and **To** barcodes for a range of cartridges to be replicated.
11. Click **Add** to view the range in the **Ranges** table. If a barcode number or barcode range appears more than once, an error message is displayed with the conflict.
12. To delete the barcode ranges from the table, click **Select all and Remove**, or click **Select none** to deselect.
13. Click **Next** and **Finish** to commit and save the policy on the server. The **Summary report** is displayed with the policy name and the number of barcode ranges that were defined.

## Deleting a policy

Deleting a policy removes the policy in its entirety from the repository. All running and pending activities are aborted.

Complete the following steps to delete a policy:

Select **Replication > Replication Policy > Delete policy**. A dialog will appear to confirm the action and a message that all running and pending activities will be aborted.

For more information on aborting replication activities, see "Stopping replication activities" on page 108.

---

## Setting the weekly replication timeframe

Scheduling a timeframe for replication to take place for all policies allows you to maximize your system's resources and prioritize between backups and replication.

## About this task

Defining a replication timeframe gives replication the highest priority with the maximum system resources used to complete the replication during the “replication window”. You can define a replication timeframe using the **Set Replication Timeframe** dialog. Outside of the set timeframe replication is **off** and does not run.

If you choose backup as the priority, or no replication timeframe is defined, replication runs continuously all day, but on low priority, thereby consuming minimal resources from the system.

You can also limit the replication throughput through the **Replication Rate Limits** window (see “Setting the replication rate limit” on page 105).

**Note:** If you define a timeframe both on the source and on the destination repositories, you need to adjust both to the same time settings.

To set the replication timeframe:

## Procedure

1. From the Systems Management view, select **Replication > Set Replication timeframe**. The **Set Replication timeframe** dialog box is displayed.

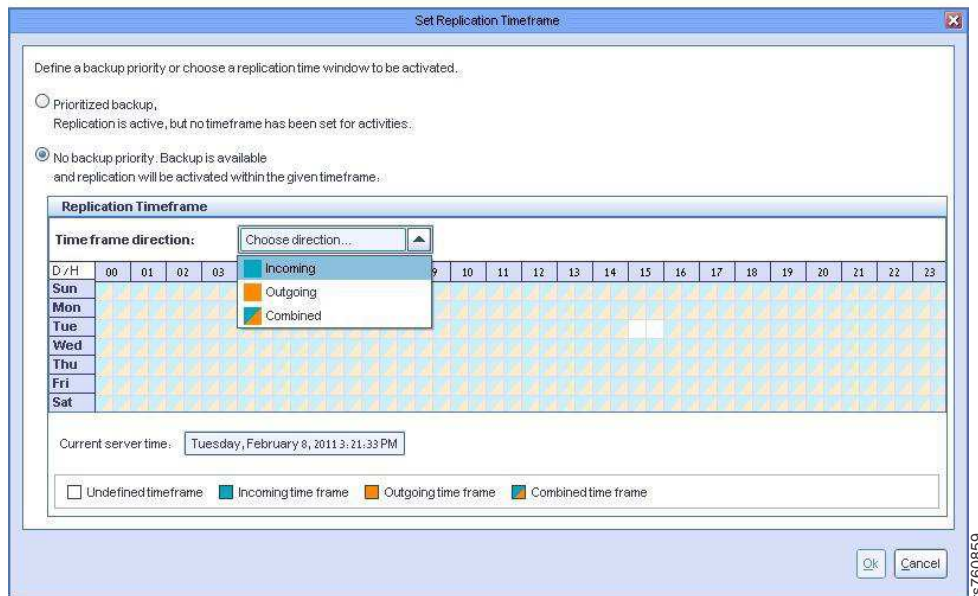


Figure 31. Set replication time frame window

2. Select an option:
  - **Prioritized backup** – Replication is active, but is of low priority.
  - **No backup priority** – Replication is off and only activated during defined timeframe.
3. Select the **Time frame direction** from the dropdown list to display the time frames scheduled for each replication task, or you can schedule a time frame for incoming, outgoing, or bi-directional (combined) replication tasks.
4. Select the replication window in daily half-hour intervals.



5. Click **OK**. The replication timeframe is set.

### What to do next

Go on to “Setting the centralized time frame.”

---

## Setting the centralized time frame

The centralized timeframe shifts the scheduling management of replication policies from the repository scope to the grid level scope to provide improved management of different replication windows.

### About this task

The centralized time frame allows for alignment of repositories in different time zones and provides a centralized view for managing the replication time frames for all repositories in a replication grid. The time frames associated with specific replication topology groups can be configured individually.

### Procedure

1. To set the centralized time frame, select a repository in the **Grids Management** view.
2. Right-click on the repository and select **Centralized time frame**, or select **Centralized time frame** from the **Group** menu. The **Centralized Time Frame** window displays with the repositories in the replication grid.
3. Select the **Time frame direction** from the dropdown list to display the time frames scheduled for each replication task, or you can schedule a time frame for incoming, outgoing, or bi-directional replication tasks.
4. Define the task precedence by selecting **Replication timeframe** to activate replication within a given time frame, or select **Backup precedence** to keep replication active, but with low priority. If no time frame is selected, replication activities are blocked.
5. Select the replication window in daily half-hour intervals.  
If the repository selected is in the same time zone with other repositories, the time zone will be displayed as *Local* in the **Time zone** column. Otherwise, the time adjustment is displayed.
6. Click **Save changes** and **Close** when finished.

---

## Setting the replication rate limit

Setting the replication rate control allows you to limit the nominal and physical throughput (data flow rate) of replication.

### About this task

The values set for the physical and nominal limits have no explicit influence on one another. That is, the values set in the physical throughput may, but do not necessarily impact those values set in the nominal throughput, and vice versa.

The physical throughput limit restrains the amount of I/O and resources replication consumes on the local repository. Implicitly, this reduces the total load on the replication networks used by the repository (you can have 2 networks) and the amount of resources needed on the peer repository, as well.

The nominal throughput directly affects the load on the destination repository. On the source repositories, the replication nominal rate does not necessarily compete with the backup. Setting the limit on a source repository guarantees that the backup gets the total possible throughput minus the nominal limit, but in many cases this is not needed.

The **Replication Rate Limits** window displays physical and nominal throughput. You can define one limit that applies to both incoming and outgoing replication activity or accept the **Default settings** mode, **Combined settings** mode, or you can define separate limits for incoming and outgoing replication activity by choosing the **Individual settings** mode.

## Procedure

1. From the Systems Management view, select **Set replication rate limits** from the **Replication** menu.
2. Choose the preferred mode to define the incoming and outgoing replication rate limits:
  - **Default settings**
  - **Combined settings**
  - **Individual settings**
3. Select the checkbox next to the desired option and enter a value (in MB/Sec). If a checkbox is not selected, the value will revert to an unlimited replication rate.

**Note:** When replication time frames are defined and replication is taking place with the time frame, replication will not be limited. If the system is not within the replication time frame, no replication will take place.

4. To return to the original replication rate limits that were defined during installation for the physical and/or nominal throughputs, select **Default system settings** as the mode. The values will default to their original settings at setup.

Following are the default values for the **combined** replication rate limits:

*Table 26. Combined replication rate limits*

| Combined settings                             | Default values (Incoming & Outgoing)                                       |
|-----------------------------------------------|----------------------------------------------------------------------------|
| Physical throughput limits (MB/Sec)           | Unlimited                                                                  |
| Limit when no backup or restore load (MB/Sec) | Max nominal throughput (the value selected during new repository creation) |
| Limit during backup or restore load (MB/Sec)  | 15% of max nominal throughput                                              |
| Limit within a replication timeframe (MB/Sec) | Unlimited                                                                  |

Following are the default values for the **individual** replication rate limits:

*Table 27. Individual replication rate limits*

| Individual settings                                              | Default values (Incoming) | Default values (Outgoing) |
|------------------------------------------------------------------|---------------------------|---------------------------|
| Physical throughput limits (MB/Sec)                              | Unlimited                 | Unlimited                 |
| Nominal throughput limit when no backup or restore load (MB/Sec) | Max throughput            | Max throughput            |

Table 27. Individual replication rate limits (continued)

| Individual settings                                              | Default values (Incoming) | Default values (Outgoing) |
|------------------------------------------------------------------|---------------------------|---------------------------|
| Nominal throughput limit during backup or restore load (MB/Sec)  | 15% of max throughput     | 15% of max throughput     |
| Nominal throughput limit within a replication timeframe (MB/Sec) | Unlimited                 | Unlimited                 |

5. Click **Ok** to save the changes and close the window.

---

## Limiting the network interface bandwidth

Complete the task in this topic to limit the bandwidth or throughput of a network interface, such as a port, on a node that is running replication.

### About this task

**Note:** This task should be performed only if it is important to limit each one of the interfaces separately. If you want to limit the total throughput over the networks, refer to “Setting the replication rate limit” on page 105 and set the physical replication rate limit of the repository.

### Procedure

1. From the Systems Management view, select a system that is being used for replication from the navigation pane. The **IP network configuration** is displayed.
2. Highlight one of the devices (e.g. eth3 or eth4) under **Replication network** appearing in the **IP Network configuration** pane. The device properties are displayed to the right.
3. Click **Limit bandwidth** on the bottom-right of the **Device properties** window. The **Limit network interface bandwidth** window is displayed:

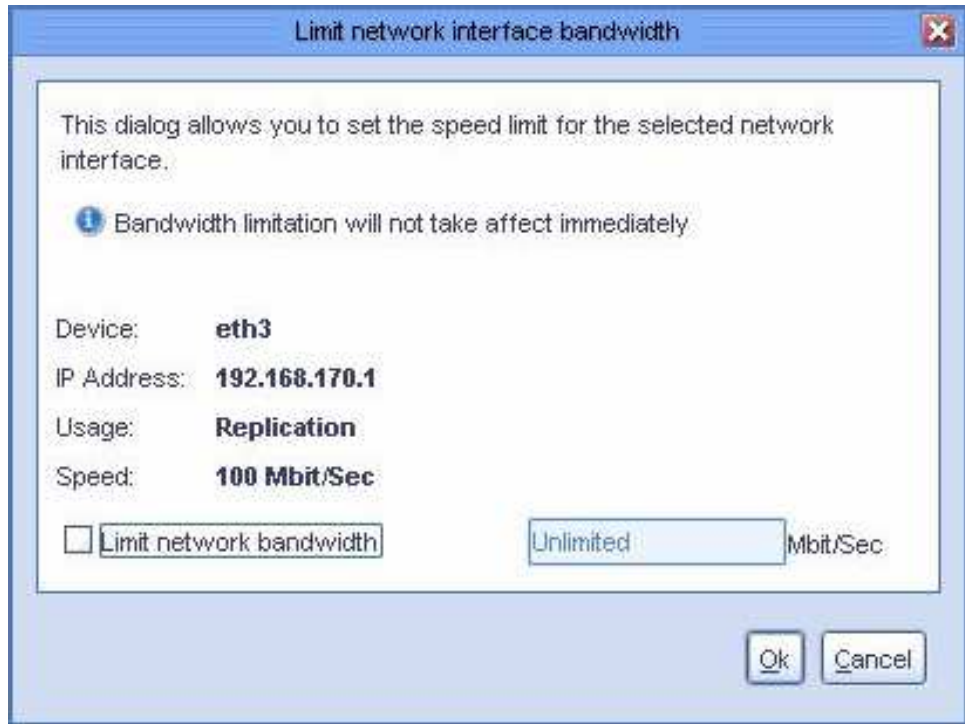


Figure 32. Limit network interface bandwidth window

4. Select the **Limit network bandwidth** checkbox to redefine the bandwidth speed (in Mbit/Sec). The bandwidth limit value can range from 1 to 1000. Other values will not be accepted. If the checkbox is not selected, the value will default to an unlimited bandwidth speed.
5. Click **Ok**. The defined limit is displayed in the **Limit (Mbit)** field of the **Replication network** display of the device.

## Results

**Note:** If the bandwidth limitation is changed during replication, the change does not take effect immediately. If replication begins after the bandwidth limitation change, the effect is immediate.

---

## Stopping replication activities

This topic describes how to stop cartridge replication activities on a repository.

When monitoring a repository, stop replication activities in one of the following ways:

- Select **Replication > Replication Policy > Stop replication activities**
- Click **Stop replication activities** at the bottom of the policy name configuration window

## Stopping running activities

You can stop running activities from the **Activities** view in the following ways:

- Right-click on the cartridge on which you want to stop activities and choose **Stop activity**.

- Highlight all of the cartridges on which you want to stop activities and select **Replication > Replication Policy > Stop replication activities**.
- Highlight all of the cartridges on which you want to stop activities and click the **Stop activity** button.

This procedure cancels all the running replication activities on a cartridge without affecting any pending activities, and not causing any backlog issues.

### **Stopping replication policies running and pending activities**

You can stop running and pending activities of a policy from the **Replication Policies** tab in either of the following ways:

- Select the policy on which to abort all replication activities and click the **Abort activities** button.
- Select the policy on which to abort all replication activities and select **Replication > Replication Policy > Abort replication activities**.
- Right-click on the policy and choose **Delete policy**.

Aborting replication activities of a policy cancels any running and pending activities that are generated from the selected policy. This method has an immediate effect on the running activities. However, the pending activities are backlogged and aborted over time because the pending triggers are canceled in the background. Although the effect is not immediate, the backlog is reduced because the pending activities are canceled one by one in the background.

If you deleting a policy, the system deletes the entire selected policy, as well as all running and pending activities.



## Chapter 10. Monitoring ProtecTIER Virtual Tape Libraries

The topics in this chapter describe how to use ProtecTIER Manager to monitor the status and performance of the ProtecTIER VTL system elements. In addition, information is provided for monitoring system functions and host activity from within the Linux shell.

### Monitoring ProtecTIER systems

This section describes how to use ProtecTIER Manager to monitor all the systems in the ProtecTIER environment from one common view.

The **All systems view** displays a list of all the systems in ProtecTIER that are configured in ProtecTIER Manager, as shown:

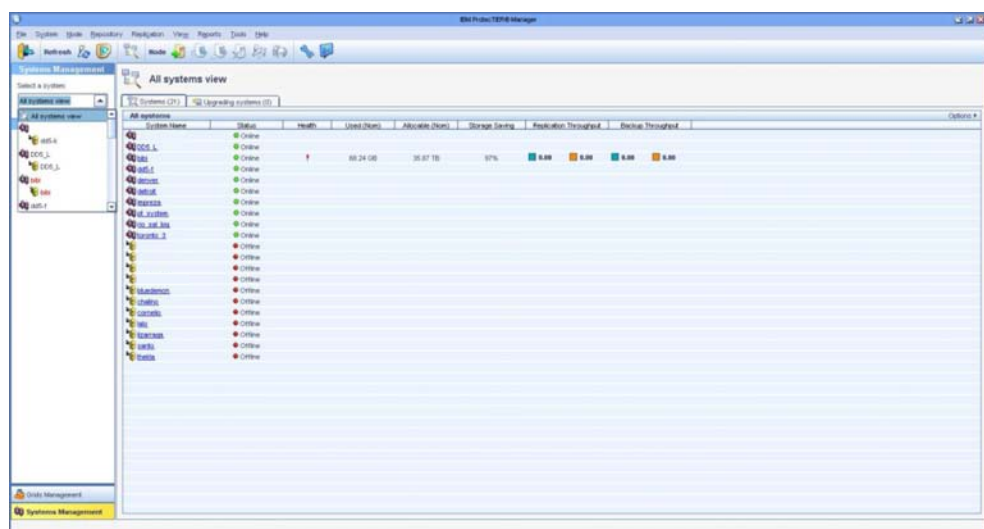


Figure 33. All systems view

Any node that has been added to ProtecTIER Manager using the **Add node** option appears in this view.

From the **All systems view**, you can log in to *online* systems by clicking on the hyperlink of the **System Name**. When you click on the hyperlink, the system's login window displays. Type in your username and password as you do when selecting a specific system from the **Select a system** dropdown list.

If the system is offline, ProtecTIER Manager refreshes the system view, and you can try to log in again. If the system still remains offline, a message displays that the system cannot be detected.

*Table 28. All systems view description.* The **All systems view** is the first option appearing in the **Select a system** dropdown list. From the **All systems view**, select the **Systems** tab to monitor the following system details:

| Column name | Description                                                                     |
|-------------|---------------------------------------------------------------------------------|
| System Name | Displays the name of the ProtecTIER system as it appears in ProtecTIER Manager. |

Table 28. All systems view description (continued). The **All systems view** is the first option appearing in the **Select a system** dropdown list. From the **All systems view**, select the **Systems** tab to monitor the following system details:

| Column name            | Description                                                                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Status                 | Displays if the system is online, offline, or upgrading.                                                                                                                |
| Health                 | Displays an exclamation point (!) if there is a software error, hardware error, or both.                                                                                |
| Used (Nom)             | Displays the total nominal capacity used for backup and replication.                                                                                                    |
| Allocable (Nom)        | Displays the amount of nominal space available for backup and replication.                                                                                              |
| Storage Saving         | Displays the percentage of data saved that is derived from the deduplication ratio. The storage savings is equal to $(1 - 1 / \text{deduplication ratio}) \times 100$ . |
| Replication Throughput | Displays the physical and nominal throughput of incoming and outgoing replication activity.                                                                             |
| Backup Throughput      | Displays the read and write throughput during backup activity.                                                                                                          |

From the **All systems view**, select the **Upgrading systems** tab to monitor the progress of the ProtecTIER systems undergoing a code upgrade. For more information on upgrading ProtecTIER software, refer to the *IBM TS7650 ProtecTIER Software Upgrade Guide*, V3.3.6.1, SC27-3643.

---

## Monitoring the ProtecTIER VTL system

The topics in this section describe monitoring of the ProtecTIER VTL system.

In the **Systems Management** view, select a system name from the **Select a system** dropdown list in the navigation pane. The **System** monitoring window is displayed:



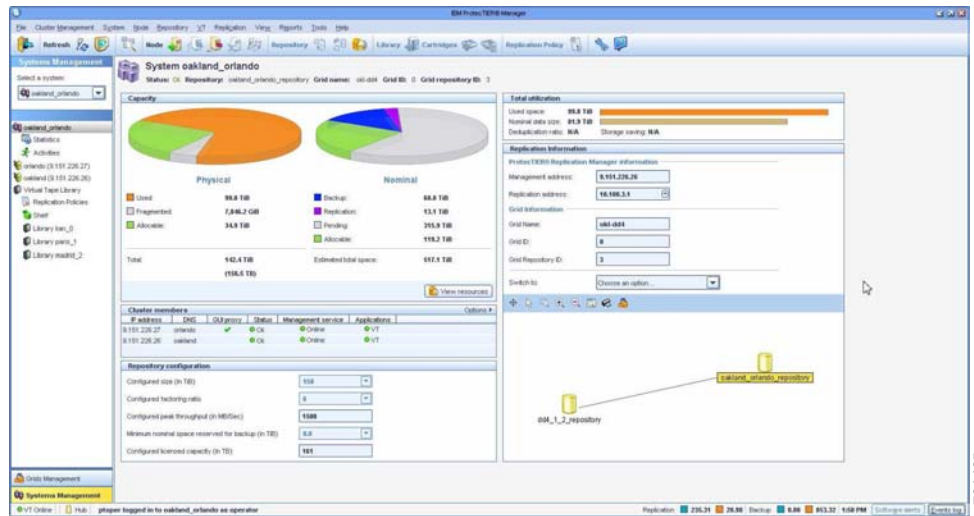


Figure 34. VTL System monitoring screen

The **System** window displays the general system configuration.

In addition, the ProtecTIER Manager status bar displays icons. These icons are for the total read and write replication and backup throughput rates for the selected system and the system time. (The status bar is at the bottom of the window.)

The status bar at the bottom of the view pane also displays the Software alerts and Events log buttons which enable you to view alert and event information for the nodes of the selected system. (For more information, see .)

The **System** window consists of the following panes:

“**Capacity**” displays the breakdown of the physical and nominal data capacity of the system.

“**Repository configuration**” on page 114 displays the configuration settings used to build the repository of the system.

“**Total utilization**” on page 115 describes the total utilization of the system.

“**Replication information**” on page 115 displays the replication information about the system.

## Capacity

This topic describes the breakdown of the ProtecTIER physical and nominal data capacity.

When the physical capacity on a file system, specifically ProtecTIER user data, is defined, a portion of the physical space is reserved for internal metadata structures. This metadata contains information such as data block allocation mapping and reference count (a number depicting how many objects are using, or referencing, a specific block). For ProtecTIER, it means that the usable capacity is lower than the physical capacity by approximately 3 percent.

The **Capacity** pane displays the physical and nominal data breakdown of the repository of the selected system:

## Physical

- **Used** refers to the amount of disk space currently containing physical data
- **Fragmented** refers to the amount of disk space pending the ProtecTIER defragmentation operation
- **Allocable** refers to the amount of free disk space available to contain physical data
- **Total** refers to the overall physical space available to the system

## Nominal

- **Backup** refers to the amount of nominal data containing backup data
- **Replication** refers to the amount of nominal data used for replication
- **Pending** refers to the amount of nominal data pending deletion and defragmentation activities
- **Allocable** refers to the amount of free disk space available to hold nominal data
- **Estimated space** refers to the overall estimated nominal space supported by the system

**Note:** The **Estimated space** value is based on the current deduplication ratio.

Click **View resources** to open the **Storage resources** window.

The **Storage resources** window displays the list of metadata and user data file systems for the repository of the selected system.

When the physical capacity on a file system, specifically ProtecTIER user data, is defined, a portion of the physical space is reserved for internal metadata structures. This metadata contains information such as data block allocation mapping and reference count (a number depicting how many objects are using, or referencing, a specific block). For ProtecTIER, it means that the usable capacity is lower than the physical capacity by approximately 3 percent.

**Note:** You can open the **Storage resources** dialog at any time by selecting **View resources** from the **Repository** menu.

## Repository configuration

This topic describes how to monitor the configuration settings used to build the repository on the ProtecTIER system.

The **Repository configuration** pane displays the following information:

*Table 29. Repository information*

| Field                      | Description                                                                                     |
|----------------------------|-------------------------------------------------------------------------------------------------|
| Configured size (in TiB)   | The physical repository size, in tebibytes, that was specified when the repository was created. |
| Configured factoring ratio | The estimated HyperFactor factoring ratio that was specified when the repository was created.   |

Table 29. Repository information (continued)

| Field                                              | Description                                                                                                                                                                         |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Configured peak throughput (in MB/Sec)             | The expected maximum peak throughput that was specified when the repository was created.                                                                                            |
| Minimum nominal space reserved for backup (in TiB) | The minimum amount of nominal space that is currently reserved for backup on the repository.                                                                                        |
| Configured license capacity (in TiB)               | The physical capacity of the repository, in tebibytes, that is specified by the user license. (The unit is shown in TiB as a decimal format, which means it is a multiple of 1024.) |

## Total utilization

This topic describes how to monitor the total utilization on a ProtecTIER system.

The **Total utilization** pane displays the following information in both graphical and numerical format:

Table 30. Total utilization information

| Field               | Definition                                                                                                                                    |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Used space          | The amount of disk space currently containing physical data.                                                                                  |
| Nominal data size   | The amount of nominal data used for backup and replication.                                                                                   |
| Deduplication ratio | The ratio of the nominal data size divided by the used space.                                                                                 |
| Storage saving      | The percentage of the data saved derived from the deduplication ratio.<br>Storage savings = $(1 - 1/\text{deduplication ratio}) \times 100$ . |

## Replication information

This topic describes how to monitor the replication information about a ProtecTIER system.

The **Replication information** pane displays the replication properties of the ProtecTIER system:

- ProtecTIER Replication Manager information:

| Field               | Definition                                                                                                                             |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Management address  | The external IP address of the ProtecTIER Replication Manager server used by ProtecTIER Manager to connect to the Replication Manager. |
| Replication address | The replication IP address of the ProtecTIER Replication Manager.                                                                      |

- Grid information:

| Field     | Definition                                                 |
|-----------|------------------------------------------------------------|
| Grid name | The name of the grid to which this repository is assigned. |

| Field   | Definition                                                                  |
|---------|-----------------------------------------------------------------------------|
| Grid ID | The identification number of the grid to which this repository is assigned. |

- The **Switch to:** field enables you to toggle between the ProtecTIER Replication Manager and the system view, or other ProtecTIER systems in the grid. A preview pane displays the replication group to which this system belongs.

## Monitoring the ProtecTIER VTL system performance statistics

This topic defines how to use ProtecTIER Manager to monitor the VTL system performance statistics.

From the Systems Management view, select a system from the dropdown list in the navigation pane and click **Statistics**. The Statistics monitoring window displays performance graphs of the repository throughput for both backup and replication.

The **Statistics** monitoring window consists of the following tabs:

- “Repository statistics”
- “Backup statistics” on page 117
- “Replication statistics” on page 119

### Repository statistics

This topic describes the utilization statistics of the repository.

The **Repository** tab of the **Statistics** monitoring window displays the following performance graphs:

- “Nominal data size graph”
- “HyperFactor ratio over time graph”
- “Utilization graph” on page 117

#### Nominal data size graph

The **Nominal data size graph** displays the amounts of nominal data contained in the repository over time.

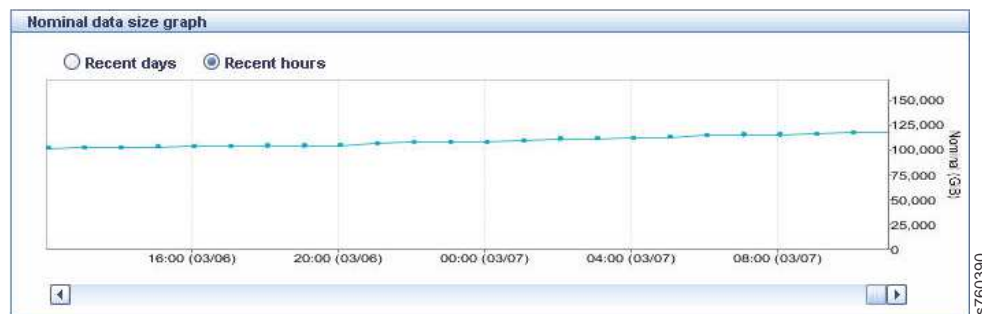


Figure 35. Nominal data size graph

#### HyperFactor ratio over time graph

The **HyperFactor ratio over time graph** displays the cumulative HyperFactor ratio as it changes over time.

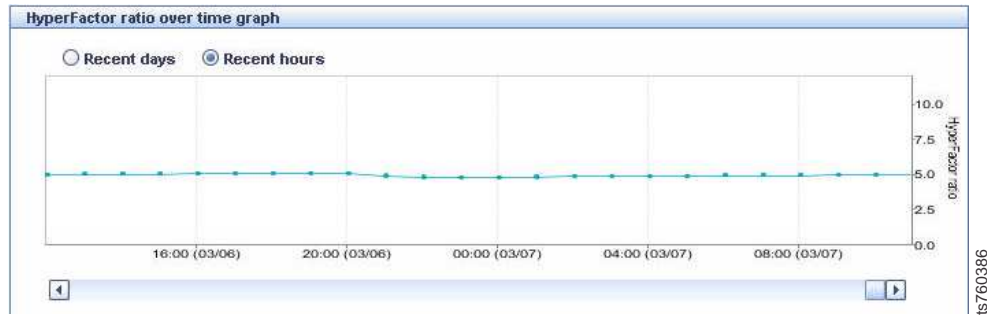


Figure 36. HyperFactor ratio over time graph

## Utilization graph

The **Utilization graph** displays the amounts of physical repository space used over time.

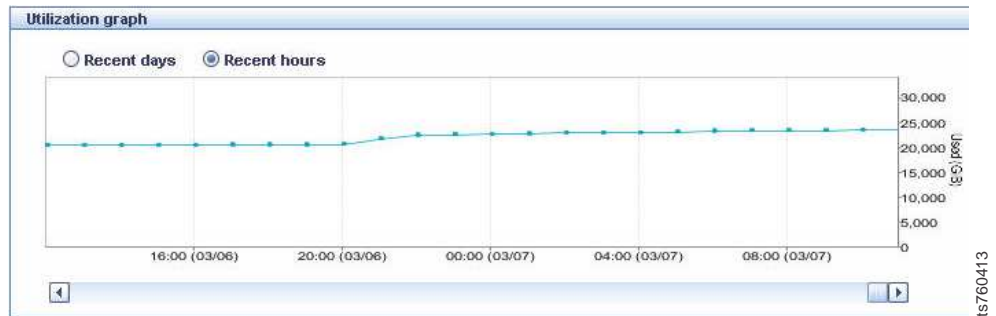


Figure 37. Utilization graph

## Backup statistics

This topic describes the system's I/O throughput statistics.

The **Backup** tab of the **Statistics** monitoring window displays the following graphs:

- "Backup read graph"
- "Backup Marginal HyperFactor ratio graph" on page 118
- "Backup write graph" on page 118

### Backup read graph

The **Backup read** graph displays the throughput (in MB/Sec) and streams of data read from the repository over time.

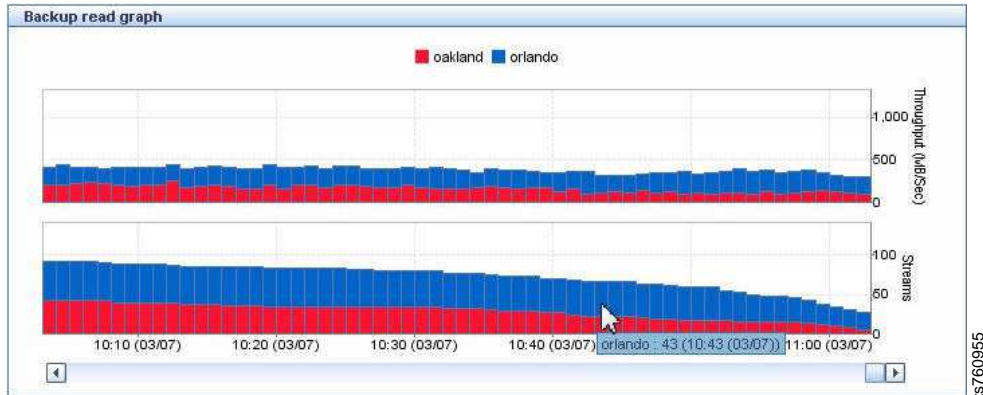


Figure 38. Backup read graph

The view displays the data over a 24-hour period in 1-minute intervals.

### Backup Marginal HyperFactor ratio graph

The **Marginal HyperFactor ratio** graph displays the amount of data written to the repository, and the physical space it occupies, at each point in time. Comparing these two values enables you to evaluate the effect of HyperFactor on the data written.

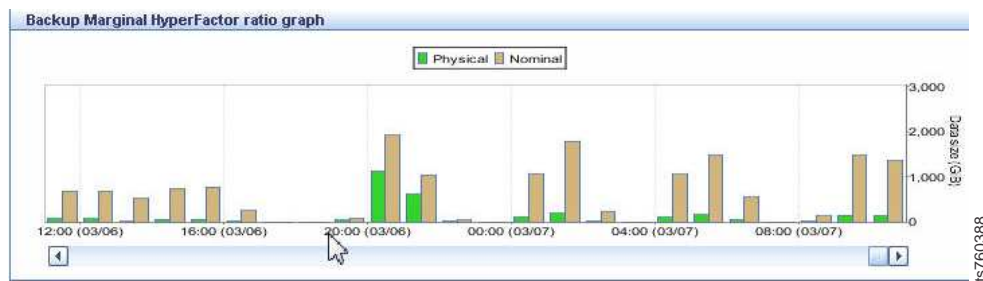


Figure 39. Marginal HyperFactor ratio graph

### Backup write graph

The **Backup write** graph displays the throughput (in MB/Sec) and streams of data written to the repository over time.

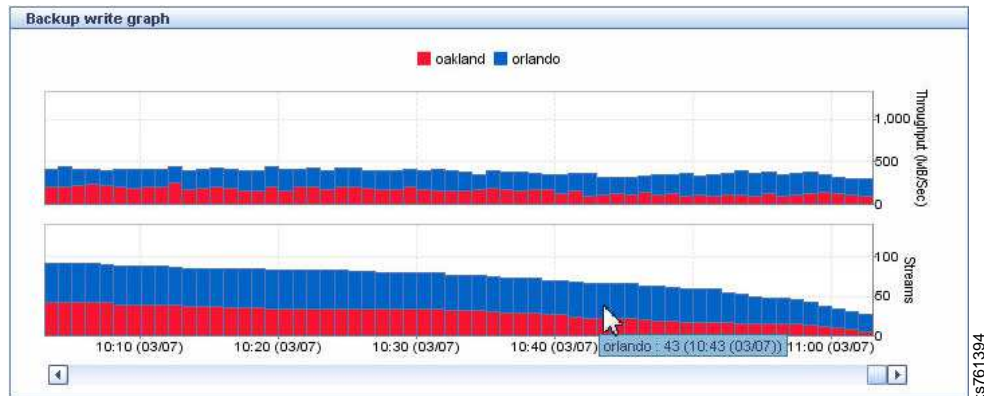


Figure 40. Backup write graph

The view displays the data over a 24-hour period in 1-minute intervals.

## Replication statistics

This topic describes the replication throughput statistics of the system.

The **Replication** tab of the **Statistics** monitoring window displays the following performance graphs:

- "Incoming replication graph"
- "Outgoing replication graph"
- "Backlog replication graph" on page 120

### Incoming replication graph

The **Incoming replication** graph displays the throughput (in MB/Sec) and streams of data replicated to the local repository from the remote repository, or repositories, over time.

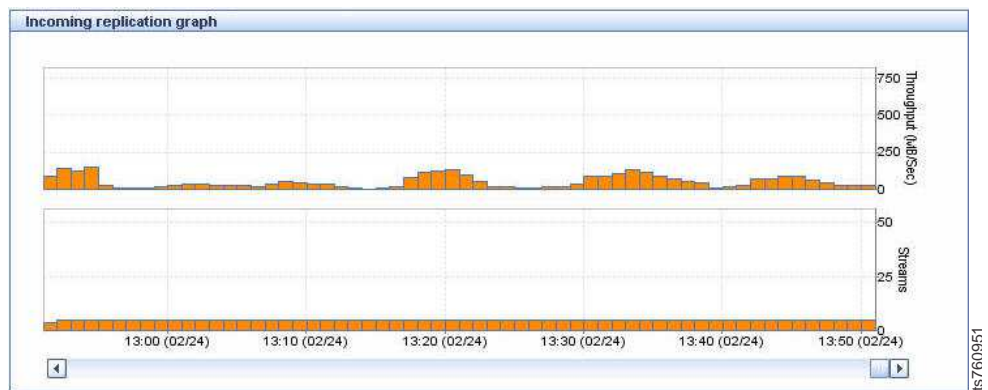


Figure 41. Incoming replication graph

The view displays the data over a 24-hour period in 1-minute intervals.

### Outgoing replication graph

The **Outgoing replication** graph displays the throughput (in MB/Sec) and streams of data replicated to the destination repository, or repositories, over time.

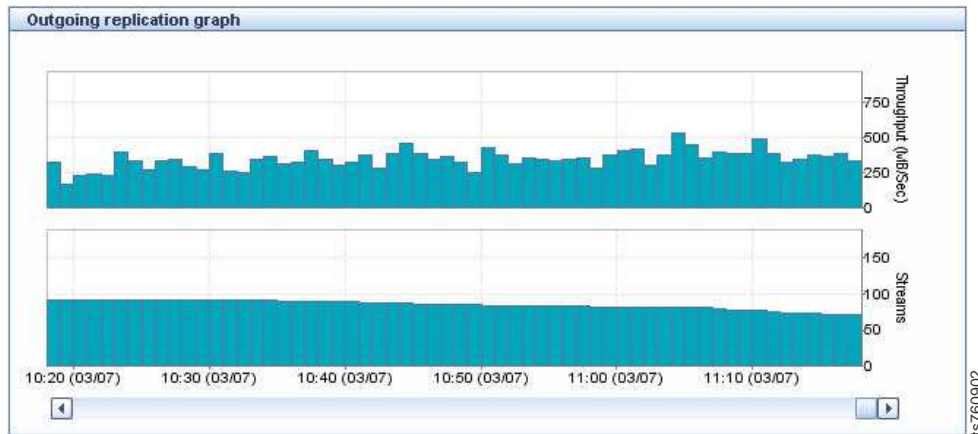


Figure 42. Outgoing replication graph

The view displays the data over a 24-hour period in 1-minute intervals.

### Backlog replication graph

The **Backlog replication** graph displays the overall data pending replication over time.



Figure 43. Backlog replication graph

## Monitoring activities

This topic describes how to use ProtecTIER Manager to monitor ongoing activities (I/O and replication) of a system.

From the **Systems Management** view, select a system from the dropdown list. Click **Activities** in the navigation pane. During replication, the list of objects undergoing replication activity is displayed. During backup, the drivers will be displayed. Select an object from the list to view additional activity details.



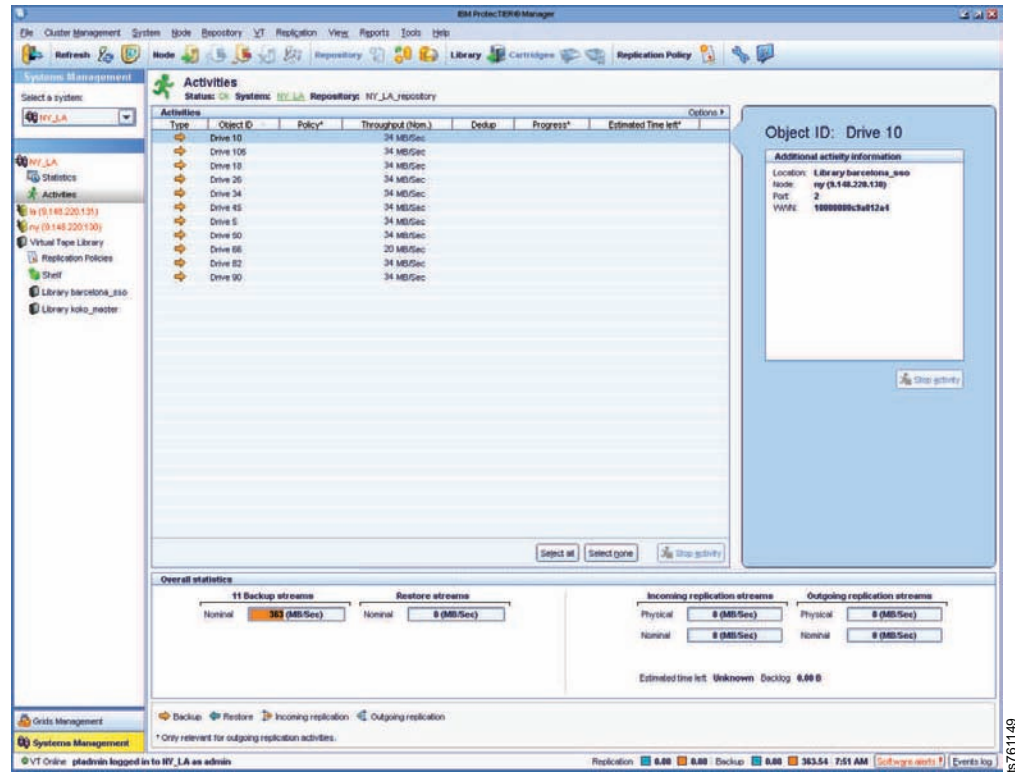


Figure 44. Activities view window

**Note:** The replication activities view is ad hoc. So, if new data is written to a cartridge while it is being replicated, the progress of the displayed data details appears in the replication view restarted.

**Note:** During backup activities, read streams may appear in the backup read stream graphs, as well as restore activity in the *Activities* view. Columns that appear with an asterisk (\*) next to the column name display data that is only relevant to outgoing replication activities.

**Type** the type of replication activity

**Object ID**  
the barcode of the cartridge or the driver ID

**Policy** the name of the policy that contains the respective cartridge in its definition

**Throughput**  
the nominal throughput of replicating or backup data in MB/sec

**Dedup\***  
displays the savings in the bandwidth for replicating this cartridge

**Progress\***  
the progress of replicating the latest changes to their destination

**Estimated time left\***  
the estimated amount of time remaining for the replication process to complete

## Overall statistics

The **Overall statistics** pane displays the nominal throughput of backup and restore streams.

The **Replication** tab displays the nominal and physical throughput of incoming and outgoing replication streams. The **Backlog** tab displays the nominal replication backlog data per destination.

## Viewing the replication data backlog by source

This topic describes how to monitor the amount of replication data backlog on a source repository for each system in a replication group.

### About this task

The **Backlog by source** window displays the backlog of nominal replication data per source repository.

The backlog displayed is updated only when replication is active and at the end of each cartridge replication. When there is no replication activity, the backlog is not updated, even if there are changes on the source repository.

Follow the procedure below to view the backlog per source:

### Procedure

1. From the Systems Management view, select **Replication > Replication Disaster Recovery > Show backlog by source**. The **Backlog by source** window displays the backlog of nominal replication data by source repository.
2. Click **Close** to exit the window.

### What to do next

Go on to “Monitoring nodes.”

---

## Monitoring nodes

These topics describe how to monitor a node with ProtecTIER Manager.

From the navigation pane, select a node. The **Node** monitoring screen displays.

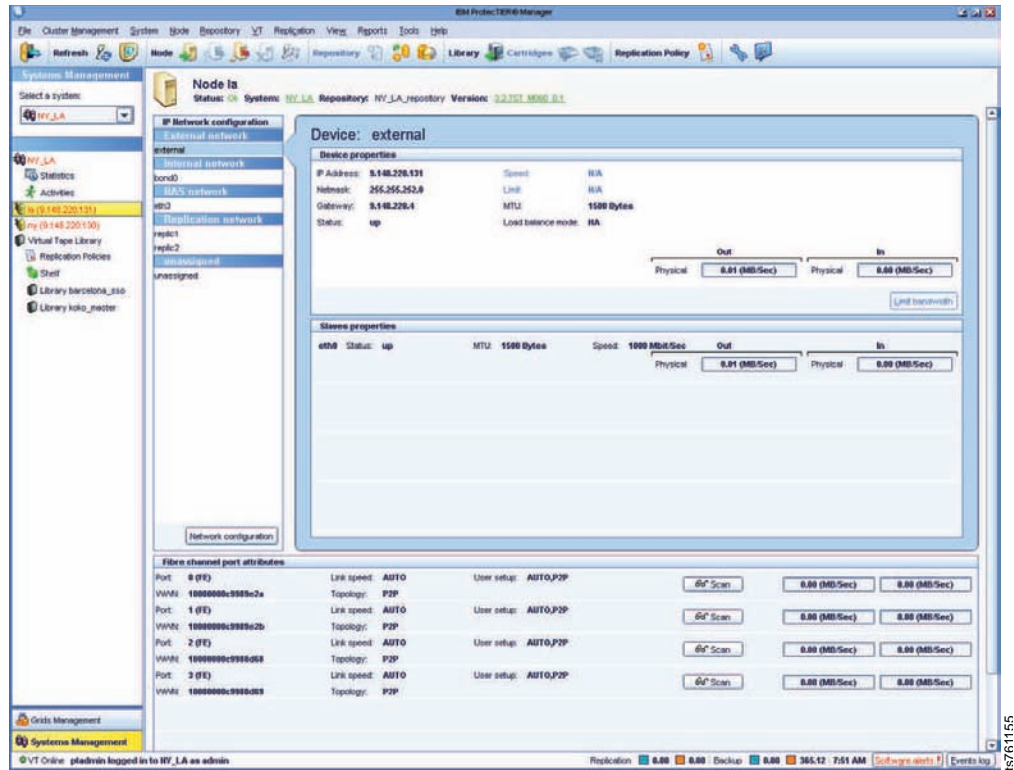


Figure 45. Node selection window

The **Node** monitoring screen consists of the following panes:

- “IP Network configuration of a node” on page 124
- “Fibre Channel port attributes of a node” on page 126

## Viewing version information

ProtecTIER Manager displays machine information and code levels for the versions of ProtecTIER and the drivers installed on the node.

To view the version and machine information of a node from ProtecTIER Manager, select a node in the navigation pane of the Systems Management view. A hyperlink of the **Version:** is displayed at the top of the view pane.

Click on the hyperlink and the **Show version information** window displays the version numbers for the following information:

Table 31. Version information

| Version information                    | Description                                                              |
|----------------------------------------|--------------------------------------------------------------------------|
| Release version                        | Displays the version number of the ProtecTIER release                    |
| ProtecTIER model                       | Displays the ProtecTIER server model type                                |
| Linux RPM version                      | Displays the version number of the Linux package installed on the server |
| DTC Emulex RPM version                 | Displays the version number of the ProtecTIER device driver              |
| ProtecTIER Replication Manager version | Displays the version of the ProtecTIER Replication Manager               |

Table 31. Version information (continued)

| Version information   | Description                                           |
|-----------------------|-------------------------------------------------------|
| Machine type model    | Displays the machine type and the model of the server |
| Machine serial number | Displays the machine's serial number                  |

## IP Network configuration of a node

This topic describes how to monitor the IP Network configuration.

The **IP Network configuration** pane displays information about the network interface card (NIC) setup of the node. Click on the devices to display the device properties. To customize the network configuration of a node, click on the **Network configuration** button at the bottom of the pane.

Table 32. Network interface card information

| Column        | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Device        | <p>The devices in the NIC:</p> <p><b>Applications network</b><br/>Displays the OST ports.</p> <p><b>Note:</b> Each virtual port can contain more than one physical interface. However, since bonding is not currently supported in this release, only 1 physical interface is displayed on each virtual port.</p> <p>The <b>Slaves properties</b> display the attributes of the actual physical ports included on the virtual device.</p> <p><b>External network</b><br/>Eth0 is the customer network port that communicates with the ProtecTIER Manager workstation</p> <p><b>Internal network</b></p> <ul style="list-style-type: none"> <li>• Eth1 and Eth4 are the cluster-internal network ports used for VTL</li> <li>• Eth1 is the cluster-internal network ports used for OST 1 GB</li> <li>• Eth1 is the cluster-internal network ports used for OST 10 GB</li> </ul> <p>bond0 is the virtual bond master device to which the internal network ports are enslaved<br/><b>Note:</b> Bond devices are defined as part of the installation process.</p> <p><b>Replication network</b></p> <ul style="list-style-type: none"> <li>• Eth2 and Eth5 are the replication ports used for VTL</li> <li>• Eth2 and Eth13 are the replication ports used for OST 1 GB</li> <li>• Eth2 and Eth9 are the replication ports used for OST 10 GB</li> </ul> |
| IP Address    | IP address of the device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Usage         | Indicates whether the device is used for the cluster-internal network or to communicate with the ProtecTIER Manager workstation and the external network.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Master device | The master device or bond device, if any, to which the device is enslaved.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Status        | Indicates whether the device is functioning properly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

Table 32. Network interface card information (continued)

| Column            | Definition                                                                     |
|-------------------|--------------------------------------------------------------------------------|
| Speed             | The supported speed of data transfer across the device in Megabits per second. |
| MTU               | Configured maximum transmission unit for the device.                           |
| Load balance mode | The load balancing method used within a bond.                                  |

## Fibre Channel port attributes of a node

The **Fibre channel port attributes** pane displays the following information for each port in the node:

Table 33. Port attribute information

| Column     | Definition                                                                                                                                                                                                                                               |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Port       | Port number and port mode. All ports in the ProtecTIER system are front-end ports that connect the node with the backup server(s). This mode is labeled FE.                                                                                              |
| WWN        | Worldwide Name of the port.                                                                                                                                                                                                                              |
| Link Speed | Transmission speed of the port.                                                                                                                                                                                                                          |
| Topology   | Fiber Channel topology of the port. The possible values are as follows: <ul style="list-style-type: none"> <li>• Point-to-point (P2P)</li> <li>• Fiber channel-arbitrated loop</li> <li>• Down - meaning there is no fiber channel connection</li> </ul> |
| User setup | User-assigned link speed and topology.                                                                                                                                                                                                                   |

In addition, for each port you can click the **Scan** button to open the **Scan Port** dialog box.

The **Scan Port** dialog box displays a numbered list of the Worldwide Names of the remote ports detected by the port.

---

## Monitoring Virtual Tape Libraries

This topic defines how to monitor VT (Virtual Tape) libraries using ProtecTIER Manager.

From the Systems Management view, choose a system from the dropdown list. Select library from the navigation pane to display the statistics, performance, and configuration of the defined virtual tape libraries.

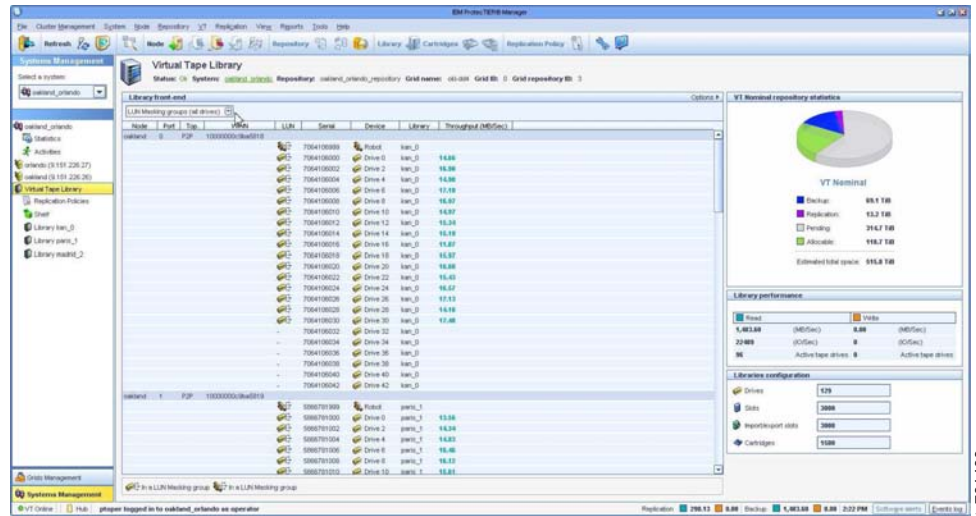


Figure 46. Virtual Tape Library view

The **Virtual Tape Library** window consists of the following panes:

- **Library front-end** - Displays the libraries and devices per port for each node. For more information, see “Library front-end” on page 130.
- **VT Nominal repository statistics**- Displays the current repository breakdown of nominal data.
  - **Backup** refers to the amount of nominal data containing backup data
  - **Replication** refers to the amount of nominal data used for replication
  - **Pending** refers to the amount of nominal data pending deletion and defragmentation activities
  - **Allocable** refers to the amount of free disk space available to hold nominal data
  - **Estimated space** refers to the overall estimated nominal space supported by the system

**Note:** The **Estimated space** value is based on the current deduplication ratio.
- **Libraries performance** - Displays the current total performance of the libraries. For more information, see “VT overview” on page 130.
- **Libraries configuration** - Displays the total number of drives, slots, import/export slots, and cartridges for all the libraries. For more information, see “Configuration” on page 131.

## Monitoring replication policies

This topic describes how to monitor replication policies of a system using ProtecTIER Manager.

From the Systems Management view, click on **Replication Policies** on the navigation pane to see the replication policies defined on the repository. The following information is displayed for each defined policy:

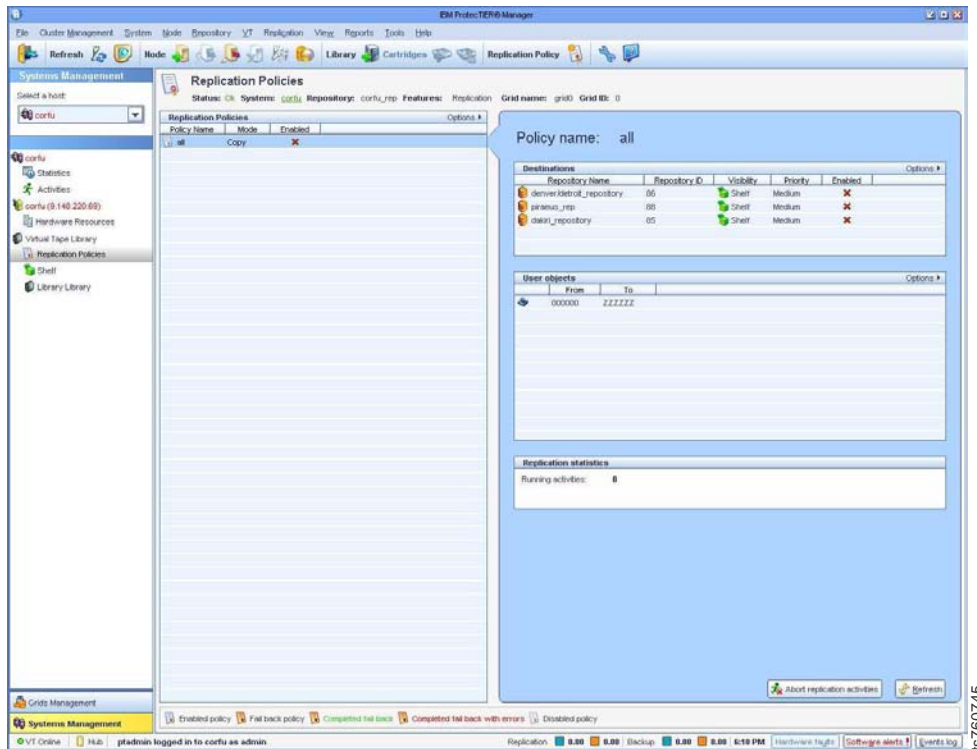


Figure 47. Replication Policies

### Policy name

The name that you defined for the policy.

**Mode** Cartridges are either copied or moved. (Note: In this release, “copy” is the only mode of operation.)

### Enabled

Policy can be enabled or disabled for execution, or partially enabled with some of the destinations disabled. A policy can also be enabled or disabled per destination.

Select a policy to see the policy's details, such as: destination repository, range of barcodes, and current activities.

Additionally, in the policy's details view, the priority of the policy is displayed. A policy can be prioritized per destination, meaning that each policy destination can have a different priority.

Policies have 3 options of priority: High, Medium, Low. The policy's Priority is defined according to the importance and/or urgency of the data that needs to be transferred. For example, a policy with a high priority is transferred first, then a policy with medium priority, followed by low priority. The default is Low for every policy.

Go on to “Monitoring the ProtecTIER VT service.”

## Monitoring the ProtecTIER VT service

The topics in this section describe how to monitor the VT services with ProtecTIER Manager.



From the Systems Management view, click a library. The **Library** monitoring screen displays with the **General** tab selected by default.

The type of monitoring information that is provided for VT services, or library, consists of the following types of information:

- General
- Drives
- Cartridges
- Slots
- Import/Export Slots

Go on to the “Monitoring Virtual Tape service - General tab”.

## Monitoring Virtual Tape service - General tab

This topic defines the general information provided by ProtecTIER Manager when it is used for monitoring Virtual Tape (VT) services.

The **Library** monitoring screen displays the **General** tab by default. The **General** tab displays information about the selected virtual library.

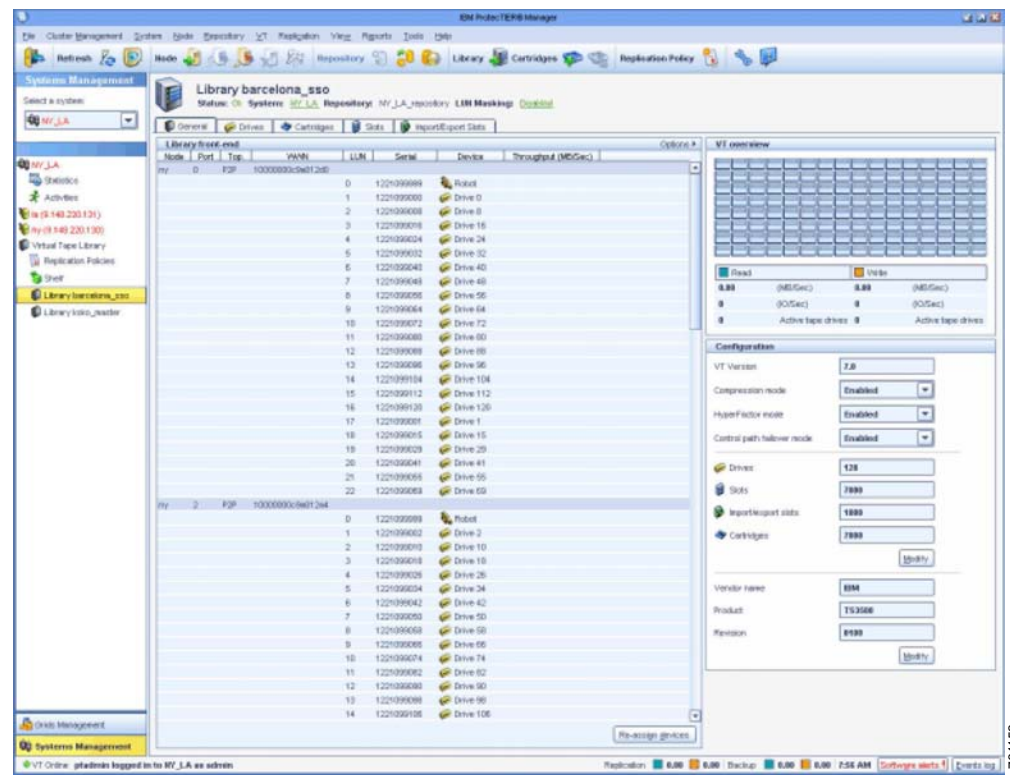


Figure 48. General tab

The **General** tab consists of the following panes:

- “Library front-end” on page 130
- “VT overview” on page 130
- “Configuration” on page 131

## Library front-end

The **Library front-end** pane displays the virtual robots and tape drives assigned to each port of each node in your ProtecTIER system. You can filter the display to show all the devices in the library, or to display the devices per robot or tape drive.

Table 34. Virtual robots and tape drive

| Column     | Definition                                                                                                                                                                                                                                      |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Node       | The node on which the virtual device is assigned.                                                                                                                                                                                               |
| Port       | The port within the node on which the virtual device is assigned.                                                                                                                                                                               |
| Top.       | The Fiber Channel topology of the port.<br>Possible values: <ul style="list-style-type: none"><li>• Point-to-point (P2P)</li><li>• Fiber channel-arbitrated loop (Loop)</li><li>• Down - meaning there is no fiber channel connection</li></ul> |
| WWN        | The Worldwide Name of the port.                                                                                                                                                                                                                 |
| LUN        | The logical unit number of the robot or tape drive relative to the port. An icon displays if the device is, or is not, part of a LUN Masking group.                                                                                             |
| Serial     | The drive's serial number of the robot or tape drive.                                                                                                                                                                                           |
| Device     | The type of device (robot or tape drive).                                                                                                                                                                                                       |
| Library    | The name of the virtual tape library.                                                                                                                                                                                                           |
| Throughput | The current rate of data transfer across the device.                                                                                                                                                                                            |

**Note:** Change the device assignments for your libraries by clicking **Reassign devices**. (For more information, see “Reassigning devices” on page 72.)

## VT overview

The **VT overview** pane displays general information about the performance of the selected library for Read and Write operations.

The following information is displayed:

- Status of each tape drive
- Rate of data transfer in Mbps
- Number of I/O operations per second
- Number of active tape drives

Each tape drive in the library is graphically represented. If the drive is currently writing, an orange icon is displayed on the graphic. If the drive is currently reading, a blue icon is displayed. To see the drive number, the current read/write rate of the drive in Mbps, hover your cursor over the graphic. Hovering your cursor over the graphic will also display the percentage of time that the tape drive is idle during backup operations. Idleness in the tape drive is due to low backup application data transfer rates.

## Configuration

The **Configuration** pane displays the configuration parameters of the selected library.

The following information is displayed:

Table 35. Library configuration information

| Field                      | Definition                                                                                                                  |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| VT version                 | Displays the version number of the ProtecTIER virtual tape library                                                          |
| Compression mode           | Displays whether data compression is enabled or disabled. This field can be modified using the dropdown list.               |
| HyperFactor mode           | Displays whether data factoring is enabled or disabled. This field can be modified using the dropdown list.                 |
| Control path failover mode | Displays whether the control path failover mode is enabled or disabled. This field can be modified using the dropdown list. |
| Drives                     | Displays the current number of drives in the selected library.                                                              |
| Slots                      | Displays the current number of slots in the selected library.                                                               |
| Import/Export slots        | Displays the current number of import/export slots in the selected library.                                                 |
| Cartridges                 | Displays the current number of cartridges in the selected library.                                                          |
| Vendor name                | Displays the vendor name of the emulated virtual library type.                                                              |
| Product                    | Displays the product name of the emulated virtual library type.                                                             |
| Revision                   | Displays the revision number of the emulated virtual library type.                                                          |

The current number of drives, slots, import/export slots, and cartridges in the selected library are displayed.

**Note:** Change the number of devices in the library by clicking **Re-assign devices** to open the **Change dimensions** wizard. (For more information, see “Editing library parameters” on page 69.)

Go on to the “Monitoring Virtual Tape service - Drives tab”.

## Monitoring Virtual Tape service - Drives tab

This topic defines the drives information provided by the ProtecTIER Manager when it is used for monitoring Virtual Tape (VT) services.

The **Drives** tab displays detailed information about the virtual tape drives in the selected library.

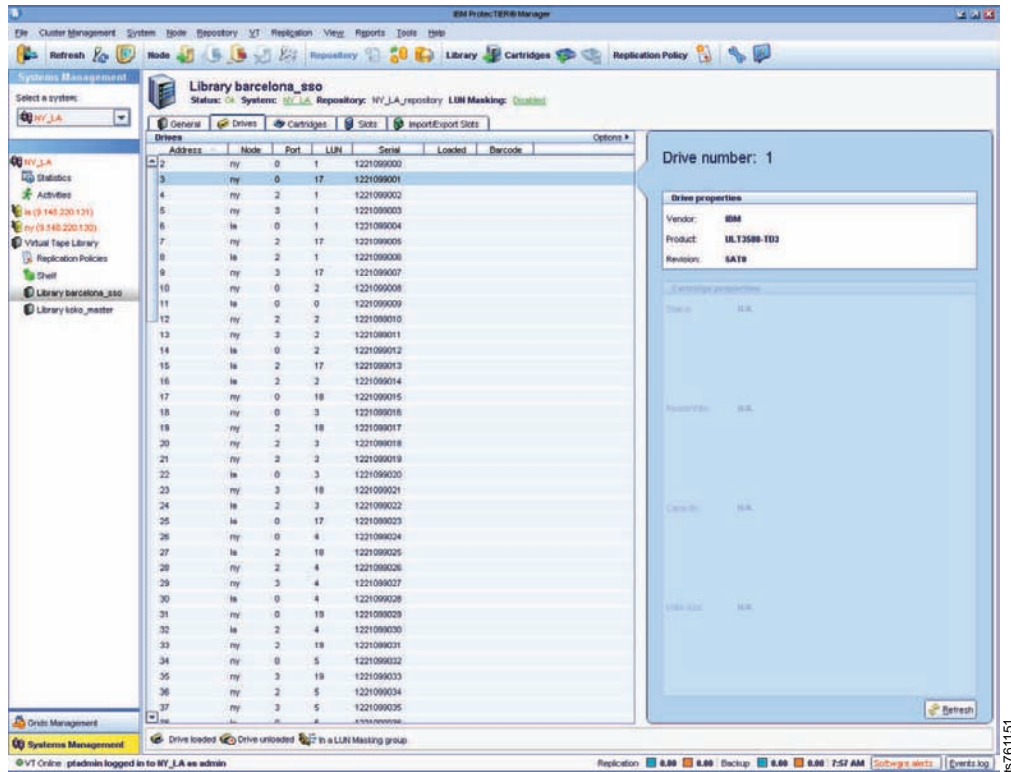



Figure 49. Drives tab

The following information is displayed:

Table 36. Drives tab information

| Column    | Definition                                                                                                                                                                                                   |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drive No. | The drive number. This number is displayed to the right of the view pane when a specific virtual tape drive is selected from the <b>Drives</b> list.                                                         |
| Vendor    | The name of the vendor whose product the virtual drive emulates. This information is displayed to the right of the view pane when a specific virtual tape drive is selected from the <b>Drives</b> list.     |
| Product   | The product name for the product that the virtual drive emulates. This information is displayed to the right of the view pane when a specific virtual tape drive is selected from the <b>Drives</b> list.    |
| Revision  | The revision number for the product that the virtual drive emulates. This information is displayed to the right of the view pane when a specific virtual tape drive is selected from the <b>Drives</b> list. |
| Address   | The drive's address within the library                                                                                                                                                                       |
| Node      | The node to which the drive is assigned                                                                                                                                                                      |
| Port      | The port on the node to which the drive is assigned                                                                                                                                                          |

Table 36. Drives tab information (continued)

| Column  | Definition                                                                                                                                                                                                         |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LUN     | The drive's logical unit number relative to the port                                                                                                                                                               |
| Serial  | The drive's serial number                                                                                                                                                                                          |
| Loaded  | Indicates whether the drive is loaded with a virtual cartridge. If the drive is loaded with a virtual cartridge,  is displayed. |
| Barcode | If the drive is loaded with a cartridge, this column displays the cartridge's barcode.                                                                                                                             |

Go on to the “Cartridges tab.”

## Cartridges tab

This topic defines the cartridges information provided by ProtecTIER Manager when it is used for monitoring Virtual Tape (VT) services.

Go to the Systems Management view of ProtecTIER Manager to see detailed information about the virtual tape cartridges in a selected library:

1. Select a library in the navigation pane.
2. Click the **Cartridges** tab to view detailed information about the virtual tape cartridges in the chosen VT library. The cartridge configuration is displayed:

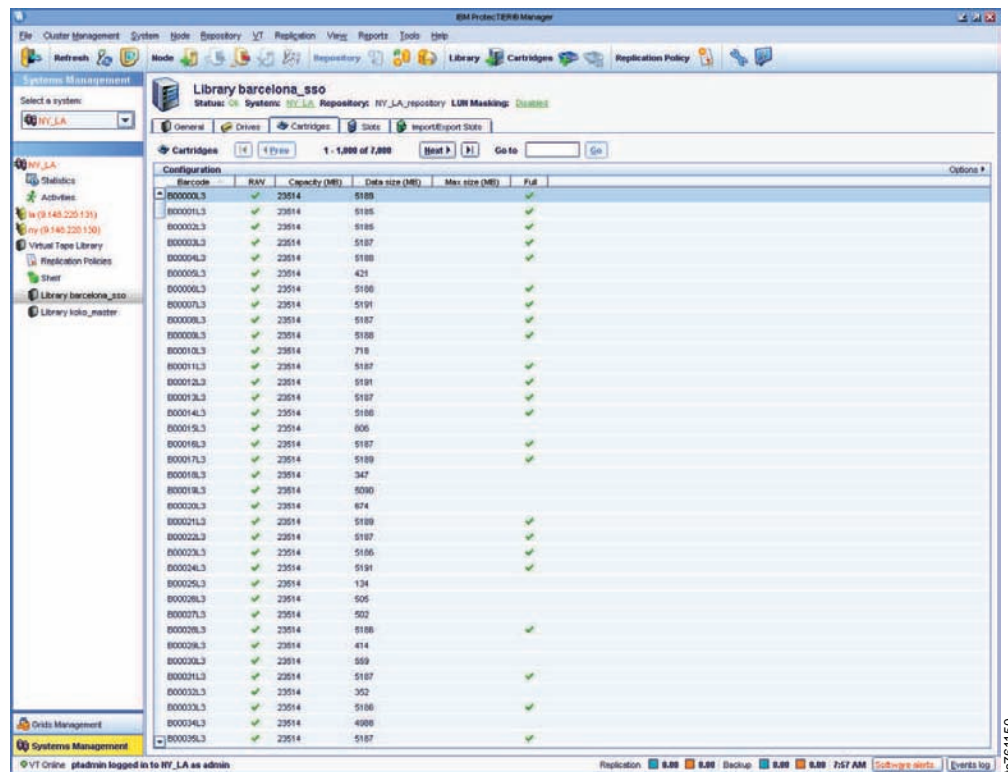


Figure 50. Cartridges tab

If the system is configured for replication, a dropdown list will appear in the **Configuration** pane. You can filter the configuration properties view of the cartridges displayed by selecting one of the following options from the **Configuration** dropdown field:

- “Backup properties”
- “Origin properties” on page 135
- “Replica properties” on page 136

## Backup properties

This topic illustrates the backup properties of a cartridge.

The **Backup properties** filter displays the general properties of the cartridge's configuration (not related to replication).

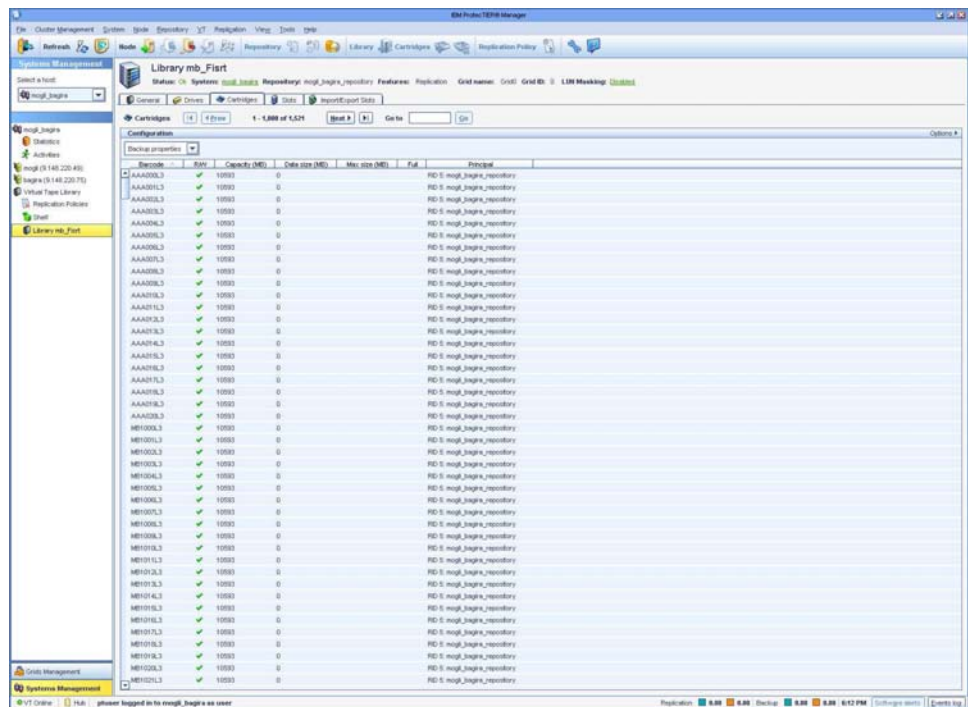


Figure 51. Cartridges tab - backup properties

The following general information is provided for the cartridges of the library you have chosen:

Table 37. Cartridges backup properties

| Column        | Definition                                                                                                                                                                  |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Barcode       | The cartridge's barcode.                                                                                                                                                    |
| R/W           | Whether the cartridge is write enabled. If the cartridge is write enabled, a green checkmark is displayed.                                                                  |
| Capacity (MB) | The cartridge's estimated data capacity in megabytes. This value varies over time depending on the HyperFactor ratio and the number of cartridges configured in the system. |

Table 37. Cartridges backup properties (continued)

| Column         | Definition                                                                                                                                                              |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Size (MB) | The amount of nominal data, in megabytes, currently stored on the cartridge.                                                                                            |
| Max Size (MB)  | The maximum amount of nominal data, in megabytes, the cartridge can contain.                                                                                            |
| Full           | Indicates whether the cartridge has reached Early Warning. If so, the cartridge is regarded as full and a green checkmark is displayed.                                 |
| Principal      | The repository on which the cartridge was created and backed up. (For more information on "principality", see "Changing cartridge ownership (Principality)" on page 78) |

Go on to "Origin properties."

### Origin properties

This topic illustrates the origin properties of a cartridge.

The **Origin properties** of a cartridge are typically useful when viewed from a source repository. The origin properties are used to understand the status of replicating the cartridges to the destination repository. Using this view, you can understand if cartridges are still pending replication (e.g. backlog > 0) and to what repository the cartridge was replicated.

**Note:** The **Origin properties** view from the destination repository is useful for situations when the destination has failed back cartridges. See "The failback policy in DR mode" on page 147.





displays whether or not the cartridge is synchronized with the most up-to-date data from the source.

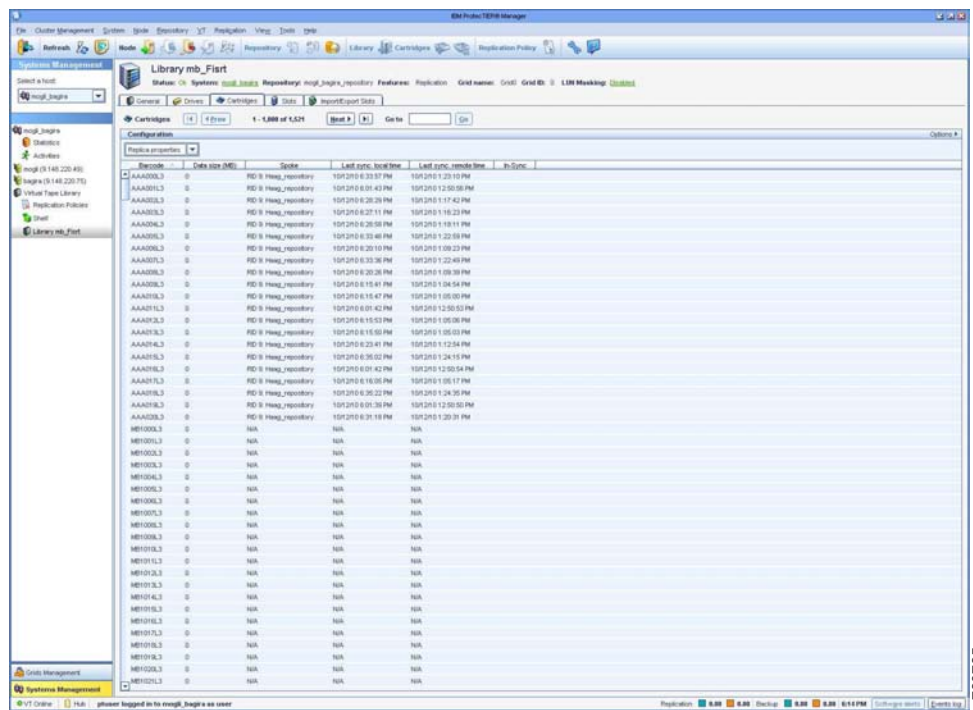


Figure 53. Cartridges tab - replica properties

The following information about cartridge replication is displayed for the cartridges of the library you have chosen:

Table 39. Cartridges replica properties

| Column                | Definition                                                                                                                                                |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Barcode               | The cartridge's barcode.                                                                                                                                  |
| Data Size (MB)        | The amount of nominal data, in megabytes, currently stored on the cartridge.                                                                              |
| Source                | The name of the source repository from which the cartridges are being replicated.                                                                         |
| Last sync local time  | The most updated date and time on the destination repository when the backup data on the cartridge was last synchronized with the destination repository. |
| Last sync remote time | The most updated date and time on the source when the backup data on the cartridge was last synchronized with the destination repository.                 |
| In-Sync               | Shows whether or not the cartridge has been replicated and is synchronized with the source repository.                                                    |

Go on to the “Monitoring Virtual Tape service - Slots tab” on page 138.

## Monitoring Virtual Tape service - Slots tab

This topic defines the slots information provided by the ProtecTIER Manager when it is used for monitoring Virtual Tape (VT) services.

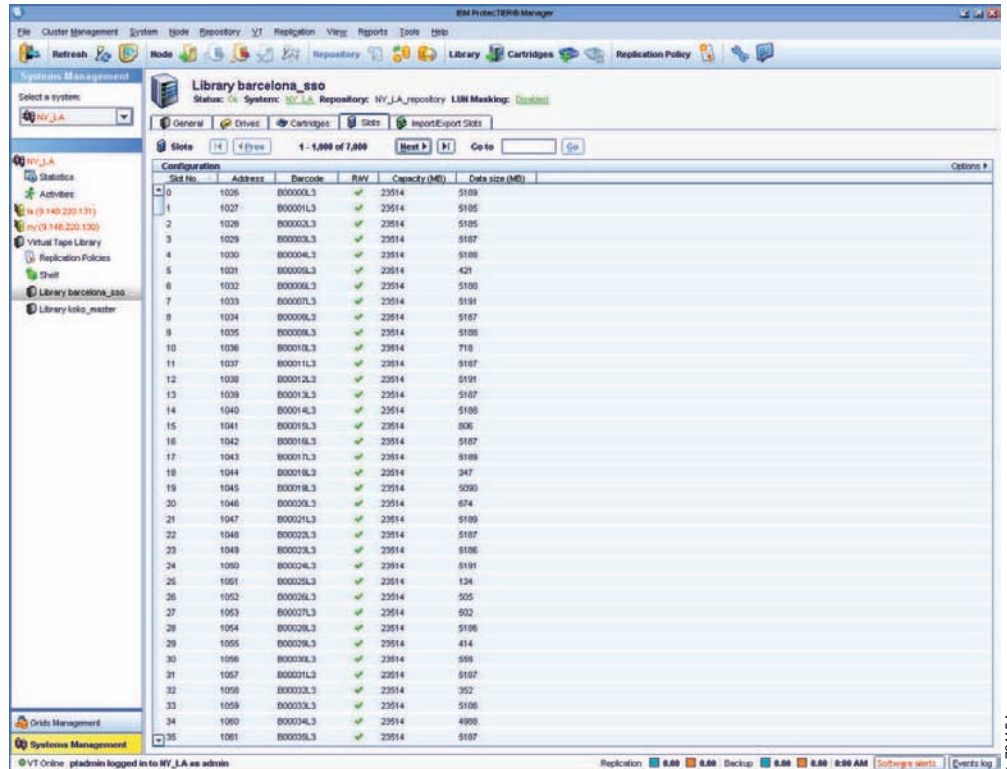


Figure 54. Slots tab

The Slots tab displays the following information:

Table 40. Slots tab information

| Column    | Definition                                                                                                                          |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------|
| Slot No.  | Indicates the slot's number in the library.                                                                                         |
| Address   | Indicates the slot's address number.                                                                                                |
| Barcode   | If the slot contains a cartridge, this column displays the cartridge's barcode.                                                     |
| Capacity  | If the slot contains a cartridge, this column displays the estimated cartridge capacity in megabytes.                               |
| Data Size | If the slot contains a cartridge, this column displays, in megabytes, the amount of nominal data currently stored on the cartridge. |

Go on to the “Monitoring Virtual Tape service - Import/Export slots tab” on page 139

## Monitoring Virtual Tape service - Import/Export slots tab

This topic defines the import/export slot information provided by the ProtecTIER Manager when it is used for monitoring Virtual Tape (VT) services.

The **Imports/Exports** tab displays detailed information about the import/export slots in the selected library.

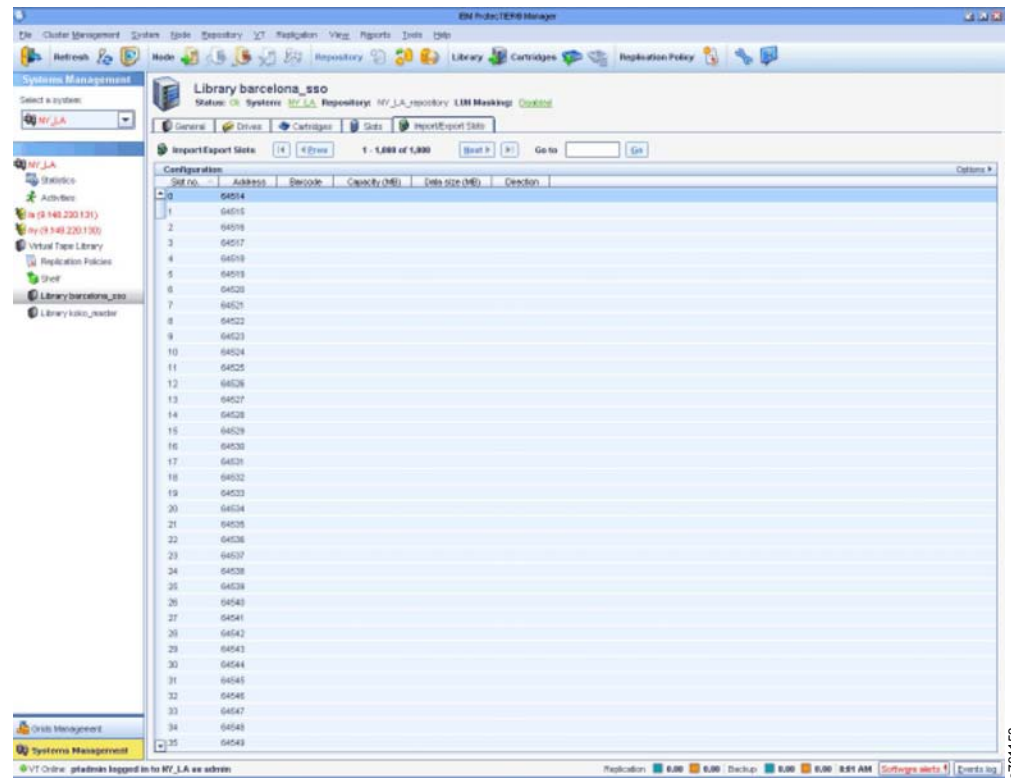


Figure 55. Imports/Exports tab

The **Imports/Exports** tab displays the following information:

Table 41. Imports/Exports tab information

| Column      | Definition                                                                                                                                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Imp/Exp No. | The number of the import/export slot.                                                                                                             |
| Address     | The import/export slot's address number.                                                                                                          |
| Barcode     | If the import/export slot contains a cartridge, this column displays the cartridge's barcode.                                                     |
| Capacity    | If the import/export slot contains a cartridge, this column displays the estimated cartridge's data capacity in megabytes.                        |
| Data Size   | If the import/export slot contains a cartridge, this column displays, in megabytes, the amount of nominal data currently stored on the cartridge. |

Go on to “Monitoring the shelf” on page 140.

---

## Monitoring the shelf

This topic details monitoring the shelf.

The shelf is a container for cartridges that do not belong to any library. Each repository contains only one shelf and whenever a cartridge in a library is moved to the library's export slot, it is automatically displaced to the shelf.

The cartridges in the shelf cannot be seen by backup applications and this facilitates the concept of being out of the library. ProtecTIER Manager displays a view of the shelf and allows access to the cartridges in the shelf.

From the shelf, cartridges can be moved to a library's import slot, replicated to another repository, or be deleted. Cartridges can also be automatically moved to a library's import slot through the visibility switching process. A cartridge that is moved to an export slot is automatically displaced to the shelf.

### **Barcode**

the barcode of the cartridge

**R/W** displays if the cartridge can be modified

### **Principal repository**

on which repository the cartridge can be modified

### **Data size (MB)**

the nominal size (in MB) of the cartridge

The monitoring view of the shelf is similar to the monitoring views of cartridges in a library. For more information, see "Cartridges tab" on page 133.

---

## Monitoring the replication grid

ProtecTIER Manager is used to monitor a replication grid. It is possible to see current grid members and their status, the relationship between the grid members and the actual throughput of replication data between the grid members.

The ProtecTIER Replication Manager periodically updates the status of the grid members and ProtecTIER Manager receives the status updates from the ProtecTIER Replication Manager. The status includes whether the grid member is online, if the grid member reports any errors related to replication, and statistics regarding replication activity currently being run on the grid member.

The grid map feature provides a consolidated view of the entire replication grid with the actual topology groups deployment. The map provides indications for local backups, replication rates and allows panning and zooming capabilities.

Select a grid from the navigation pane and click on one of the repositories. The grid member details are displayed to the right.

The Information tab displays the following:

- Capacity - physical and nominal
- Replication activities - running, pending, and backlog
- Backup activities
- Grid member replication configuration

The details displayed are a partial view of the full repository view. For more information, see “Monitoring the ProtecTIER VTL system performance statistics” on page 116.



Figure 56. Detailed view of a repository in a replication group

Click the **Traffic** tab to display the replication direction.



---

## Chapter 11. Disaster recovery (DR) mode operations

The topics in this section includes tips, guidelines, and tasks for disaster recovery (DR).

In Disaster Recovery (DR) mode, the disaster recovery site (destination) temporarily replaces the production site when a “disaster” occurs or the production site goes offline. The disaster recovery site acts as the production site until the primary site comes back online or a new one is created.

If you cannot use the primary repository (if it is down or has been destroyed) and you want to use the remote repository as your backup target, enter DR mode on the remote repository before you start working with it as the primary site. See “Entering Disaster Recovery (DR) mode.” Once you enter DR mode, all incoming replication activities from the production site to the DR site are blocked. When the primary site is rebuilt or replaced, you can return the data to the primary site and continue backups and replication. Replicated or newly created tapes can then be moved back to the main production site.

---

### Working at the DR site

Complete these tasks when working with the disaster recovery site after a disaster has occurred or when testing disaster recovery.

Begin working at the DR site by entering the DR mode. Cartridges that were created at the production site are in “read only” mode at the DR site. To work with the DR site as the new backup target, the backup application must have read/write (R/W) permission on cartridges originating from the production site so that the cartridges can be used for backup.

Cartridges at the DR site can be restored for recovery at any time. If you want to work with the DR site as the new backup target, instead of the primary site, you can either:

- Create new cartridges at the DR site and work with them
- Run the cartridge ownership takeover procedure to take control of the cartridges belonging to a down repository in order to have R/W permission at the DR site (see “Changing cartridge ownership (Principality)” on page 78.)

### Entering Disaster Recovery (DR) mode

Complete this task to enter disaster recovery (DR) mode and failover to the DR site.

#### Before you begin

**Note:** You can enter DR mode only on a repository that is defined as the destination repository in the grid. See Chapter 9, “Native Replication Management (for VTL),” on page 89.

#### About this task

Entering DR mode on the DR site destination repository “declares” that the primary, or source site is now down. Furthermore, all incoming replication

activities to the DR site are blocked from the selected source. To enter DR mode on the destination repository:

### Procedure

1. From the Systems Management view, click on the destination repository.
2. Select **Replication > Replication Disaster Recovery > Enter DR mode**.
3. Choose the repository from which you want to block incoming replication activities.
4. Type **yes** to confirm that you want to enter DR mode. An automatic procedure is executed that blocks incoming replication to the DR site from the source selected.

**Note:** If replication is not blocked, the safety of the data at the DR site cannot be guaranteed.

5. Repeat steps 2 through 4 to block incoming replication on additional repositories.

### What to do next

Once you have entered DR mode, go to “Assessing cartridge status and syncing with the catalog.”

## Assessing cartridge status and syncing with the catalog

The following section explains the process for assessing cartridge status on the DR site and synchronizing the backup application catalog with the cartridges.

Before running a restore for disaster recovery, you must verify that the list of associated cartridges are marked as "In-Sync" with the primary site, otherwise an earlier full backup image must be used for recovery. The easiest way to determine the time of the last full backup is if you have a specific time each day where your replication backlog is zero (i.e. there is no pending data to replicate and backups are not running). If this is not the case, you can assess the cartridges by recovering the backup application catalog and scanning it to find the last full backup where its associated cartridges completed replication.

### Recovering the backup application catalog

There are several ways to obtain a copy of the catalog at the remote site:

- From a catalog backup on a virtual cartridge that will be replicated to the remote site
- From disk-based replication, or by other means

If the catalog is backed up to a virtual cartridge, check on the DR site that this cartridge appears as In-Sync with the primary site. If the cartridge is not In-Sync, you will need to compare the cartridge's last sync time with the time of the last full backup.

To recover the backup application catalog from a backup on a virtual cartridge, you must work with the replicated cartridges on the hub to get an updated copy of the catalog back to the remote site. From the Systems Management window, select the **Replica properties** view on the **Cartridges** tab and use the following guidelines for each cartridge before running the procedure for recovering the catalog:



**Note:** The procedure for recovering the selected catalog backup depends on the backup application and is documented in the backup application official documentation.

- If the cartridge has been replicated, either a red `X` or a green checkmark will appear in the **In-Sync** column. If the In-Sync property has a green checkmark, then nothing further needs to be verified and this cartridge is valid for recovery.
- If the cartridge is not marked In-Sync, refer to the **Last sync time** column. This column displays the last time each cartridge's data was fully replicated to the DR site. The cartridge marked with the most recent **Last sync time** date should be used to recover the backup application catalog.

**Note:** The sync time is updated during replication, and not only when replication for this cartridge is finished.

## Recovering the data

Once recovered, scan the backup application catalog and search for the full backup image you want to recover:

- Get the start and end backup time of the full backup image.
- View the list of cartridges associated with this full backup.

Use the Cartridge Query Tool (see “Using the cartridge query tool (for VTL)” on page 164), or the PTCLI inventory filter command to filter the cartridges according to the following properties (see Table 19 on page 50 for more information on running the command):

- In-Sync
- Last update time
- Last sync time

All the cartridges marked as *In-Sync* are valid for recovery. For those cartridges not marked as In-Sync, compare between the **last update time**, which represents the last time the replica was updated, and the **last sync point destination time**.

If the **last update time** is less than or equal to the **last sync point destination time**, the replica cartridge has consistent point in time. Otherwise, the cartridge is incomplete, or in-transit. If the cartridge has consistent point in time, ensure this time stamp is larger than the full backup image end time. This will indicate that the cartridge contains all the required data for this recovery operation. Otherwise, you will have to use a previous full backup image for recovery.

You may have a case where the cartridge sync point is after the backup start time, but before the end of the backup. This may happen in cases where replication is working in parallel to the backup. If the backup has many cartridges, the first cartridges may finish replicating before the backup ends and they get a sync point earlier than the backup end time.

As such, if the **last sync time** flag on one (or more) of the cartridges indicates a time later than the **backup start time**, but earlier than the **backup complete time**, those cartridges need further inspection. Scan the backup application catalog for each of those cartridges and get the **backup start time** and the **backup complete time**. If the **last sync time** flag on all the cartridges indicates a time later than the **backup complete time**, your backup image was fully replicated.

**Remember:** When processing the cartridge list to find a complete set of DR tapes, you must keep track of the date/time discrepancies. Compare the date/time values of the source master backup server and the source ProtecTIER system. The destination environment may be in a different time zone or may be set to the incorrect date/time and as such, is unreliable. Thus, use the source date/time, rather than the destination sync time when comparing cartridge states to the backup catalog/database. The destination sync time should only be used to determine which cartridges are whole.

In addition, there could be a time difference between the source backup server and the source ProtecTIER server. Your Administrator should be aware of the discrepancy, measure it regularly and communicate the delta to the DR Administrator or operator(s). For instance, if the backup server is 2 hours behind, a cartridge may have a sync time that precedes its backup complete time, i.e. it will appear as a previous, old backup.

If there is uncertainty regarding the time differences, compare the nominal size of the cartridge to the Catalog/DB value as an additional (not a substitute) layer of verification.

Go on to “Reestablishing the production site in DR mode.”

---

## Reestablishing the production site in DR mode

Complete these tasks to reestablish and update the production site.

In order for the production site to come back online, or for a new site to be established to replace the original production site, these actions are required to reestablish and update the site with the most recent and up-to-date data.

Follow these procedures for reestablishing and updating the production site:

- Replacing the destroyed repository with a new one
- Creating a failback policy when DR mode is set

### Replacing a destroyed VTL repository

Complete this task to initiate a VTL repository takeover that will replace the destroyed repository at the production site with a new repository.

#### Before you begin

**Note:** Be careful when replacing a repository that you do not accidentally replace a good repository.

If the repository at the production site (source) has been destroyed and cannot be repaired, you can replace it with a new, or existing, repository that isn't part of another replication group. The replacing repository must be part of the replication grid.

#### About this task

Follow the steps below in the order in which they appear:

#### Procedure

1. Enter DR mode as described in “Entering Disaster Recovery (DR) mode” on page 143

2. From the Grids Management view, select **Grid > VTL Repository takeover** to run the **VTL Repository takeover** wizard.
3. Select the **Unrecoverable repository** from the dropdown list.
4. From the **Replacing repository** dropdown list, select the repository with which you want to replace the unrecoverable repository (the repository should appear in the dropdown list).

**Note:** This operation is not reversible.

5. Click **Ok** to begin.

## Results

When you run the **Repository takeover** wizard, the ProtecTIER Replication Manager will internally do the following actions:

- Remove the unrecoverable repository from its group and its grid.
- Rebuild the group with the replacing repository at the new primary site.

If the replacing repository is a new repository, then no cartridge ownership is changed. Otherwise, the "principality" is changed to the replacing repository.

**Note:** If cartridges remain on other repositories within the group with the principality of the destroyed repository, the **Repository takeover** wizard must be run on the additional repositories.

## What to do next

Go on to "The failback policy in DR mode" section for more information on failback policies and how to create them.

## The failback policy in DR mode

This topic explains the failback policy and how to create one.

Failback is the procedure for replicating back new or old updated cartridges from a DR site to their original restored production site (in order to bring it up-to-date in case it was down), or to a new production site.

If the primary repository was down and has been restored, you can return to working with the primary site as the production site and use the DR site as the secondary site. In order to replicate back new or old updated cartridges from the DR site, create a failback policy.

**Note:** The cartridges that originally came from the primary site do not need to be replicated because they were not changed at the DR site, unless they were deleted or destroyed at the primary site.

**Note:** The failback policy, in addition to copying the cartridges, also takes care of transferring the principality, or ownership, of all the cartridges from the temporary primary repository at the DR site to the restored primary repository at the production site.

Go on to "Creating a failback policy."

### Creating a failback policy

Complete this task to create a failback policy.

## Before you begin

**Important:** Only cartridges on the shelf are valid for failback.

### Procedure

1. Select **Replication > Replication Disaster recovery > Fail back**. The Fail back wizard welcome screen is displayed.
2. Click **Next**. The **Properties** screen is displayed. Type a unique name for the failback policy in the **Policy name** field.
3. Select a spoke repository on which to create the failback policy.
4. Click **Next**. The **Barcode ranges** screen is displayed.
5. Enter the barcode range of the cartridges that you want to fail back to the old or replaced primary repository.
6. Click **Add** to validate and submit the defined barcode range. If the barcode range is invalid, an error message is displayed.
7. Click **Next**. The **Validation Results** window displays the validation results of the cartridges in range, the cartridges valid for failback, and those that are invalid for failback.

### What to do next

Click the **Save report as...** button if you want to save the validation summary report. Click **Next** to view the validation summary report and exit the Failback wizard.

Go on to “Completing failback and leaving DR mode.”

## Completing failback and leaving DR mode

Complete this task to create the failback policy and leave disaster recovery (DR) mode.

### Before you begin

Once the primary site is rebuilt or replaced, create the failback policy and wait for it to complete. When the data is returned to the primary site, you can exit DR mode and continue with backups and replication as usual.

The failback policy is a one-time policy. When failback is complete, the policy still remains in the **Replication policies** list. Running and/or modifying this policy is not allowed, and on trying to do so, an error message is displayed.

**Note:** Do not run any backup activities on the restored repository until the failback operation is complete.

### About this task

When the failback operation is complete, follow the steps below to exit DR mode:

### Procedure

1. Select **Replication > Replication Disaster Recovery > Leave DR mode**. The **Leave DR mode** window is displayed.
2. From the dropdown menu, select the repository from which you want to exit DR mode.

3. Click **Ok**. Once the repository is out of DR mode, any replication policy defined on the spoke repository can modify the cartridge data.

**What to do next**

You can now begin working again with the restored repository.



---

## **Part 3. Performance optimization, reporting and troubleshooting**

This part contains information about performance optimization, creating and generating reports, and troubleshooting procedures using ProtecTIER Manager.





---

## Chapter 12. Optimization

The topics in this section describe how to optimize the performance of the ProtecTIER system using ProtecTIER Manager.

---

### Changing the CRC setting

This topic explains how to change the CRC calculation algorithm for optimized backup and replication activities.

The Change CRC calculation window allows you to change the CRC calculation algorithm to a different algorithm that consumes less CPU resources and can help improve the performance of backup, restore, and replication activities.

CRC is also used in replication communication, regardless of the kind of CRC used for backups, or replication.

**Note:** It is recommended that all repositories within a replication group have ProtecTIER version 3.1.8, or higher. If the version level of a member in the replication group does not support the fast 32-bit CRC calculation, replication will fail.

Typically, changing the CRC calculation is a onetime event. Once the calculation is changed from the default value, you are not expected to change the calculation back to the default setting. When new data is written to the repository, the latest CRC algorithm selected is used.

"Old" data remains with the CRC calculation that was selected at the time of backup. Even if the "old" data is replicated, the CRC calculation that was selected at the time of backup remains the same and is transferred togetherwith the replicated data.

**Note:** Changing the CRC calculation does not affect deduplication in any way.

You can change the CRC calculation algorithm from the **Systems Management** view in ProtecTIER Manager. To access the **CRC calculation** window, select **System > Optimization > CRC calculation**.

Select a CRC calculation option from the dropdown list:

- Software 64-bit CRC
- Hardware/Software fast 32-bit CRC

Click **Ok** to save and exit the window.



---

## Chapter 13. Reporting

The topics in this section describe how to create and generate various reports from the ProtecTIER system using ProtecTIER Manager.

Simple Network Management Protocol (SNMP), when it is configured on a ProtecTIER system, can be used to send a problem notification in the event of hardware or software degradation or failure to designated recipients.

Use the Cartridge Query tool to filter cartridges in a repository for use in generating service and statistics reports, or to select a range of cartridges for various ProtecTIER tasks.

---

### Using SNMP traps

#### About this task

If a hardware or software degradation or failure occurs, ProtecTIER systems, which are configured to use Simple Network Management Protocol (SNMP) can send a problem notification to designated recipients. SNMP notifications, or traps, can be sent even if the ProtecTIER Manager interface is unavailable.

To use SNMP traps, you need the following items:

- SNMP trap receiver software that is installed on an SNMP trap server. Follow the instructions from the manufacturer to install and configure the SNMP trap receiver software.
- The file name and location of the management information base (MIB) file for the SNMP trap receiver. On the ProtecTIER server, the file name is: `IBM-TS7600-SNMP-MIBV2.mib` in: `/usr/share/snmp/mibs`. The full path is: `/usr/share/snmp/mibs/IBM-TS7600-SNMP-MIBV2.mib`.
- The `IBM-TS7600-SNMP-MIBV2.mib` file needs to be copied onto the SNMP trap receiver and the trap receiver software must point to the directory location of the MIB file for translation of the trap messaging.
- SNMP trapping enabled on one or more of your ProtecTIER servers. Use the ProtecTIER Manager Configuration wizard to enable the SNMP trap option on 3959 SM1 servers. See the *IBM TS7620 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, and OpenStorage Systems, v3.3, GA32-0914* for instructions on SNMP configuration. For 3958 AP1 or 3958 DD4 servers, see the *IBM ProtecTIER User's Guide for Enterprise Edition and Appliance Edition, V3.3.6.1, GA32-0922*.

The ProtecTIER servers have the following improvements in SNMP support.

- ProtecTIER software events that send specific notifications that are based on the error that occurred.
- ProtecTIER hardware events that trigger specific notifications are based on the error that occurred, such as a processor event or power event.
- Send enough detailed information with the SNMP notification so that you can understand the problem. The ProtecTIER Manager Configuration menu gives you the option to filter SNMP traps that are based on severity.
  - Error-level severities can be filtered by:
    - Error

- Warning
- Information
- Software error categories include the following:
  - VTL
  - Replication
  - OpenStorage
  - FSI
  - Repository storage
  - Cluster
  - System
- Hardware error categories include the following:
  - Processor memory module
  - Cooling module (fan)
  - Internal boot drives
  - Ethernet cards
  - Power supplies
  - RAID card
  - RAID battery
  - Front-end adapter, if VTL enabled
  - General server errors
  - General network errors
  - Ethernet switch, if cluster enabled with SMC switch (TS7650 or TS7650G only)
  - Network power switch, if cluster enabled with new network power switch (TS7650 or TS7650G only)
  - 3958 AP1 specific
  - Back-end adapter (TS7650 or TS7650G only)
  - Disk controller (TS7650 or TS7650G only)
  - Disk expansion (TS7650 or TS7650G only)
  - 3959 SM1 specific
  - SAS expander
  - SATA hard disk drives
- Warning-level severity includes the following:
  - Replication warnings
  - VTL warnings
  - OpenStorage warnings
  - FSI warnings
  - Capacity warnings
  - RAS warnings
- Information-level severity includes the following:
  - VTL configuration change events
  - OpenStorage configuration change events
  - FSI configuration change events
  - Replication events

- SNMP in ProtecTIER version 3.1 or higher supports threshold monitoring and allows the user to specify thresholds for the following system runtime behavior:
  - Repository space issues
    - Nominal capacity
    - Physical capacity
  - There are two threshold levels a user can set:
    - Information level: a trap is sent when the repository regains free space and rises about the information level.
    - Warning level: a trap is sent when the free space in the repository falls below the warning level
  - Going below the informational threshold issues an SNMP trap only if the warning threshold is crossed. This method is to ensure that the user is not flooded with alerts when the normal operation crosses the low water mark threshold frequently.
  - Capacity thresholds can be set specifying % from the repository or specifying space (GBs).
- Using an IBM-registered management information base (MIB) file.
  - The MIB file is implemented in a tree structure and has a unique OID for each message supported.
  - The MIB file ships on the ProtecTIER server.
- Provide reporting to the network management application software.
- Improved communication options:
  - SNMP traps are sent through the customer network (eth0) by using the UDP protocol.
  - By default, port 162 is used and up to five destinations are supported.
  - Customers can optionally select a different port for SNMP traffic by using the ProtecTIER Manager Configuration menu.

On systems that are configured to use SNMP traps, an agent monitors the ProtecTIER server and reports fault information to a network management application. Periodically the data is sent to the designated SNMP server in the form of an SNMP trap report, a portion of which is shown in Figure 57 on page 158. SNMP trap reports notify you of hardware or software faults even if you do not have access to the ProtecTIER Manager interface. The display format of the trap report varies between different trap receiver software applications. Your trap report might not look exactly like the following example.

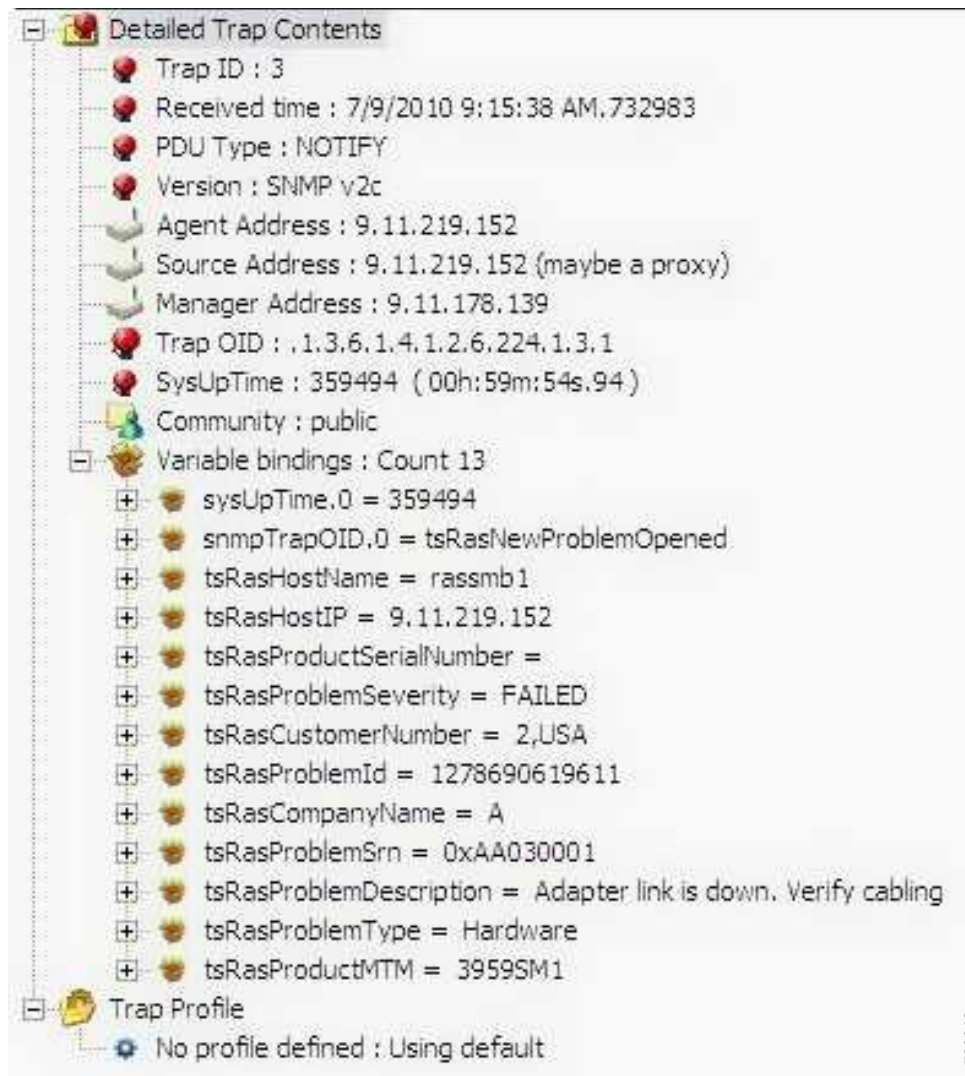


Figure 57. SNMP trap report

### Procedure

1. Run the SNMP trap catcher program on the SNMP server.
2. Open the SNMP report and review the information.
3. Make note of the defective component's name (or type) and FRU ID.

**Note:** The FRU ID (part number) for both CRU and FRU components, is expressed as a FRU ID.

4. Verify that the alert received was not caused by an easy to resolved condition, such as a loose power cord or a defective cable.

## Using the ProtecTIER Manager Configuration menu

### About this task

This task describes how to use the **ProtecTIER Manager Configuration** menu to enable and define the parameters for SNMP reporting.

Typically, hardware faults are reported in ProtecTIER Manager. However, certain conditions will prevent the GUI from communicating with the server, and prevent the reporting of fault information for the failed component. By enabling SNMP reporting, you will have greater assurance that hardware faults do not go undetected.

## Accessing the Configuration menu

### Procedure

1. If it is not already running, launch ProtecTIER Manager and log in to your system.
2. In the **ProtecTIER Manager** window, select the **Systems Management** view.
3. Open the **ProtecTIER Manager Configuration** menu. From the menu bar at the top of the **ProtecTIER Manager** window, click: **System > Configuration**.

The **Configuration** menu is displayed with the **SNMP Traps** option selected and the **Communities** window open.

**Note:** You can complete the menu options in any order. However, for best results and proper operation of all functions, it is recommended that you start by configuring SNMP traps in “Configure SNMP Traps” on page 160, and then complete the remaining tasks in the order in which they are documented.

4. Go on to “Configure SNMP Traps” on page 160.

## Entering registration details

### Procedure

1. In the **Registration** window (shown in Figure 58), enter the requested **Company** and **System Administration** information:

Configuration

Enter a Company name in the Registration window.  
Enter a Country code in the Registration window.  
Enter a Customer number in the Registration window.

**Registration**

SNMP Traps

Alert Filtering By Severity

Physical Space Threshold Alerts

Nominal Space Threshold Alerts

Backlog Threshold SNMP Alerts

F.S. Usage Threshold SNMP Alerts

E-mail Alerts

Call Home

**Instructions**

Register your IBM ProtecTIER® system by supplying the information below. Note that your Country Code and Customer Number are required to enable the Call Home feature.

**Registration**

**Company information**

Name:  Street:

City:  State:

Postal code:  Customer number:

Country code:

**System administration information**

Name:

Phone:

E-mail:

Submit Cancel

IS761468

Figure 58. Registration



Until you have completed all of the fields in the **Registration** window, the pop-up reminder displays each time you log in to ProtecTIER Manager. To dismiss the reminder, click **Ignore**.

2. When you have finished entering registration information, go on to “Configure SNMP Traps.”

## Configure SNMP Traps Procedure

1. From the **Configuration** menu, select the **SNMP Traps** option.  
The **SNMP Traps** window opens.

**Note:** In order to receive and display SNMP trap reports, you must have SNMP trap receiver software installed on the SNMP trap server. For instructions about the installation, configuration, and use of your SNMP trap receiver software, refer to the documentation that came with the product.

In addition, to enable the trap receiver to translate and display the SNMP trap data, you must specify the filename and location of the management information base (MIB) files for the SNMP trap receiver. On the TS7600 servers, the MIB filename is: **IBM-TS7600-SNMP-MIBV2.mib**, located in: `/usr/share/snmp/mibs`. The full path is: **`/usr/share/snmp/mibs/IBM-TS7600-SNMP-MIBV2.mib`**.

2. In the **Communities** pane, click **Add**.  
The **Add SNMP Trap Destination** dialog box is displayed.
3. In the **Host address** field, enter the SNMP IP address of the host server.  
This is the IP address of the destination server that collects the SNMP traps.
4. In the **Community** field, select one of the default community names (**public** or **private**), from the dropdown list, or type in a custom community name.  
The community name defines a device (or group of devices) that sends traps to the SNMP trap receiver. The receiver accepts traps from the default public and private communities, and any custom communities that were manually added to the communities list in the trap receiver program. Traps from unrecognized community names are ignored.
5. If the default **Port** value does not match the port value used by the SNMP trap receiver for the corresponding community, enter the correct value.
6. Click **Add**.  
You are returned to the **SNMP Trap** window. The new SNMP trap destination displays in the **Communities** list, and a test SNMP trap is automatically sent to the destination.
7. Repeat steps 2 through 6 to add additional SNMP trap destinations, if needed, and click **Submit**.
8. Proceed as appropriate:
  - If you selected public or private in step 4, go on to step 9 on page 161.
  - If you entered a custom community name in step 4:
    - a. Add the custom community name(s) to the communities list on the trap receiver. Refer to the documentation that came with the product for instructions.
    - b. Enter the port value(s) that correspond to the ones specified in step 5.
    - c. Go on to step 9 on page 161.



9. (Optional, but recommended for any communities that were added with a custom name.) To manually send an SNMP trap, select an SNMP host server from the **Communities** list, and then click **Test**. The system sends a test SNMP trap to the selected SNMP server. Repeat this step to manually send test SNMP traps to other host servers.

**Note:** To remove an SNMP trap destination from the **Communities** list, select the destination and click **Remove**.

10. When you are finished adding and testing SNMP trap destinations, from the navigation pane, select the **Alert Filtering by Severity** option.

The **Alert Filtering by Severity** window opens.

Use the options in this window to specify the severity level(s) which trigger the generation of an SNMP trap. The filter levels are listed from most severe (Error) to least severe (Information).

11. Select the checkbox for each severity level for which an SNMP trap report should be generated and sent.

**Note:** To send SNMP traps, you must select at least one check box in the **Alert filtering by severity configuration** pane. Also, note that the level(s) of severity selected apply to all SNMP destinations in the **Communities** list.

12. When you have finished setting the severity levels, click **Submit** and from the navigation pane, select the **Physical Space Threshold Alerts** option.

The **Physical Space Threshold Alerts** window opens with the **Physical space threshold alerts configuration** options disabled.

13. Read the information provided in the **Physical Space Threshold Alerts** pane to determine whether you want to set physical space threshold limits.
  - If you **do not** want to set physical threshold limits, leave the checkbox clear and go on to step 15 on page 162.
  - If you **do** want to set physical threshold limits, in the **Physical space threshold alerts configuration** pane, select the checkbox (as shown in Figure 59 on page 162) then go on to step 14

**Note:** The physical threshold limits specified will apply to all SNMP destinations in the **Communities** list.

14. Select the threshold unit type (GB or Percent) and enter the corresponding values for the lower and upper free space threshold limits in the input fields, as shown in Figure 59 on page 162:

**Physical Space Threshold Alerts**

An alert will be sent if the free space in the repository falls below the Warning threshold. A second alert will be sent once the repository's free space increases to an amount above the Information threshold.

**Physical space threshold alerts configuration**

Send an alert when the repository enters or leaves the limited physical free space state.

Units for Threshold:

GB

Percent

Warning threshold when free space falls below:  (for example, 5 GB)

Information threshold when free space rises above:  (for example, 10 GB)

ts761384

Figure 59. Physical space threshold alerts configuration options

15. When you have finished setting the physical threshold limits, click **Submit** and from the navigation pane, select the **Nominal Space Threshold Alerts** option.

The **Nominal space threshold alerts configuration** window opens.

16. Read the information provided in the **Nominal Space Threshold Alerts** pane to determine whether you want to set nominal threshold limits.
  - If you **do not** want to set nominal threshold limits, leave the check box clear and go on to 18.
  - If you **do** want to set nominal threshold limits, in the **Nominal space threshold alerts configuration** pane, select the checkbox (as shown in Figure 60) then go on to step 17.

The nominal threshold limits specified will apply to all SNMP destinations in the **Communities** list.

17. Select the threshold unit type (GB or Percent) and enter the corresponding values for the lower and upper free space threshold limits in the input fields, as shown in Figure 60:

**Nominal Space Threshold Alerts**

An alert will be sent if the free space in the repository falls below the Warning threshold. A second alert will be sent once the repository's free space increases to an amount above the Information threshold.

**Nominal space threshold alerts configuration**

Send an alert when the repository enters or leaves the limited nominal free space state.

Units for Threshold:

GB

Percent

Warning threshold when free space falls below:  (for example, 5 GB)

Information threshold when free space rises above:  (for example, 10 GB)

ts761383

Figure 60. Nominal space threshold alerts configuration

18. When you have finished setting the nominal threshold limits, click **Submit**.

**Note:** The **Backlog Threshold SNMP Alerts** option appears on the menu only if a replication grid has been created on the server. If the **Backlog Threshold SNMP Alerts** does not appear in the navigation pane, go on to 24 on page 164.

19. From the navigation pane, select the **Backlog Threshold SNMP Alerts** option. The **Backlog Threshold SNMP Alerts** window opens and displays the replication backlog threshold settings status of the remote repositories, if any exist.
20. Read the information provided in the **Backlog Threshold SNMP Alerts** pane to determine whether you want to set the replication backlog threshold limits.
  - If you **do not** want to set replication backlog threshold limits, go on to 23.
  - If you **do** want to set replication backlog threshold limits, go on to 21.
21. From the **Replication Backlog Thresholds** pane, select the remote repository on which to set the backlog threshold and click **Set Threshold**. The **Set backlog threshold for repository** window is displayed, as shown in Figure 61:

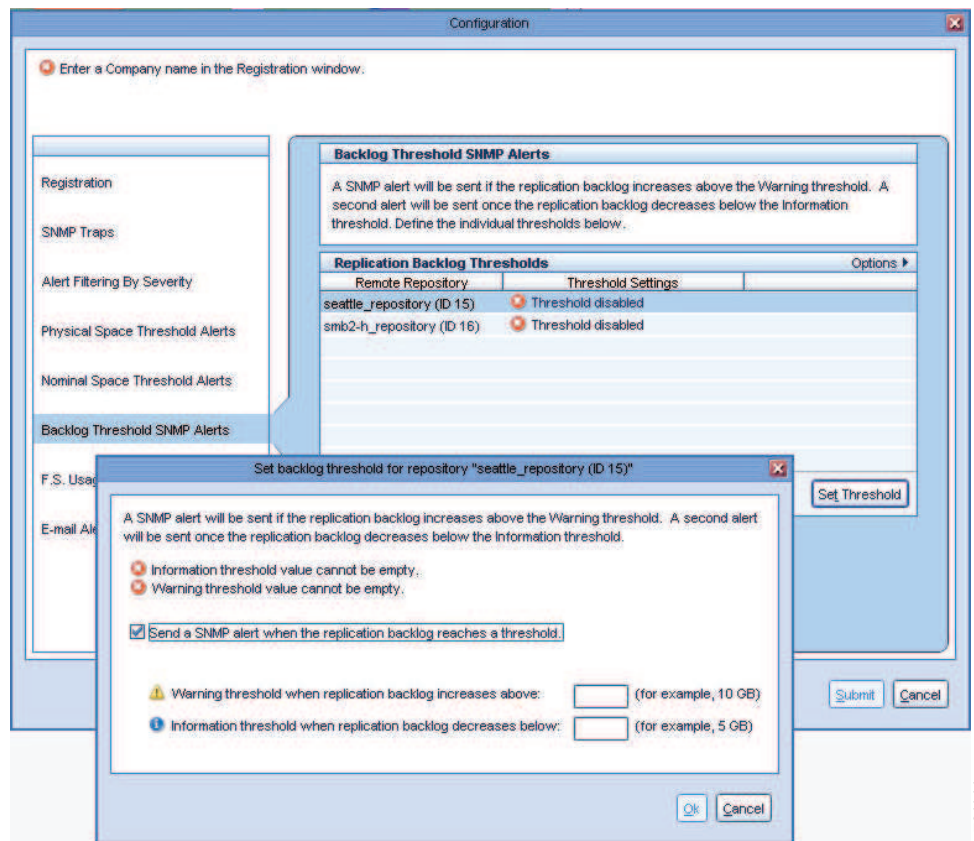


Figure 61. Set backlog threshold for repository

22. Select the checkbox to enable the threshold value input fields and enter the corresponding values (in GB) for the upper and lower replication backlog threshold limits.
23. When you have finished setting the replication backlog threshold limits, click **Ok** to close the window and click **Submit**. The threshold settings values for the selected repository display in the **Replication Backlog Thresholds** pane.

24. From the navigation pane, select the **E-mail Alerts** option. The **E-mail Alerts** window opens displaying the e-mail to which the alerts will be sent.

**Note:** The e-mail displayed is the e-mail address that was configured during RAS configuration.

25. The system configuration to enable and define the parameters for SNMP reporting is now complete.

---

## Using the cartridge query tool (for VTL)

This topic describes how to use the cartridge query tool to filter a specified set of cartridges in a repository.

### About this task

**Note:** To use the cartridge query tool, an up-to-date repository must be created.

Use this procedure to run a query:

### Procedure

1. From the Systems Management view, select **Reports > Cartridge Query tool**.  
A message displays when the repository inventory was last refreshed.

**Note:** If you are using the Cartridge Query Tool to change the principality of a cartridge, or a set of cartridges, select **VT > VT Cartridges > Principality Cartridge Query Tool**. See “Changing cartridge ownership (Principality)” on page 78 for more information.

2. Click **Yes** to refresh the cartridge inventory. When the operation completes, the following window is displayed:

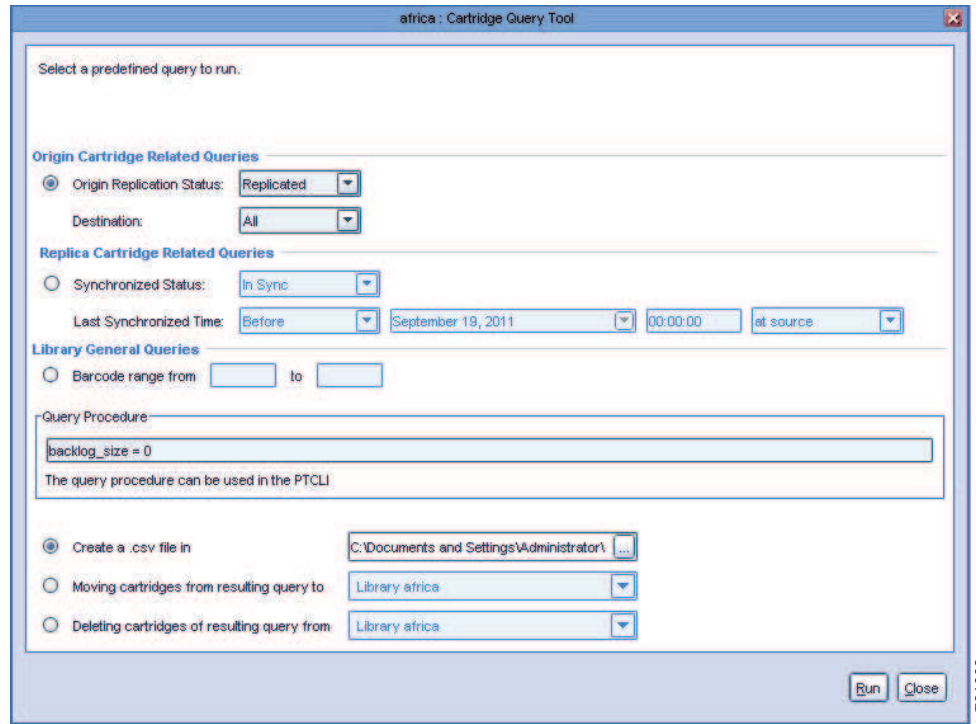


Figure 62. Cartridge Query Tool window

3. Select one of the desired predefined query types:
  - Origin Cartridge Related Queries  
Select the replication status from the dropdown list of the cartridges on the repository from which they were replicated and their destination.
  - Replica Cartridge Related Queries  
Select the synchronized status from the dropdown list of the cartridges on the repository to which they were replicated and the last synchronized time.
  - Library General Queries  
Select a range of cartridges to query by entering the barcode range (from/to).
4. Depending upon your selections, a predefined query is formulated in the **Query Procedure** frame. This procedure can be copied and used to run the query from a command-line interface using PTCLI (or you can click **Run** to run the procedure). Refer to “Query” on page 54 for more information.
5. Choose one of the following options to be performed with the query results:
  - Choose a file directory in which you want to create and save a .csv file with the query results.
  - Select a library from the dropdown list **to** where you want to **move** the filtered cartridges resulting from the query.
  - Select a library from the dropdown list **from** where you want to **delete** the filtered cartridges resulting from the query.
6. Click **Run**. The query is generated and the resulting task is performed.

**Note:** If you chose to **delete** the cartridges of the resulting query, you will be prompted to type **data loss** to confirm running the procedure.

## Generating a ProtecTIER service report

Complete this task to generate a service report on your ProtecTIER system for use by IBM Service.

### About this task

A trained ProtecTIER specialist might request that you generate a service report detailing the status of your ProtecTIER system. Service report files can be attached to a support ticket and sent to a trained ProtecTIER specialist. Service reports can be generated for only one node at a time. You must be logged in as an administrator (ptadmin) to perform this function.

### Procedure

1. From the Systems Management view, choose **Reports > Create service report**. The **Create service report** window is displayed.

brndy124075 : Create service report

Fill in the service report fields to continue.

All fields must be completed

Selected node: brandy (9.148.220.88)

Customer information

Customer site:

Backup application

Host operating system:

Backup application name:

Backup application version:

Problem description

Briefly describe the problem

Filters:

Selected profile: default Details

Start date: April 17, 2011

End date: April 17, 2011

Ok Cancel

ts760851

Figure 63. Create service report window

2. From the **Selected node:** dropdown list, select a node for which to generate a service report.
3. Complete each of the input fields in the **Backup application** pane:
  - Host operating system
  - Backup application name
  - Backup application version
4. In the **Problem description** pane, type a brief description describing the problem.

- From the **Filters** pane, select a report profile from the **Selected profile:** dropdown list. The following profile options are available:

| Profile name         | Description                                                                                                                                |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Default</b>       | Collects all system information reports and all log files from either 4 days prior, or a maximum of 10 file entries, whichever comes first |
| <b>Performance</b>   | Troubleshoots performance-related issues                                                                                                   |
| <b>Deduplication</b> | Troubleshoots deduplication-related issues                                                                                                 |
| <b>Basic</b>         | Used when a customer has an issue that requires a quick problem determination                                                              |
| <b>Monitoring</b>    | Used when IBM Support requires frequent summaries on the system's health and behavior                                                      |
| <b>Full</b>          | Collects all system information reports and all log files in their entirety                                                                |
| <b>System view</b>   | Collects system information required to generate the system view html output                                                               |
| <b>CoreDump</b>      | Collects the <i>vmcore</i> dumps from the system to determine the cause of a system crash                                                  |

- Select the start and end dates to filter the report data by date range.
- Click **Ok**. The Service Report file is created on the ProtecTIER server and a standard save dialog box is displayed.
- Click **Save**. The report file is saved to the selected location.

---

## Generating a service report using the ProtecTIER Service menu

Complete this task to generate a service report on your ProtecTIER system using the ProtecTIER Service menu.

### About this task

A trained ProtecTIER specialist might request that you generate a service report detailing the status of your ProtecTIER system. Service report files can be attached to a support ticket and sent to a trained ProtecTIER specialist.

### Procedure

- Connect a USB keyboard and graphics-capable monitor to the server.
- Verify that the server is running:
  - If it is, go on to step 3.
  - If it is not running: power it on now, wait for the boot cycle to complete, and then go on to step 3.
- At the localhost **Login** prompt, type: **ptconfig** and press **<enter>**.
- At the **Password** prompt, type: **ptconfig** and press **<enter>**  
The **ProtecTIER System Menu** displays:

```

-----
 ProtecTIER Service Menu running on rassmx
-----
 1) ProtecTIER Configuration (...)
 2) Manage ProtecTIER services (...)
 3) Health Monitoring (...)
 4) Problem Alerting (...)
 5) Version Information (...)
 6) Generate a service report
 7) Generate a system view
 8) Update ProtecTIER code

 E) Exit
-----
 >>> Your choice?

```

5. Select **Generate a service report**. Type the corresponding number and press **<enter>**. The following output is displayed:

```

Your choice? 6
Begin Processing Procedure

Please choose a profile:
 1) Default - Collects all system information reports and all log
    files from the either the last 4 days, or a maximum of 10 file
    entries, whichever comes first
 2) Performance - Used to troubleshoot performance-related issues
 3) Deduplication - Used to troubleshoot deduplication-related issues
 4) Basic - Used when customer has an issue that requires a quick
    problem determination
 5) Monitoring - Used in cases where Support provides frequent summaries
    on the system's health and behavior
 6) Full - Collects all system information reports and all log files
    in their entirety
 7) Systemview - Collect system information required to generate the
    system view html output
 8) Coredump - Collects the vmcore dumps from the system
 q) Quit

Choose:

```

6. Choose a profile from the options displayed. Type the corresponding number and press **<enter>**. The following output is displayed:

```

Choose: 1
Please choose from what date to collect log files: ('q' to quit)
Choose: [YYYYMMDD]

```

7. Enter the date range to filter the report data. Type the start date in the format specified **[YYYYMMDD]** and press **<enter>**.

8. Type the end date in the format specified **[YYYYMMDD]**. The following example output is displayed:

```

Choose: [YYYYMMDD] 20110401
Please choose until what date to collect log files: ('q' to quit)
Choose: [YYYYMMDD] 20110410

```

9. Press **<enter>**. The service report is generated according to the chosen profile and a series of prompts are then displayed.

10. Complete the prompts as they appear:

- a. **Please specify the customer name (less than 10 characters or digits)**  
Type your customer name and press **<enter>**.
- b. **What is the operating system running on the host ?** Type the operating system running on the host and press **<enter>**.



- c. **What backup application (including version) is running on the host ?**  
Type the backup application and version running on the host and press **<enter>**.
- d. **Please describe the problem briefly.** Type a brief description of the problem and press **<enter>**.

11. The following example output is displayed:

```

Please wait...
Creating report...
done

Created /pt_work/ProtectTier_customer_popeye_default_Apr_12_2011_18_37_58_Report.tar.gz

End Processing Procedure with return code=1
+-----+
| ProtectTIER Service Menu running on popeye |
+-----+
| 1) ProtectTIER Configuration (...)          |
| 2) Manage ProtectTIER services (...)       |
| 3) Health Monitoring (...)                |
| 4) Problem Alerting (...)                 |
| 5) Version Information (...)              |
| 6) Generate a service report              |
| 7) Generate a system view                 |
| 8) Update ProtectTIER code                |
|   |
| E) Exit                                   |
+-----+
Your choice?

```

The service report is now complete. You can repeat this procedure for additional nodes, or type **e** to exit the menu. The service report is now complete. Type **e** to exit the menu.

### What to do next

When you have finished, contact a trained ProtectTIER specialist.

## Creating a long-term statistics report

This task describes how to generate a long-term statistics report using ProtectTIER Manager.

### About this task

Create a long-term statistics report for the nodes in your system when you want to analyze your system statistics.

### Procedure

1. From the Systems Management view, choose **Reports > Create long term statistics report**. The **Create long term statistics report** window is displayed.

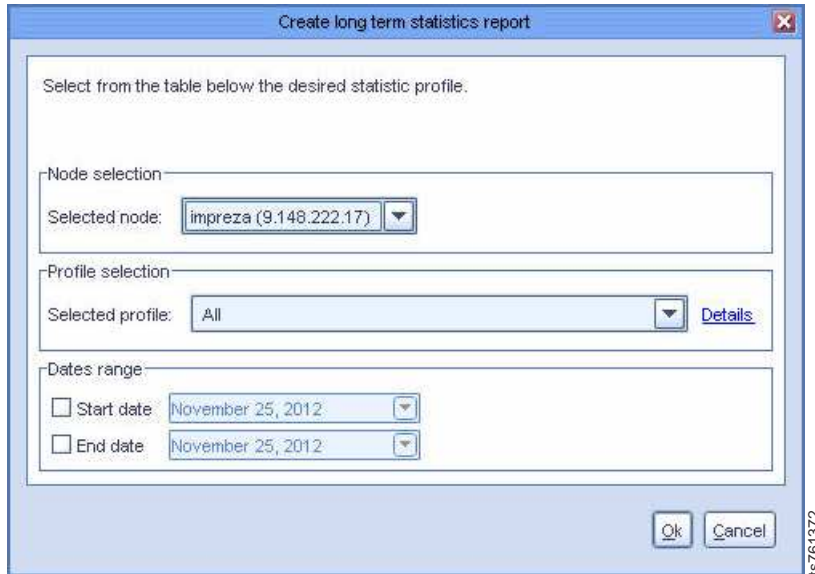


Figure 64. Create long term statistics report window

2. From the Node selection pane, select a node from the **Selected node:** dropdown list, or select **All** for all of the nodes in the system.
3. From the Profile selection pane, select a statistics profile from the **Selected profile:** dropdown list. The following options are available:

| Profile name                      | Description                                                                                                         |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------|
| All (for support)                 | Collects all of the statistical data from the system. The report can be sent as a file to IBM Service for analysis. |
| ProtectTIER VTL Statistics Report | Displays statistics data for monitoring purposes.                                                                   |

The following table displays the information included in the ProtectTIER Statistics report. Each record measures the data from the timestamp of the previous record to the timestamp of the current record.

Contents of the **ProtectTIER VTL Statistics Report:**

| Column                              | Description                                                               |
|-------------------------------------|---------------------------------------------------------------------------|
| processId                           | The ID number of the process.                                             |
| pollId                              | The time according to the Unix timestamp conversion.                      |
| Timestamp                           | The readable date and time of the sampling.                               |
| SamplingTimeSeconds                 | The duration, in seconds, between samples.                                |
| nSamplesPerPoll                     | The number of samples used for each poll.                                 |
| Physical Size of Repository (bytes) | The physical size of the repository.                                      |
| Nominal Data Size (bytes)           | The amount of nominal data on the repository.                             |
| Used Physical Space (bytes)         | The amount of space on the repository currently containing physical data. |

Contents of the **ProtectTIER VTL Statistics Report**:

| Column                                            | Description                                                                                                        |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Allocable Space (bytes)                           | The amount of free physical space on the repository that is available for new allocations.                         |
| Non-Allocable Space (bytes)                       | The amount of fragmented space on the repository that has to be defragmented to be available for new allocations.  |
| Average Write Throughput (bytes/sec)              | The average throughput of nominal data written to this node, in bytes/second.                                      |
| Average Number of Writing Streams                 | The average amount of write streams on this node.                                                                  |
| Average Read Throughput (bytes/sec)               | The average throughput of nominal data read from this node, in bytes/second.                                       |
| Average Number of Reading Streams                 | The average amount of read streams on this node.                                                                   |
| Nominal Deleted Size (bytes)                      | The amount of nominal data deleted from the repository during the last poll.                                       |
| Average Delete Throughput (bytes/sec)             | The average throughput of nominal data that has been deleted.                                                      |
| Average Delete Backlog Per Node (bytes)           | The average amount of nominal data backlog per node, in bytes, that still needs to be deleted from the repository. |
| Factoring Ratio                                   | The ratio of the total amount of nominal data size over the used physical space.                                   |
| Number of Defraggers tasks Finished               | The number of defraggers tasks that have completed during this poll.                                               |
| Defraggers Defragmented Size Bytes (cluster wide) | The amount of space freed up after defragmentation operations.                                                     |
| Nominal Incoming Throughput Average (KB/sec)      | The average amount of incoming nominal throughput from the different sources replicating to this node.             |
| Physical Incoming Throughput Average (KB/sec)     | The average amount of incoming physical throughput from the different sources replicating to this node.            |
| Nominal Outgoing Throughput Average (KB/sec)      | The average amount of outgoing nominal throughput sent from this node to the destination(s).                       |
| Physical Outgoing Throughput Average (KB/sec)     | The average amount of outgoing physical throughput sent from this node to the destination(s).                      |
| Total Replication Backlog Average (bytes)         | The average of the total amount of nominal data in the queue pending replication.                                  |
| Replication Backlog Average Dest RID 0-3 (bytes)  | The average of the total amount of nominal data in the queue pending replication per destination repository ID.    |

4. From the **Dates range** pane, select the start and end dates to filter the report data by date range.
5. Click **OK**. The long term statistics report file is created on the ProtectTIER server and a standard save dialog box is displayed.

- Click **Yes** to download the report and save the file on the ProtecTIER Manager workstation.

---

## Creating a system activities statistics report

This task describes how to generate a statistics report of the system activities in frequent and short-term intervals..

### About this task

Create a system activities statistics report for each node in your system when you want to analyze your short-term system activities.

### Procedure

- From the Systems Management view, choose **Reports > Create system activities statistics report**. The **Create system activities statistics report** window is displayed.
- From the Node selection pane, select a node from the **Selected node:** list.
- Click **OK**. The system activities statistics report file is created on the ProtecTIER server and a standard save window is displayed.
- Click **Yes** to download the report and save the *.csv* file on the ProtecTIER Manager workstation.
- Click **Ok** to complete the procedure.

The following table displays the information included in the System Activities Statistics report. Each record measures the data from the timestamp of the previous record to the timestamp of the current record.

Contents of the **System Activities Statistics Report**:

| Column                                         | Description                                                                                              |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| poll-id                                        | The time according to the UNIX timestamp conversion.                                                     |
| friendly-poll-id                               | The readable date and time of the sampling.                                                              |
| timestamp                                      | The time according to the UNIX timestamp conversion.                                                     |
| Deletion throughput (bytes/sec)                | The rate at which data is deleted.                                                                       |
| Defragmented throughput (bytes/sec)            | The rate at which data is defragmented.                                                                  |
| FSI write throughput (bytes/sec)               | The average throughput of nominal data that is written to the repository, in bytes.                      |
| Writing streams                                | The average number of writing streams on the system.                                                     |
| FSI read throughput (bytes/sec)                | The average throughput of nominal data that is read from the repository, in bytes.                       |
| Reading streams                                | The average number of reading streams on the system.                                                     |
| Physical in-replication throughput (bytes/sec) | The average throughput of incoming physical data from the different sources that replicate to this node. |
| Nominal in-replication throughput (bytes/sec)  | The average throughput of incoming nominal data from the different sources that replicate to this node.  |

### Contents of the **System Activities Statistics Report**:

| Column                                          | Description                                                                                         |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| In-replication activities                       | The average number of replication streams in to the system.                                         |
| Physical out-replication throughput (bytes/sec) | The average throughput of outgoing physical data that is sent from this node to the destination(s). |
| Nominal out-replication throughput (bytes/sec)  | The average throughput of outgoing nominal data that is sent from this node to the destination(s).  |
| Out-replication activities                      | The average number of replication streams out of the system.                                        |

## Viewing machine reported product data (MRPD)

This topic explains how to view machine reported product data, or MRPD.

MRPD is the sub process that provides the capability of a system to report its own current hardware and software configuration information and vital product data, and make it available to those IBM processes and applications that need timely and accurate machine configuration information. Product data is gathered by a machine and sent to a destination, such as an IBM support server.

You can display machine product data using ProtecTIER Manager:

1. From the Systems Management view, choose **Reports > View product data (MRPD)**. The **View product data (MRPD)** window is displayed:

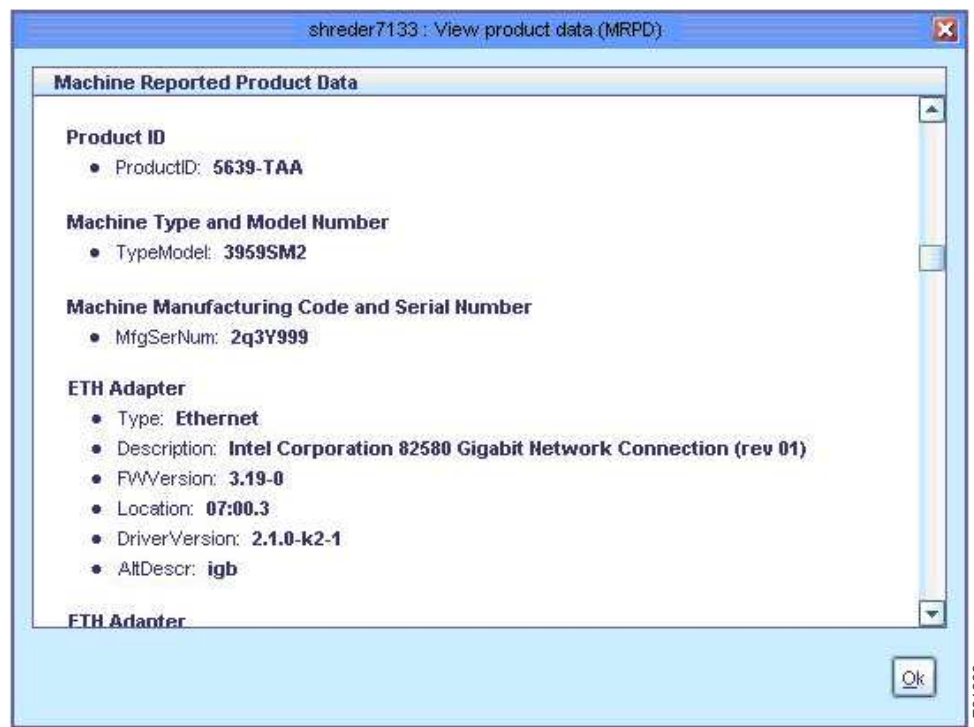


Figure 65. View product data (MRPD) window

- Analyze the data to determine the required action. When you are finished, click **Ok** to close the window.

---

## Monitoring ProtecTIER backup and deduplication activities

This topic describes how to collect and analyze ProtecTIER backup and deduplication data using CLI tools.

### About this task

Use the `analyze_sessions` utility, under the `/opt/dtc/app/utis/` directory, to monitor the data statistics for the backup and deduplication sessions of your ProtecTIER system.

### Procedure

- Change to the `/opt/dtc/app/utis/` directory.
- Type `./analyze_sessions` at the command prompt.

| Usage options  | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>-n</b>      | Number of previous months back to scan.                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>-sd</b>     | The <code>&lt;source directory&gt;</code> option is for working on compressor (.csv) files in locations other than the compressor miscellaneous directory (or, the default directory).                                                                                                                                                                                                                                              |
| <b>-io</b>     | (I/O throttle in MB/s) This tool runs on the machine, so that the available resources from the machine are not depleted. The default value is 5MB/s.                                                                                                                                                                                                                                                                                |
| <b>-daily</b>  | Adds a section with a line for each day.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>-hourly</b> | Add a section with a line for each hour.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>-d</b>      | If the session is idle for more than <code>&lt;x&gt;</code> (1-20 minutes) amount of time, a new session is started.                                                                                                                                                                                                                                                                                                                |
| <b>-s</b>      | (Start date) Date format is YYYY-MM-DD-HH-MM, e.g. 2006-09-30-05-23. The processed times are <code>startTime &lt;= time &lt;= endTime</code> .                                                                                                                                                                                                                                                                                      |
| <b>-e</b>      | (End date) Date format is YYYY-MM-DD-HH-MM, e.g. 2006-09-30-05-23. The processed times are <code>startTime &lt;= time &lt;= endTime</code> .                                                                                                                                                                                                                                                                                        |
| <b>-i</b>      | <code>&lt;cart_list_file&gt;</code> is the file name (full path) of the file that contains a list of cartridges names. The file report format contains each cartridge name on a separate line. The file format must be a Unix text file (and not Windows).<br><b>Note:</b> Make sure there are no empty lines at the end of the cartridge list. If an empty line exists at the end of the cartridge list, the data will not filter. |

| Usage options          | Explanation                                                                                                                                                                                                                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>-c</b>              | This option is only relevant with the <b>-i</b> option. Creates a file with the name of the cartridge file + <code>__</code> .csv that contains the rows from the original compressor .csv files, related to the cartridges in the list. The .csv file is saved in the <code>/pt_work</code> directory.              |
| <b>-o</b>              | <code>&lt;output file name&gt;</code> The output data is dumped into this file, instead of the default file ( <code>&lt;machine name&gt;</code> + <code>&lt;time&gt;</code> ) in the <code>/pt_work</code> directory)                                                                                                |
| <b>-min</b>            | Minimal output displays "all" with the grand totals and headers. The daily and hourly flags are overridden.                                                                                                                                                                                                          |
| <b>-l</b>              | This option is only relevant with the <b>-i</b> option. Adds a section to the regular report file with a line of the totals for each cartridge in the list (limited to 4K cartridges). If there are more than 4K cartridges with the <b>-l</b> option, an error message will be displayed and the utility will exit. |
| <b>Nosessionfilter</b> | Includes all sessions, even the small ones, in the sessions list. For example, if you have a session that is smaller than 1MB, it is included in the output. (The minimum file size with the session filter is 1MB.)                                                                                                 |

- An output file containing statistics for the recent sessions is generated at the following location: `/ptwork/<server name>-<date>-<time>.csv` during the respective time period.

## Results

The following is an example of running the `analyze_sessions` utility with the `-l` and `-i` server options to display a list of the cartridge names and their totals in the report:

```
[root@ny utils]# ./analyze_sessions -d 5 -s 2012-12-01-00-00 -e 2012-12-31-01-00
-l -i /pt_work/cart_list

analyze_sessions: this program analyzes the logs on the current
ProtectTIER server. Its output is the change rate between each
session and data that was available in the repository at the time.

This program and its output contain proprietary information of
International Business Machines Corporation.

(c) Copyright International Business Machines Corporation 113. All rights reserved.

startDate date: 2012-12-1 00:00:00
endDate date: 2012-12-31 01:00:59

Read 167MB, throughput: 5.21MB/s
Output file is /pt_work/ny-2013-01-03-16-27-09.csv
[root@ny utils]#
```

The .csv file looks similar to the following:

|                                                                                                                                    |                 |                 |                    |                 |                             |                  |                  |
|------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|--------------------|-----------------|-----------------------------|------------------|------------------|
| <b>Analysis of factoring results from ny</b>                                                                                       |                 |                 |                    |                 |                             |                  |                  |
| <b>03/01/2013<br/>16:27</b>                                                                                                        |                 |                 |                    |                 |                             |                  |                  |
|                                                                                                                                    |                 |                 |                    |                 |                             |                  |                  |
| This output was generated by analyze_sessions and contains proprietary information of International Business Machines Corporation. |                 |                 |                    |                 |                             |                  |                  |
| (c) Copyright International Business Machines Corporation 2013. All rights reserved.                                               |                 |                 |                    |                 |                             |                  |                  |
|                                                                                                                                    |                 |                 |                    |                 |                             |                  |                  |
| SAMBA Release 7.133.94                                                                                                             |                 |                 |                    |                 |                             |                  |                  |
| There are 6 temporary fixes:                                                                                                       |                 |                 |                    |                 |                             |                  |                  |
| 81022100.25                                                                                                                        |                 |                 |                    |                 |                             |                  |                  |
| 81023626.5                                                                                                                         |                 |                 |                    |                 |                             |                  |                  |
| 81023644.2                                                                                                                         |                 |                 |                    |                 |                             |                  |                  |
| 81023656.1                                                                                                                         |                 |                 |                    |                 |                             |                  |                  |
| 81023661.5                                                                                                                         |                 |                 |                    |                 |                             |                  |                  |
| 81023713.1                                                                                                                         |                 |                 |                    |                 |                             |                  |                  |
| Name                                                                                                                               | Total data (TB) | Total data (GB) | System change rate | Factoring ratio | compressed Bytes Count (GB) | start time       | end time         |
|                                                                                                                                    |                 |                 |                    |                 |                             |                  |                  |
| Grand totals                                                                                                                       |                 |                 |                    |                 |                             |                  |                  |
| all                                                                                                                                | 0.146472        | 149.988         | 35.13%             | 2.84659         | 31.2975                     | 23/12/2012 12:31 | 30/12/2012 04:05 |
|                                                                                                                                    |                 |                 |                    |                 |                             |                  |                  |
| carts total                                                                                                                        |                 |                 |                    |                 |                             |                  |                  |
| B00000                                                                                                                             | 0.0360501       | 36.9153         | 35.84%             | 2.79007         | 7.85946                     | 23/12/2012 12:32 | 30/12/2012 04:01 |
| B00001                                                                                                                             | 0.0367187       | 37.6            | 34.50%             | 2.8982          | 7.70792                     | 23/12/2012 12:31 | 30/12/2012 03:49 |
| B00002                                                                                                                             | 0.0366516       | 37.5312         | 36.33%             | 2.75257         | 8.09903                     | 23/12/2012 12:33 | 30/12/2012 04:05 |
| B00003                                                                                                                             | 0.0370518       | 37.9411         | 33.87%             | 2.95244         | 7.63114                     | 23/12/2012 12:33 | 30/12/2012 04:05 |
|                                                                                                                                    |                 |                 |                    |                 |                             |                  |                  |
| By session (summary)                                                                                                               |                 |                 |                    |                 |                             |                  |                  |
| 2012-12-23 12:31:32 to 2012-12-23 13:04:19                                                                                         | 0.0490185       | 50.195          | 100%               | 1               | 29.8033                     | 23/12/2012 12:31 | 23/12/2012 13:04 |



| Analysis of factoring results from ny      |           |         |       |         |            |                  |                  |
|--------------------------------------------|-----------|---------|-------|---------|------------|------------------|------------------|
| 03/01/2013 16:27                           |           |         |       |         |            |                  |                  |
| 2012-12-27 12:16:30 to 2012-12-27 12:24:06 | 0.0247249 | 25.3183 | 0.05% | 2145.05 | 0.00807142 | 27/12/2012 12:16 | 27/12/2012 12:24 |
| 2012-12-27 12:39:27 to 2012-12-27 12:47:20 | 0.0237776 | 24.3483 | 5.52% | 18.1139 | 0.803133   | 27/12/2012 12:39 | 27/12/2012 12:47 |
| 2012-12-30 03:45:10 to 2012-12-30 04:05:31 | 0.0489512 | 50.126  | 2.27% | 43.9995 | 0.683006   | 30/12/2012 03:45 | 30/12/2012 04:05 |

A summary of statistical information is included by session:

*Table 42. Recent backup session and deduplication statistics*

| Statistic                 | Description                                                                                                                           |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Total data (TB)           | Total amount of data backed up during the session, in terabytes.                                                                      |
| Total data (KB)           | Total amount of data backed up during the session, in kilobytes.                                                                      |
| System change rate        | Percentage of nominal data in the backup session that was factored and recognized as changed relative to the previous backup session. |
| Factoring ratio           | The ratio of the total amount of nominal data size over the used physical space.                                                      |
| compressedBytesCount (GB) | The amount of data that was written to the disk after factoring and compression.                                                      |
| Start time                | Start time of the backup session.                                                                                                     |
| End time                  | End time of the backup session.                                                                                                       |



---

## Chapter 14. Troubleshooting

The topics in this section provide tips, guidelines, and procedures for handling error situations that might arise within the ProtecTIER system.

Errors that occur in your ProtecTIER system can be monitored using the Alerts dialog and the Event Log dialog. All errors within the ProtecTIER system should be reported to a trained ProtecTIER specialist. A trained ProtecTIER specialist can guide you in determining the cause of the error and finding a solution. In addition, the **Check and recover** wizard, included in ProtecTIER Manager, can find and repair some errors.

---

### Common troubleshooting tasks

The topics in this section describe common troubleshooting tasks you might perform while working with a trained ProtecTIER specialist.

Miscellaneous tasks that a trained ProtecTIER specialist might ask you to perform during the troubleshooting process are listed here.

**Attention:** Do not perform these tasks unless you are directed to do so by IBM Support.

- **Disabling defragmentation** - Enables you to stop the defragmentation process. For more information, see “Disabling defragmentation.”
- **Disabling compression** - Enables you to stop the data compression process. For more information, see “Disabling data compression” on page 180.
- **Changing the HyperFactor mode** - Enables you to stop the HyperFactoring process. For more information, see “Changing the HyperFactor mode” on page 180.
- **Modifying the trace buffer** - Enables you to dump or reset the trace buffer, or to change the trace settings. For more information, see “Modifying the trace buffer” on page 181.
- **Resetting devices** - Enables you to reset a robot or tape drive in a virtual library. For more information, see “Resetting devices” on page 183.
- **Unloading and moving cartridges** - Enables you to manually move virtual cartridges between slots and tape drives. For more information, see “Unloading and moving cartridges” on page 184.

### Disabling defragmentation

Complete this task to disable defragmentation.

#### About this task

The ProtecTIER system automatically defragments fragmented repository disk space as a background task at a rate that does not cause the system to slow down. Stop defragmentation to free the resources used by the defragmentation process.

#### Procedure

1. Choose **Repository > Defragmentation control**. The **Defragmentation control** dialog is displayed.

2. Select **Disable defragmentation** and click **Ok**. The **Defragmentation control pane** closes and defragmentation is disabled.

## Results

**Note:** Selecting **Enable defragmentation** in the **Defragmentation control pane** resumes system defragmentation.

## Disabling data compression

Complete this task to disable data compression.

### About this task

Under normal circumstances, the ProtecTIER system compresses data. Stop compression on a specific virtual library to free the resources usually demanded by the compression process.

Perform the following steps to disable data compression for a specified Virtual Tape (VT) library.

### Procedure

1. Choose **VT > VT Library > Set compression type**. The **ProtecTIER compression mode** dialog is displayed.
2. Select **VT, VT Library**, and finally **Set compression type**. The compression mode dialog box is displayed.
3. Select **Disable compression** and click **Ok**. The **ProtecTIER compression mode** dialog closes and compression is stopped.

**Note:** Selecting **Enable compression** in the **ProtecTIER compression mode** dialog box resumes data compression.

## Changing the HyperFactor mode

Complete this task to change the HyperFactor mode for a specified library.

### About this task

By default, ProtecTIER factors all new incoming data, detecting recurring data and storing only the data segments that have not previously been written to the repository. You can change the default HyperFactor mode for each library.

Perform the following steps to change the HyperFactor mode on a specified VT library.

### Procedure

1. Choose **VT > VT Library > Set HyperFactor mode**. The **ProtecTIER VT HyperFactor mode** dialog is displayed.

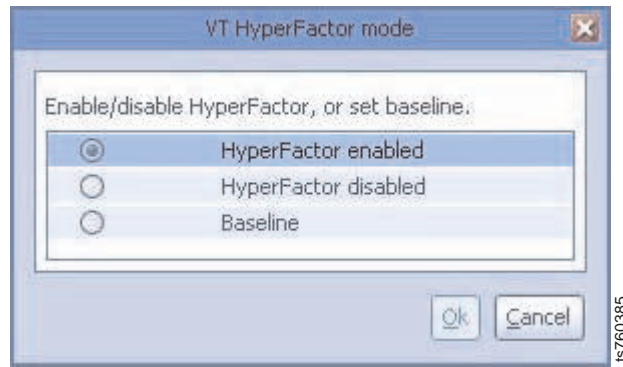


Figure 66. ProtecTIER VT HyperFactor mode dialog

2. Select one of the following options, as directed by a trained ProtecTIER specialist:
  - **Hyperfactor enabled.** HyperFactor operates as normal.
  - **HyperFactor disabled.** HyperFactor stops. When you restart HyperFactor, the HyperFactor process proceeds as normal based on the data stored from before HyperFactor stopped.
  - **Baseline.** HyperFactor stops factoring incoming data and uses the newly stored non-factored data as the reference for factoring new data after Hyperfactor is resumed.
3. Click **Ok**. The **ProtecTIER VT HyperFactor mode** dialog closes and HyperFactor stops.

## Modifying the trace buffer

The ProtecTIER system stores runtime information in a cyclic memory buffer. A trained ProtecTIER specialist might direct you to dump the trace buffer for analysis, set the trace recording levels, or reset the trace buffer.

**Note:** You can manage the trace buffer for only one node at a time.

### Dumping the trace buffer

Complete this task to create a file of the trace buffer contents for a specified node and save it to the ProtecTIER server.

#### About this task

Dumping the trace buffer saves a file of the trace buffer contents to the ProtecTIER server. Attach this file to a support ticket to send to a trained ProtecTIER specialist.

#### Procedure

1. In the **Systems Management** view, select a node from the navigation pane.
2. Choose **Node > Trace > Dump trace**. A confirmation message box is displayed.
3. Click **Yes**. The trace buffer information is saved to the ProtecTIER server.  
The trace buffer report is generated for the node and saved to the ProtecTIER server.

**Note:** Record the file name so that you can find it when IBM Service asks you to send it in with an attached support ticket.

## Setting the trace levels

Complete this task to change the trace levels for a specified node.

### About this task

The ProtecTIER system traces and records many types of operation information at various levels of detail. These trace levels are initially set in manufacturing.

IBM Support might direct you to reduce the level of detail traced for certain components. This request is made so that system resources are freed up or to increase the level of detail for system components that are suspected to be problematic.

Perform the following steps to set the trace levels for a specified node.

### Procedure

1. From the **Systems Management** view, select a node in the navigation pane.
2. Choose **Node > Trace > Set trace levels**. The **Set trace levels** window is displayed.

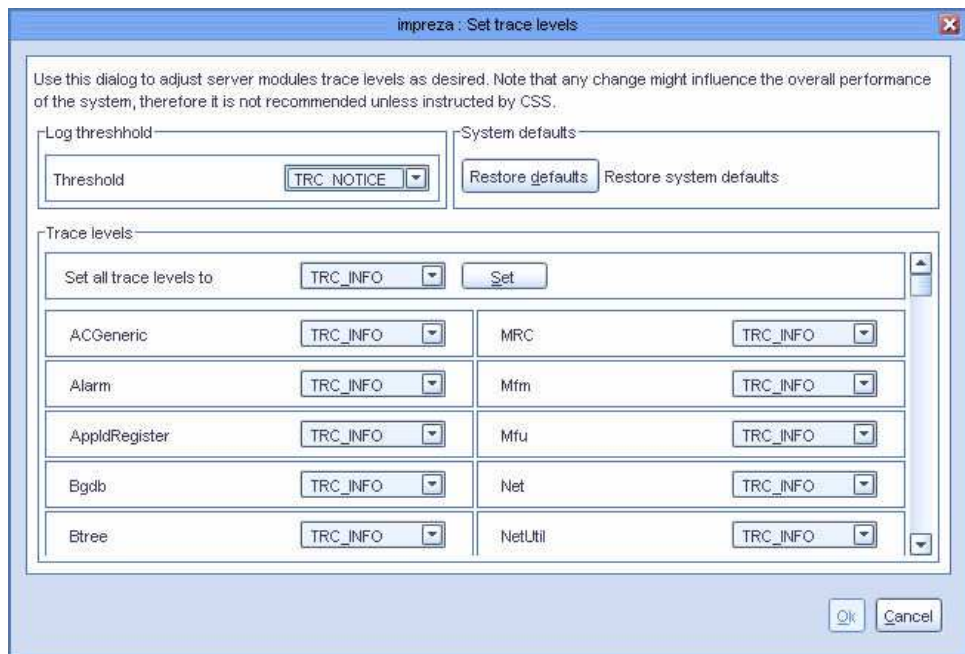


Figure 67. Set trace levels window

3. Change the trace level settings, as directed by IBM Support.
4. Click **Ok**. The **Set trace levels** window closes and the new trace levels are set.

## Resetting the trace buffer

### About this task

Resetting the trace buffer empties the buffer.

### Procedure

1. From the **Systems Management** view, select a node from the navigation pane.
2. Choose **Node > Trace > Reset trace**. A confirmation message box is displayed.

3. Click **Yes**. The trace buffer is reset for the designated node and new information begins to be gathered for that node.

## Resetting devices

If a virtual robot or tape drive is locked, reset the device to break any existing SCSI reservations on the device.

**Attention:** Resetting a robot or tape drive while the backup application is accessing the library can harm the backup operations. Do not reset a device unless directed to do so by a trained ProtecTIER specialist.

### Resetting robots

Complete this task to reset a robot.

#### About this task

There might be times when a virtual robot is locked and you need to reset the robot to break any existing SCSI reservations on the robot.

**Note:**

1. Do not initiate this action unless directed to do so by a trained ProtecTIER specialist.
2. Resetting a robot while the backup application is accessing the library can harm the backuphost operations.

Perform the following steps to reset a robot:

#### Procedure

1. From the **Systems Management** view, select a library from the navigation pane.
2. Choose **VT > VT Library > Reset robot**. A confirmation message box is displayed.
3. Click **Yes**. The robot is reset.

### Resetting the virtual tape drives

Complete this task to reset a virtual tape drive.

#### About this task

There might be times when a virtual tape drive is locked and you need to reset the drive to break any existing SCSI reservations on the robot.

**Note:**

1. Do not initiate this action unless directed to do so by a trained ProtecTIER specialist.
2. Resetting a virtual tape drive while the backup application is accessing the library can harm the backup operations.

Perform the following steps to reset a virtual tape drive.

#### Procedure

1. From the **Systems Management** view, select a library in the navigation pane.
2. Click the **Drives** tab.
3. Select a drive.

4. Choose **VT > VT Drive > Reset drive**. A confirmation message box is displayed.
5. Click **Yes**. The tape drive is reset.

## Unloading and moving cartridges

**Attention:** Manual unloading and moving of cartridges is not detected by your backup application and can result in the loss of synchronization between your backup application and ProtecTIER. Furthermore, unloading or moving cartridges while the backup application is using the library can harm the backup operations. Do not unload or move a cartridge manually unless directed by a trained ProtecTIER specialist.

### Unloading cartridges

Complete this task to unload a cartridge by using ProtecTIER Manager.


#### About this task

You must unload a cartridge from its drive before you can move it to a slot.

Perform the following steps to disconnect (unload) a cartridge from a drive:

#### Procedure

1. From the **Systems Management** view, select a library from the navigation pane.
2. Click the **Drives** tab.
3. Select a drive that contains a loaded cartridge.

**Note:** Loaded drives are indicated with .

4. Choose **VT > VT Drive > Unload drive**. A confirmation message box is displayed.
5. Click **Ok**. The drive is unloaded.

**Note:** Unloaded drives are indicated with  ts760411.

### Moving cartridges

Complete this task to move a cartridge after it has been disconnected (unloaded) from a virtual tape drive.

#### Procedure

1. From the **Systems Management** view, select a library from the navigation pane.
2. Navigate to the Services pane and select a library.
3. Click the **Drives** tab.
4. Select a drive that contains an unloaded cartridge.

**Note:** When moving cartridges from a slot, select the Slot tab and select a slot that contains a cartridge.

5. Choose **VT > VT Cartridge > Move cartridge**. The **Move cartridge** window is displayed.



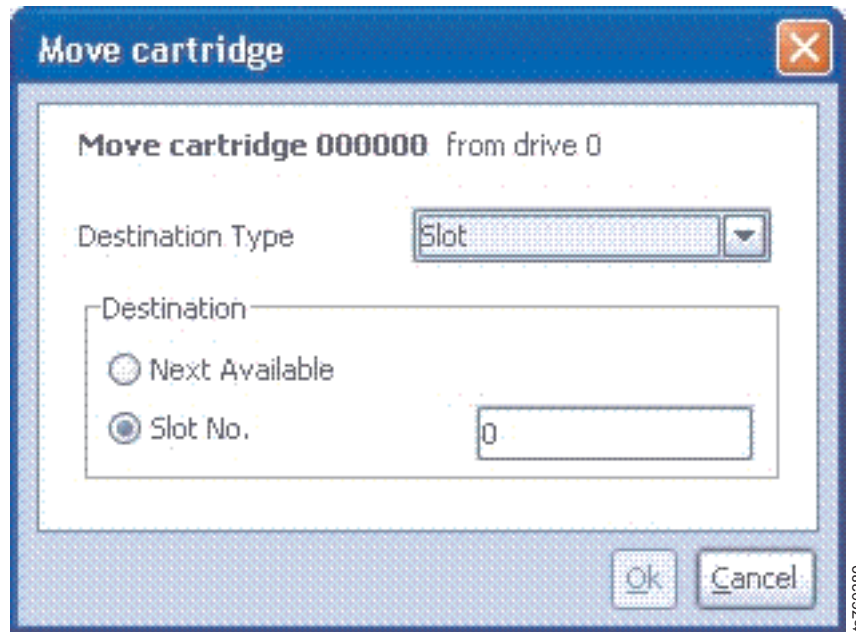


Figure 68. Move cartridge window

6. In the **Destination Type** field, select one of the following destinations:
  - Drive
  - Slot
  - Import / Export
7. In the **Destination** area, select one of the following options:
  - **Next Available** - The cartridge is placed in the next available location of the selected type.
  - **Slot/Drive No.** - The cartridge is placed in the slot or drive with the number specified in the field. The name of this field depends on your selection in the **Destination Type** field.
8. Click **Ok**. The cartridge is moved to the specified location.

---

## Viewing the alerts and events log windows

This topic describes how to view alerts and events in the ProtectTIER system logs using the ProtectTIER Manager application.

### About this task

If an error occurs, the Alerts button on the bottom-right of the View pane turns red and features a blinking exclamation mark.

Click **Alerts** to view the list of error events in the **Alerts Log** dialog.

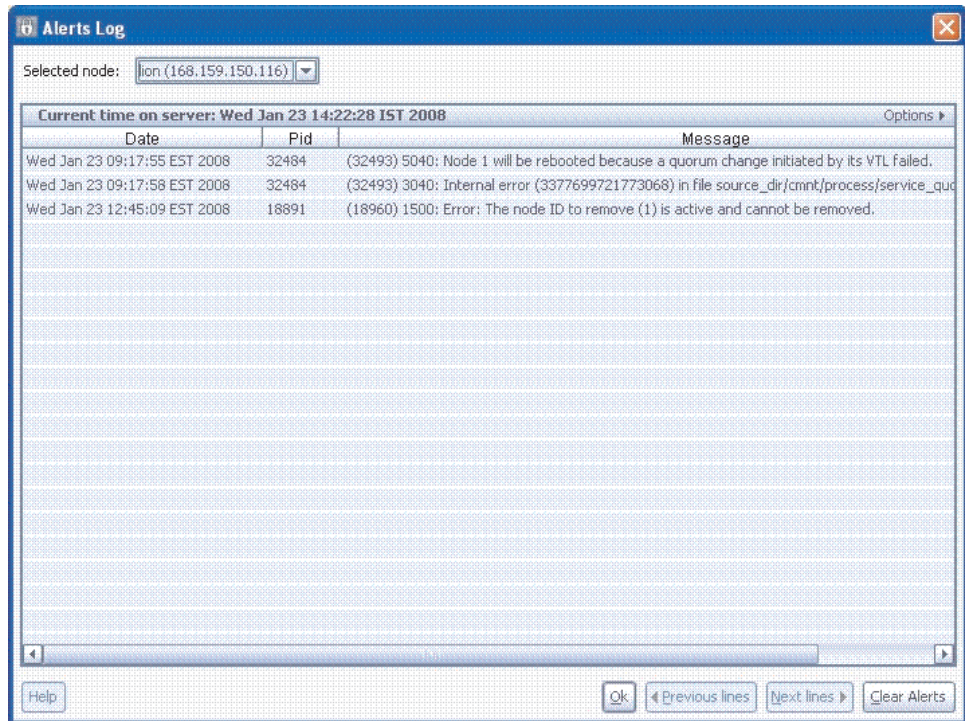


Figure 69. Alerts log

Click **Events Log** on the bottom-right of the **View** pane to view all the events occurring in the ProtecTIER system.

The **Alerts Log** and **Events Log** dialogs only display information for one node at a time. In addition, the **Alerts Log** and **Events Log** dialogs only display up to 200 alert events at one time. Navigate to a previous set of 200 alert events by clicking **Previous lines**. Navigate to a later set of 200 alert events by clicking **Next lines**.

**Note:** View the error log directly on a ProtecTIER server by opening the `/pt_work/log/vtf_error.log` file. View the alerts log by opening the `/pt_work/log/vtf_event.log` file.

## Wizard error messages

ProtecTIER Manager wizards feature a **Message** area to inform you of issues that relate to each wizard screen.

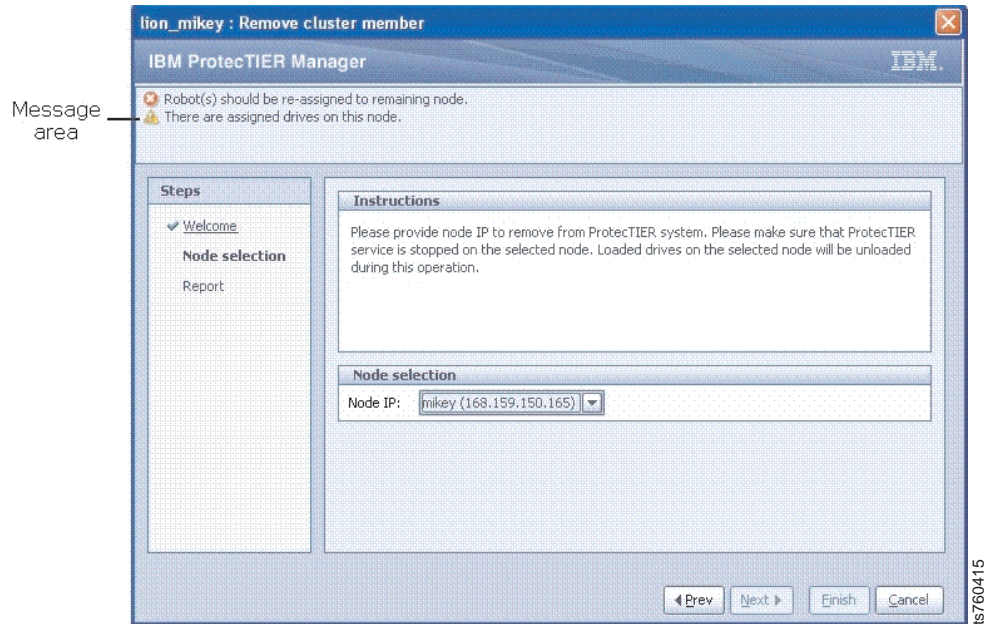


Figure 70. Message area

Messages can be of the following types:



You cannot continue the wizard until this problem is resolved.



You can continue the wizard without resolving this issue, but it is not recommended.

## Checking and repairing errors

Before checking and recovering errors with ProtecTIER Manager, ensure that the file systems are stable and free of errors that require fsck. Running the ProtecTIER Manager check and recovery wizard on inconsistent file systems can impair the consistency of the repository.

### Checking for errors requiring fsck

Complete this task to check for file system consistency.

#### About this task

The purpose of this task is to discover all error messages that indicate the need to run fsck. Perform the following steps to check for file system consistency errors:

## Procedure

1. Open the `/var/log/messages` file.
2. Search for error messages of the following types:
  - GFS: fsid=<cluster name>:<file system name>: fatal filesystem consistency error
  - GFS: fsid=<cluster name>:<file system name>: about to withdraw from the cluster
  - GFS: fsid=<cluster name>:<file system name>: telling LM to withdraw
  - GFS: fsid=<cluster name>:<file system name>: withdrawn
  - kernel: [<ffffffff887e8094>] :gfs:gfs\_lm\_withdraw+0xc4/0xd3
  - gfs\_controlld[2905]: <file system name> finish: needs recovery jid 0 nodeid 2 status 1

## Results

If you find these types of error messages, run **fsck** on the file systems referenced by the error messages.

## Determining the volume names of file systems

Complete this task to find the volume names for file systems.

### Procedure

1. Run `gfs_tool df`. Summary information for all Global File Systems (GFS) in your repository is displayed.
2. Locate the appropriate file system names and determine their mount points.

The following output file is an example of the system output when you run `gfs_tool df`. The file system name is in bold and the mount point name is italicized:

```
/mnt/vgfs0113-lvfs0113
SB lock proto = "lock_dlm"
SB lock table = "lurebimepegoco:gfs_0113"
SB ondisk format = 1309
SB multihost format = 1401
Block size = 4096
Journals = 3
Resource Groups = 16384
Mounted lock proto = "lock_dlm"
Mounted lock table == "lurebimepegoco:gfs_0113"
Mounted host data = "jid=0:id=14876673:first=0"
Journal number = 0
Lock module flags = 0
Local flocks = FALSE
Local caching = FALSE
Opses OK = FALSE
Type      Total Blocks  Used Blocks  Free Blocks  use%
-----
inodes    512           512          0            100%
metadata  5176264      4223508     952756       82%
data      2142060068  2111434535  30625533    99%
```

3. Open `/etc/fstab` and determine the corresponding logical volumes names. The following output is an example of the `fstab` entry format:

```
/dev/mapper/<logical volume name> /<mount point> gfs defaults,noatime,nodiratime,noquota,acl 0 0"
```

## Running fsck online

ProtecTIER Version 3.3.7 includes the capability of running fsck online. You do not need to take the system offline while you run fsck. The system stays operational so that backups and restores continue while you check the consistency of the file systems.

### Before you begin

Before you run fsck, run the procedure in “Checking and repairing errors” on page 187 to check for errors that require the use of fsck. Also, ensure that the file system on which you intend to run fsck is unmounted.

To run the Online fsck Recovery, your system must meet the following requirements:

- ProtecTIER must be configured as a 2-node cluster.
- Each node in the ProtecTIER cluster must be configured with at least 64 GB of RAM.
- One of the following criteria must be true:
  - Medium changer is active on the node that is up during the FSCK Recovery process, OR
  - Control Path Failover (CPF) is enabled if you use Tivoli Storage Manager as its backup application.

If your system does not meet this criteria, use the procedure that is described in “Running fsck” on page 190.

### Procedure

1. Select one of the ProtecTIER nodes.
2. At the **login:** prompt, log in with the ID root and the password admin.
3. Shut down the **vtfd** and **ptcluster** services in the following order:

```
# service vtfd shutdown
# service ptcluster shutdown
```

**Attention:** Make sure to use the *shutdown* option and not the *stop* option. If you use *stop*, the services restart automatically if a reboot occurs.

4. Start the **cman** and **clvmd** services in the following order:

```
# service cman start
# service clvmd start
```

5. For each of the problematic file systems, run the **gfs\_fsck -yv** command in the background with high verbosity and direct the output to a file:

```
# gfs_fsck -yv logical volume name > /pt_work/vgxx_fsck.out 2>&1 &
```

For example, the following command runs gfs\_fsck on the logical volume */dev/mapper/vg0-lv\_vg0*:

```
# gfs_fsck -yv /dev/mapper/vg0-lv_vg0 > /pt_work/vg0_fsck.out 2>&1 &
```

The output is saved in the file *"/pt\_work/vg0\_fsck.out."*

**Note:** ProtecTIER supports up to 10 parallel gfs\_fsck instances.

6. When all the gfs\_fsck processes are complete, remove the */etc/pt/dont\_start\_vtfd* and */etc/pt/dont\_start\_ptcluster*.

```
# rm -f /etc/pt/dont_start_vtfd
# rm -f /etc/pt/dont_start_ptcluster
```

7. Restart the node.  

```
# reboot -nf
```

 ProtecTIER is now up and running.
8. Send the fsck output to trained ProtecTIER specialist to determine the next step.

## Running fsck

Complete this task to run fsck to check the consistency of the file systems before you run ProtecTIER Manager to check and repair any ProtecTIER system errors.

### Before you begin

Before you run fsck, run the procedure in “Checking and repairing errors” on page 187 to check for errors that require the use of fsck. Also, ensure that the file system on which you intend to run fsck is unmounted.

### Procedure

1. On a two-node cluster, select one of the ProtecTIER nodes. If you have a single node system begin with step 7 on page 191.
2. At the **login:** prompt, log in with the ID root and the password admin.
3. Type menu on the command line and press Enter. The ProtecTIER Service main menu appears.

```
-----
ProtecTIER Service Menu running on rassmx
-----
 1) ProtecTIER Configuration (...)
 2) Manage ProtecTIER services (...)
 3) Health Monitoring (...)
 4) Problem Alerting (...)
 5) Version Information (...)
 6) Generate a service report
 7) Generate a system view
 8) Update ProtecTIER code

 E) Exit
-----
>>> Your choice?
```

4. Select **Manage ProtecTIER services (...)**. The **Manage ProtecTIER services (...)** menu is displayed.

```
-----
ProtecTIER Service Menu running on rassmx
Manage ProtecTIER Services (...)
-----
 1) Display services status
 2) Start all services
 3) Stop all services
 4) Stop ProtecTIER services only (including GFS)
 5) Stope VTFD service only (including GFS)
 6) Poweroff This Node
 7) Reboot This Node

 B) Back
 E) Exit
-----
>>> Your choice?
```

5. Select **Stop all services** to stop the ProtecTIER services on the node.
6. Shut down the stopped node.

7. On the active node, shut down the **vtfd** and **ptcluster** services in the following order:

```
# service vtfd shutdown
# service ptcluster shutdown
```

**Attention:** Make sure to use the *shutdown* option and not the *stop* option. If you use *stop*, the services restart automatically if a reboot occurs.

8. Start the **cman** and **clvmd** services in the following order:

```
# service cman start
# service clvmd start
```

9. For each of the problematic file systems, run the **gfs\_fsck -yv** command in the background with high verbosity and direct the output to a file:

```
# gfs_fsck -yv logical volume name > /pt_work/vgxx_fsck.out 2>&1 &
```

For example, the following command runs **gfs\_fsck** on the logical volume */dev/mapper/vg0-lv\_vg0*:

```
# gfs_fsck -yv /dev/mapper/vg0-lv_vg0 > /pt_work/vg0_fsck.out 2>&1 &
```

The output is saved in the file *"/pt\_work/vg0\_fsck.out"*.

**Note:** ProtecTIER supports up to 10 parallel **gfs\_fsck** instances.

10. When all the **gfs\_fsck** processes are complete, remove the */etc/pt/dont\_start\_vtfd* and */etc/pt/dont\_start\_ptcluster* so that these services begin again when you restart the node.

```
# rm -f /etc/pt/dont_start_vtfd
# rm -f /etc/pt/dont_start_ptcluster
```

11. Restart the node.

```
# reboot -nf
```

12. Restart the inactive node.

ProtecTIER is now up and running.

13. Send the fsck output to trained ProtecTIER specialist to determine the next step.

## Checking and repairing with ProtecTIER Manager

After any problematic file systems have been repaired, scan the ProtecTIER system for errors, and attempt to repair them, using the **Check and recover** wizard.

**Note:** The check and recovery process is time-consuming and the ProtecTIER system goes offline for the duration of the process. IBM therefore recommends that you use the **Check and recover** wizard only for severe problems.

### Checking the system

Complete this task to check the system for errors.

#### About this task

**Attention:** The check and recovery process is time-consuming and is to be used only when you suspect a severe problem. Running the ProtecTIER Manager check and recovery wizard on top of inconsistent file systems can impair the consistency of the repository.

Perform the following steps to use ProtecTIER Manager to check for errors:

## Procedure

1. Choose **System > Check and recover**. A confirmation message box is displayed.
2. Click **Yes**. The ProtecTIER system goes offline and scans itself. The **Check and recover** dialog is displayed with the results of the scan.

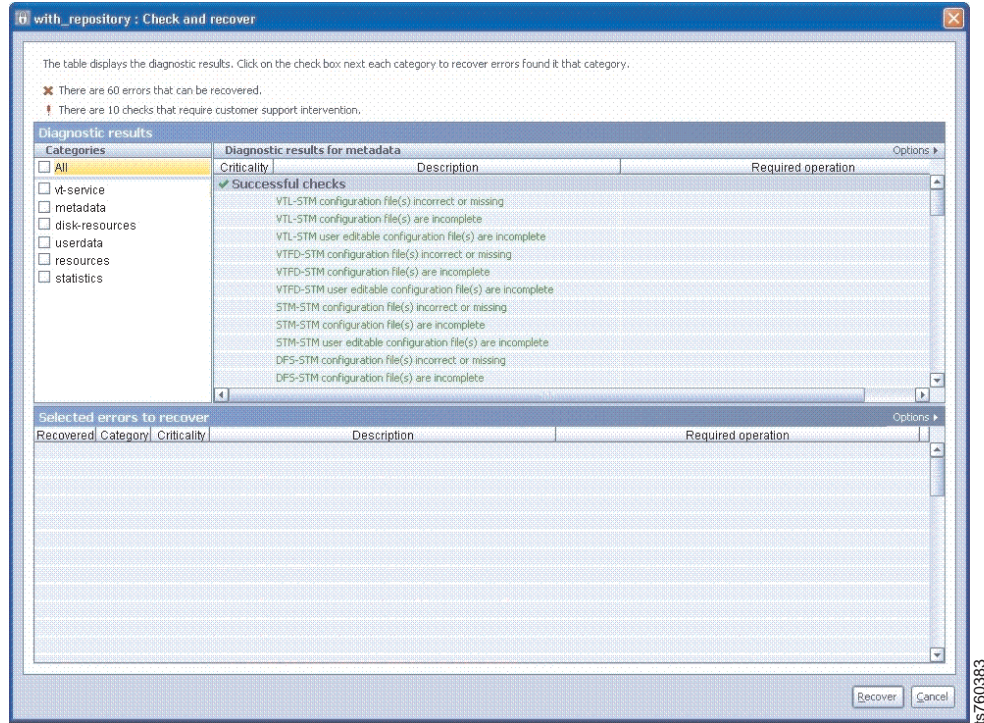


Figure 71. Check and recover dialog

## Results

The Diagnostic results pane displays each element of the ProtecTIER system in one of the following lists:

- **Positive checks** - no errors.
- **ProtecTIER recoverable errors** - has errors that the ProtecTIER system might be able to repair.
- **Support required errors** - has errors that cannot be repaired by the ProtecTIER system without the assistance of a trained ProtecTIER specialist.

In the **Category** subpane, filter the list contents by selecting individual categories.

Categories that contain errors of the type **ProtecTIER recoverable errors** feature an empty check box.

## Repairing the system

### About this task

If the checking process discovers errors of the type ProtecTIER recoverable errors, attempt to repair the errors using ProtecTIER Manager.

**Attention:** Make sure to allot sufficient down-time for system recovery. The recovery process is time-consuming and the ProtecTIER system goes offline for the duration of that process.



## Procedure

1. In the **Categories** sub-pane, select the checkbox for each category for which you want to repair errors. All list items of the type **ProtectTIER recoverable errors** in each selected category appear in the **Selected errors to recover** pane and are labeled with a red X.
2. Click **Recover**. ProtecTIER Manager attempts to repair the errors. Errors that are successfully repaired are labeled with a green checkmark. Errors that cannot be repaired remain labeled with a red X.

**Note:** For assistance with errors that cannot be repaired, contact a trained ProtecTIER specialist.



---

## **Part 4. System Recovery**

This part of the guide describes system recovery procedures for the TS7610 or TS7620 Appliance Express.



---

## Chapter 15. ProtecTIER system recovery procedures

The topics in this section provide instructions for recovering a ProtecTIER server. This procedure should be used for node replacement with the same server model in a Disaster Recovery scenario.

If you want to perform a node replacement and the server model of the new node is different from the server being replaced, contact IBM. This replacement must be ordered as an RPQ.

The recovery process described in these topics define the customer responsibilities and includes the following procedures:

1. Preparing to reload a node
2. Installing the Red Hat Enterprise Linux Advanced Platform operating system v5.6
3. Installing the ProtecTIER code v3.3
4. Recovering the TS7610 or TS7620 Appliance Express server
5. Activating ProtecTIER Replication Manager (if the Replication Manager was originally installed on the designated server before node replacement)
6. Backing up the configuration files
7. Analyzing and restoring the replication manager

---

### Preparing to reload a node

Complete this task to prepare to reload a node as part of the system recovery process.

#### About this task

To reload a node, you must first install the Red Hat Enterprise Linux Server release 5.6. If this is a standalone server that is being recovered, proceed to “Installing Red Hat Linux version 5.6 and ProtecTIER version 3.3.6.1.”

If the node you are recovering is still running, perform the following steps to prepare to reload the node:

#### Procedure

1. If a KVM is installed in the rack unit and a connection exists to the node to be recovered, press the <PrtSc> key and select the node from the list. -OR- If a KVM is not installed in the rack, attach a graphics capable monitor and a USB keyboard to the server to be reloaded.
2. Proceed to “Installing Red Hat Linux version 5.6 and ProtecTIER version 3.3.6.1.”

---

### Installing Red Hat Linux version 5.6 and ProtecTIER version 3.3.6.1

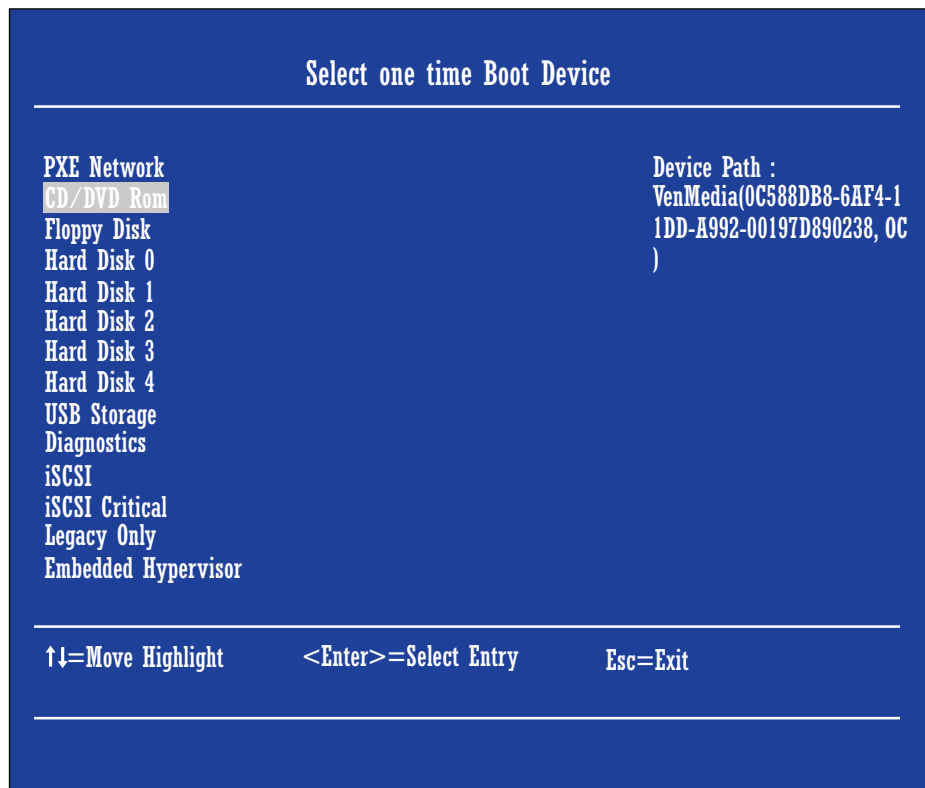
This task is part of the recovery process. Complete this task to install Red Hat Linux version 5.6 and ProtecTIER version 3.3.6.1 on the server that you are reloading.

## Procedure

1. Power on the server if it is not already powered on.
2. Insert the *IBM ProtecTIER Maintenance and Recovery Disk* into the DVD/CD-ROM drive on the server.



3. Reboot the server by entering in the following command at the command line: reboot.
  - a. To boot from the *IBM ProtecTIER Maintenance and Recovery Disk*, during the start-up sequence, press the **Delete** key when the IBM logo screen appears.
  - b. Select the CD/DVD ROM drive as the Boot Device. After the selection is made, it will boot from the specified device.



4. After a few minutes, the Red Hat Linux version 5.6 splash screen opens. At the text prompt at the bottom of the screen, there are options for **install** or **upgrade**.



5. Type **1** to select the **Install** option.
6. Type **yes** to confirm the installation and press Enter to view the license agreement.
7. Press **Enter** to read the next page, repeating until you reach the end of the license agreement.
8. When prompted to accept the software license agreement, type **yes** and press **Enter** to continue.
9. The installation begins. The installation takes approximately 30 minutes to complete.

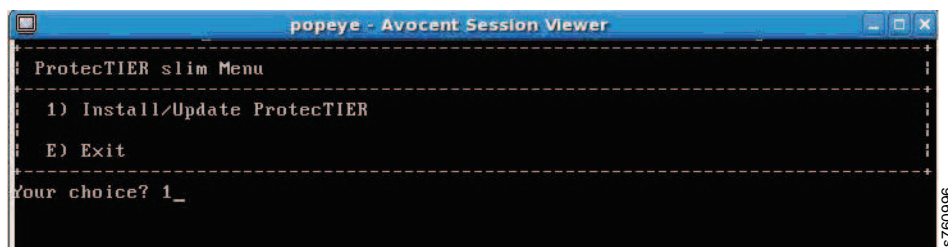


Figure 72. Red Hat Linux Installation Progress Screen

10. The server restarts automatically at the end of the installation process. Manually eject and remove the *IBM ProtecTIER Maintenance and Recovery Disk* from the DVD drive during the restart.

**Note:** If you do not remove the disk during the reboot cycle, it will attempt to boot to the Recovery DVD again, and as long as no option (1.install or 2.upgrade) is selected, it will time out and boot to the hard drives in the server that were just reloaded.

11. At the **login:** prompt, log in with the ID **ptconfig** and the password **ptconfig**.
12. The slim version of the ProtecTIER Service menu is displayed.



13. Type the number for the option to **Install/Update ProtecTIER** and press **Enter**.
14. The system displays the following message:  
Locating the CDRom device...done  
  
Place the ProtecTIER code disc in the DVD tray, close the tray and press <enter>.
15. Insert the DVD that contains the appropriate file for TS7620 or TS7610. For TS7620 use one of the following: for 6 TB use PT\_MD5\_TS7620\_6TB\_V3.3.0.0-full.x86\_64.tar, for 12 TB use PT\_MD5\_TS7620\_12TB\_V3.3.0.0-



full.x86\_64.tar, for 23 TB use PT\_MD5\_TS7620\_23TB\_V3.3.0.0-  
full.x86\_64.tar, for 35 TB use PT\_MD5\_TS7620\_35TB\_V3.3.0.0-  
full.x86\_64.tar. For TS7610 use PT\_TS7610\_Medium\_V3.3.x.x.x86\_64.tar.  
After the DVD is loaded for whatever configuration is being reloaded into the  
server CD/DVD drive press **Enter**. The system displays the following  
message:

```
Mounting... done  
Extracting the code package...
```

16. Press **Enter**. The system shows the following message:

```
Copying files...  
Copied.... 100% Done  
Please remove the disc from the drive, and press <enter> to continue.
```

**Note:** This process will take about 7 minutes to complete. The progress is  
displayed until it reaches 100%, as shown in the example message.

17. After the operation is done, follow the instructions and remove the disk from  
the CD/DVD-ROM drive.
18. Press **Enter** to continue. The ProtecTIER code installation begins.
19. When the ProtecTIER installation is complete. You are prompted to restart the  
server. Press **Enter** to restart.
20. When the reboot completes, the login: prompt is shown. Verify the Microcode  
version on the server by using the ProtecTIER Service menu.
- a. At the **login:** prompt, log in with the ID **ptconfig** and the password  
**ptconfig**.
- b. The ProtecTIER Service menu is displayed:

```
-----  
ProtectTIER Service Menu running on rassmx  
-----  
1) ProtecTIER Configuration (...)  
2) Manage ProtecTIER services (...)  
3) Health Monitoring (...)  
4) Problem Alerting (...)  
5) Version Information (...)  
6) Generate a service report  
7) Generate a system view  
8) Update ProtecTIER code  
  
E) Exit  
-----  
>>> Your choice?
```

- c. From the main menu, select **Version information**.
- d. The **Version information** menu is displayed.

```
-----  
ProtectTIER Service Menu running on rassmx  
Version Information (...)  
-----  
1) Display version information  
2) Display Machine Reported Product Data (MRPD)  
3) Display Firmware Versions  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

- e. Select **Display version information**. The ProtecTIER version is shown in  
the first line of output, in the first three digits after the colon. The version  
information looks similar to the following message:

PT version : 3.3.6

If the ProtecTIER version is correct, continue to the next step. If the ProtecTIER version is incorrect, the installation has failed. Contact IBM Support for assistance.

## Results

The re-installation process for Red Hat Linux version 5.6 and ProtecTIER version 3.3.6.1 is complete. Proceed to “Recovering the configuration of a replaced server.”

---

## Recovering the configuration of a replaced server

Complete this task to recover the configuration of a replaced server as part of the recovery process.

### Procedure

1. After the system boots up from installing the ProtecTIER package, type **ptconfig** at the login as: prompt and **ptconfig** at the **password:** prompt. The ProtecTIER Service Menu is displayed:

```
-----  
ProtecTIER Service Menu running on rassmx  
-----  
1) ProtecTIER Configuration (...)  
2) Manage ProtecTIER services (...)  
3) Health Monitoring (...)  
4) Problem Alerting (...)  
5) Version Information (...)  
6) Generate a service report  
7) Generate a system view  
8) Update ProtecTIER code  
  
E) Exit  
-----  
>>> Your choice?
```

2. From the ProtecTIER Service Menu, select **ProtectTIER Configuration (...)**. Type the corresponding number and press **<Enter>**. The **ProtectTIER Configuration (...)** menu is displayed:

```
-----  
ProtectTIER Service Menu running on rassmx  
ProtectTIER Configuration (...)  
-----
```

- 1) Configure ProtectTIER node
  - 2) Recover Configuration for a replaced server
  - 3) Configure enclosure serial number for a replaced enclosure
  - 4) Update Time, Date, Timezone & Timeserver(s)
  - 5) Configure replication (...)
  - 6) IP Network configuration (...)
  - 7) Update Firmware
  - 8) Update the System's name
  - 9) Validate configuration
  - 10) Single node - code upgrade (For Support Use ONLY)
- B) Back  
E) Exit

```
-----  
>>> Your choice?
```

3. Select the **Recover Configuration for a replaced server** option. Type the corresponding number and press **<Enter>**.

The server type and application are automatically detected where **Application** is **OST\_1G** if replacing a server in an OpenStorage environment, **VTL** if replacing a VTL server, or **FSI\_1G** if replacing a server in an FSI environment.

4. On a TS7610 and TS7620 Appliance Express, the ProtectTIER configuration command set that is entered next is dependant on the amount of cache that is connected to the server.

Choose the model. Type the corresponding number and press **<Enter>**.

The following sample output is displayed:

```
Your choice? 2  
Begin Processing Procedure  
  
About to execute:  
Operation:  replace  
Model:      TS76200_23TB  
Application: VTL  
  
Continue? (yes|no) yes  
This will stop the VTFD service.  Do you wish to continue? (yes|no)
```

5. Type **yes** to continue.

**Note:** When prompted to select the node to be replaced, enter the proper node option number. Only the valid options for replacement are displayed. Meaning, the system will identify the components installed, and make a determination of the model you are trying to recover.

6. Type **yes**.
7. The procedure will prompt you to enter the option of the server you are recovering. Enter the option number and press **<Enter>**.
8. Press **<Enter>** to continue. The replacement procedure will restore the configuration files from the server's repository, and this will take several minutes to complete.
9. Once the information has been provided, proceed to "Activating ProtectTIER Replication Manager" on page 205.

---

## Activating, analyzing and restoring ProtecTIER Replication Manager

This section describes the procedure for activating, analyzing and restoring an inactive or "lost" ProtecTIER Replication Manager server using ProtecTIER Manager.

The ProtecTIER Replication Manager restore procedure is done grid by grid and can be done in either of the following ways:

- Using an existing backup file:  
PtReplicationManager\_<hostName>\_<customerName>\_time\_ConfigurationBackup.zip
- Using an accessible repository that was once a member of a grid.

**Important:** Use the most updated file determined by the newest **time** value.

Go on to "Activating ProtecTIER Replication Manager" on page 205.

### Backing up the configuration files

The ProtecTIER Replication Manager configuration files are automatically backed up and saved by default. However, you can choose to cancel the automatic configuration file backups and perform the operation manually. The following task explains how to manually back up the Replication Manager configuration files.

#### About this task

Backups of the configuration files from ProtecTIER Replication Manager are saved as a .zip file.

Automatic backups can be cancelled by deselecting the **Backup configuration files** checkbox found on the **Backup** tab under the **Tools > Preferences** window in the **Grids Management** view.

From the Preferences window, you can also specify the number of backup files to save (the default is 20). The backup is done by rotation on the saved files. For instance, the backup files are named consecutively from gm\_backup.0 to gm\_backup.20. When a new backup is generated, gm\_backup.0 is renamed to gm\_backup.1 and the new backup is saved as gm\_backup.0. This continues until the backups reach the total number saved and the old backups are deleted.

To manually back up the configuration files:

#### Procedure

1. From the Grids Management view, select **Replication Manager > Backup configuration files**. The **Backup configuration files** dialog is displayed.
2. Enter the customer name in the **Customer name** field for which to provide backup information and click **Ok**. A message is displayed that the backup .zip file was saved on the ProtecTIER Replication Manager server in the /tmp directory.
3. Click **Yes** if you want to download the backup file to a specific directory or **No** to close the window.
4. If **Yes**, browse to the directory in which you want to save the backup configuration file and click **Save**. The file is saved to the respective directory and the **Save** window closes.

---

## Activating ProtecTIER Replication Manager

Use this procedure to reactivate the ProtecTIER Replication Manager application on a replaced server in your replication grid in a disaster recovery scenario. This procedure should only be used if the Replication Manager was originally installed on the designated server before node replacement and if there is no Replication Manager running on any other node in the replication grid.

### About this task

The Replication Manager should be activated on the server that remotely manages the replication grid or grids within an organization. IBM recommends activating the ProtecTIER Replication Manager on the target server at the remote (destination) site. By doing so, the Replication Manager remains available in a disaster recovery situation.

This task might be completed at any time during the replication configuration process. However, creation of the replication grid and verification of the replication configuration, cannot take place until ProtecTIER Replication Manager is up and running on the designated server.

### Procedure

1. If it is not already displayed, access the ProtecTIER System menu on the designated ProtecTIER Replication Manager server.
2. From the main menu, select **ProtecTIER Configuration (...)**. Type the corresponding number and press **<Enter>**. The **ProtecTIER Configuration (...)** menu is displayed.

```
-----  
ProtecTIER Service Menu running on rassmx  
ProtecTIER Configuration (...)  
-----  
1) Configure ProtecTIER node  
2) Recover Configuration for a replaced server  
3) Configure enclosure serial number for a replaced enclosure  
4) Update Time, Date, Timezone & Timeserver(s)  
5) Configure replication (...)  
6) IP Network configuration (...)  
7) Update Firmware  
8) Update the System's name  
9) Validate configuration  
10) Single node - code upgrade (For Support Use ONLY)  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

3. Select **Configure replication (...)** . Type the corresponding number and press **<Enter>**. The **Configure replication (...)** menu is displayed.

```
-----
ProtectTIER Service Menu running on rassmx
ProtectTIER Configuration (...)
Configure Replication (...)
-----

1) Configure/Unconfigure ProtectTIER Replication Manager on this node
2) Configure Static Routes

B) Back
E) Exit
-----
>>> Your choice?
```

4. Select **Configure/Unconfigure ProtectTIER Replication Manager on this node**. Type the corresponding number and press **<Enter>**.
5. When the **Replication Manager is currently deactivated, do you wish to activate it? (yes|no)** prompt displays, type: **yes <Enter>**.  
The system displays the following warning displays:  
Warning: You should not activate Replication Manager on more than one server in a grid, as doing so may cause conflicts within the grid. It is recommended that you designate the Target server (Hub) as the Replication Manager.
6. When the **Are you sure you want to activate the ProtectTIER Replication Manager on this node? (yes|no)** prompt displays, type: **yes <Enter>**.  
The system displays the following message:  
Gathering information [ Done ]  
The "activatePTReplicationManager ended successfully" message displays.
7. When the **Press the ENTER key to continue...** prompt displays, press **<Enter>**. You are returned to the **Configure replication (...)** menu.
8. Type **E** and press **<Enter>** to exit.
9. After activating ProtectTIER Replication Manager, you must restore the replication grid using the **Restore grid** procedure. Go on to "Restoring the ProtectTIER Replication Manager."

---

## Restoring the ProtectTIER Replication Manager

The following tasks describe the different methods for restoring the processed grid using the **Restore grid** procedure.

The ProtectTIER Replication Manager server automatically handles *grid analysis*. Grid analysis validates and checks the integrity of the grid in relation to its grid members. To begin restoring a grid, import a grid for analysis by selecting one of the tabs appearing on the **Restore grid** window:

- File (see "The File tab")
- IP Address (see "The IP Address tab" on page 207)

### The File tab

The following task describes how to restore the Replication Manager from the **File** tab.

## About this task

If you are restoring a grid from a backup .zip file, follow the steps below to import a grid for analysis and restore:

### Procedure

1. Select the **Restore grid** option from the **Replication Manager** menu. The **Restore grid** dialog is displayed.
2. Select the **File** tab.
3. Browse to the backup filename from which you want to analyze and restore the grid, or enter a filename in the **Backup .ZIP file name** field.
4. Click **Read file**.
5. Select a grid to analyze from the dropdown list. The grid analysis is displayed.
6. Click **Restore**. The current grid is restored and removed from the grid analysis list.
7. Select the next grid for analysis from the dropdown list. Continue restoring, grid by grid, until the entire Replication Manager is restored.

## What to do next

If there are inconsistencies and ProtecTIER Replication Manager does not recognize the repository as part of the grid, proceed with “Forcing a repository to leave a grid” on page 208.

If the **Restore grid** procedure was successfully completed, proceed to “Working with ProtecTIER Replication Manager” on page 89.

## The IP Address tab

The following task describes how to restore a grid from the Replication IP address of a repository from the **IP Address** tab.

### About this task

If you search for a backup file and cannot find one, then you can restore a grid on which the repository was previously a member. With a given replication IP address, the analysis phase is done with the respective repository's grid data in relation to the other grid members.

Follow the steps below to import a grid for analysis and restore:

### Procedure

1. Select the **Restore grid** option from the **Replication Manager** menu. The **Restore grid** dialog is displayed.
2. Select the **IP Address** tab.
3. Enter the **Replication IP address** of the accessible repository that was previously a member of the grid.
4. Click **Analyze grid**. The grid analysis is displayed.
5. Click **Restore**. The current grid is restored.

## What to do next

If there are inconsistencies and ProtecTIER Replication Manager does not recognize the repository as part of the grid, proceed with “Forcing a repository to leave a grid.”

If the **Restore grid** procedure was successfully completed, proceed to “Working with ProtecTIER Replication Manager” on page 89.

---

## Forcing a repository to leave a grid

Complete this task to force a repository to leave a grid.

### About this task

**Important:** Do not perform this procedure without instruction from a trained ProtecTIER specialist.

**Note:** A repository can be removed from a replication grid without the "cooperation" of the repository. However, it is preferable to remove a repository from a grid with coordination between the two. A temporary network disconnection between the replication manager and the repository is not enough reason for forcing a repository from a grid.

Force a repository to leave a grid **only** if the repository has been destroyed and should not be part of the grid or is inconsistent with the grid. This situation might arise if the Replication Manager was permanently destroyed, or if the repository was removed from the grid without coordination due to temporary network disconnection.

For example, if the Replication Manager was installed on a Target repository which was destroyed, the replication grid can be restored from a Source repository that was a member of the now destroyed grid. After restore, the repository "thinks" it is part of the grid, but the Replication Manager might not recognize the repository as part of the grid. The repository will, therefore, be marked as *inconsistent* and must be forcibly removed from the replication grid via the Grids Management view.

### Procedure

From the Grids Management view, select **Repository > Uncoordinated repository removal** to forcibly remove a repository from a grid.

**Note:**

If this procedure is being performed in a Disaster Recovery (DR) mode scenario, the repository can be forcibly removed from the grid from the Systems Management view. Select **Replication > Uncoordinated repository removal from grid**.

For more information, see Chapter 11, “Disaster recovery (DR) mode operations,” on page 143.

## What to do next

Once the repository has been removed from the replication grid, add the new repository to the replication grid. Go to “Adding a repository to a replication grid” on page 92



on page 92 and “Replacing a destroyed VTL repository ” on page 146.



---

## Chapter 16. Call Home

IBM recommends that you enable the Call Home feature on each of your ProtecTIER servers. Doing so speeds-up problem determination and fault resolution of hardware-related issues. When enabled on the TS7610 and TS7620 Appliance Express, Call Home uses a connection on your Ethernet network to transmit hardware-specific problem reports to IBM. For detailed instructions on enabling Call Home on your TS7610 and TS7620 Appliance Express servers, see *IBM TS7610 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, OpenStorage, and FSI Systems, v3.3, GA32-0914* or *IBM TS7620 ProtecTIER Deduplication Appliance Express Installation and Setup Guide for VTL, and OpenStorage Systems, v3.3, GA32-0914*.

When the Reliability, Availability, and Serviceability (RAS) software on the TS7610 or TS7620 servers detect an error condition on a hardware component, Call Home sends detailed error information to IBM (home). If the error indicates a problem with a field replaceable unit (FRU), and IBM Remote Service Representative and an IBM Service Representative can then prepare an action plan to handle the problem before traveling to your site.

The TS7610 and TS7620 Appliance Express provide three Call Home capabilities: Problem Call Home, Heartbeat Call Home, and Test Call Home; described below. RAS sends data files that may be helpful to IBM Support Center personnel for all three types of Call Home. These data files include error logs and configuration information, such as the Machine Reported Product Data (MRPD) log.

### Test Call Home

After enabling the Call Home feature, you can send a Test Call Home to ensure that the setup is correct and that the TS7610 and TS7620 can successfully open a Problem Management Record (PMR) in the IBM Remote Technical Assistance Information Network (RETAIN).

**Note:** The Call Home test can take up to 10 minutes to complete. While the test is in progress, the **Testing Call Home** dialog box displays. When the test completes successfully, the **Call Home test succeeded** dialog box displays.

### Problem Call Home

When RAS detects a problem, RAS initiates a Call Home operation to create a PMR in RETAIN. The PMR is a single page of text data that enables the Support Center or the Service Representative to access an action plan and a list of applicable FRU components.

### Heartbeat Call Home


To ensure proper ongoing Call Home functionality, the system sends a Heartbeat Call Home on a regularly-scheduled basis. The heartbeat interval is user-defined.

---

# Using the ProtecTIER Manager Configuration menu to enable IBM Call Home

## About this task


Use these procedures to enable IBM Call Home using the Configuration menu:

 Typically, hardware faults are reported in ProtecTIER Manager. However, certain conditions can keep ProtecTIER Manager from communicating with the server, and prevent the reporting of fault information for the failed component. By enabling SNMP traps, email alerts, and IBM Call Home, you have greater assurance that hardware faults, including exceeded thresholds and software alerts, do not go undetected.

## Accessing the Configuration menu

### Procedure


1. If it is not already running, launch ProtecTIER Manager and log in to your TS7610 Appliance Express system. Refer to “Logging in and out of the ProtecTIER Manager application” on page 29 for instructions, and then return to this page and go on to step 2. To access and use the menu, you must be logged in as **ptadmin/ptadmin**.
2. In the **ProtecTIER Manager** window, verify that the **Systems Management** heading (as opposed to **Grids Management**) displays at the top of the left-side navigation pane. :

 If the **Grids Management** heading is displayed, go to the bottom of the navigation pane and select **Systems Management** to switch management modes.

3. Open the **ProtecTIER Manager Configuration menu**. From the menu bar at the top of the **ProtecTIER Manager** window, click: **System > Configuration**. The **Configuration menu** displays with the **Registration** option selected in the navigation pane, and the **Registration** window open. ).
4. Continue to “Enable Call Home.”

## Enable Call Home

### Before you begin

 Before you enable Call Home, make sure that ports 80 and 443 in your firewall (if one is in use) are configured to allow outgoing traffic. If ports 80 and 443 are blocked, Call Home cannot transmit hardware-specific problem reports to IBM. This causes the test in step 3 on page 213 to return an error, and Call Home enablement to fail.

### Procedure

1. From the navigation pane, select the **Call Home** option.  
The **Call Home** window opens, with the **Enable Call Home** check box cleared, as shown in Figure 73 on page 213:

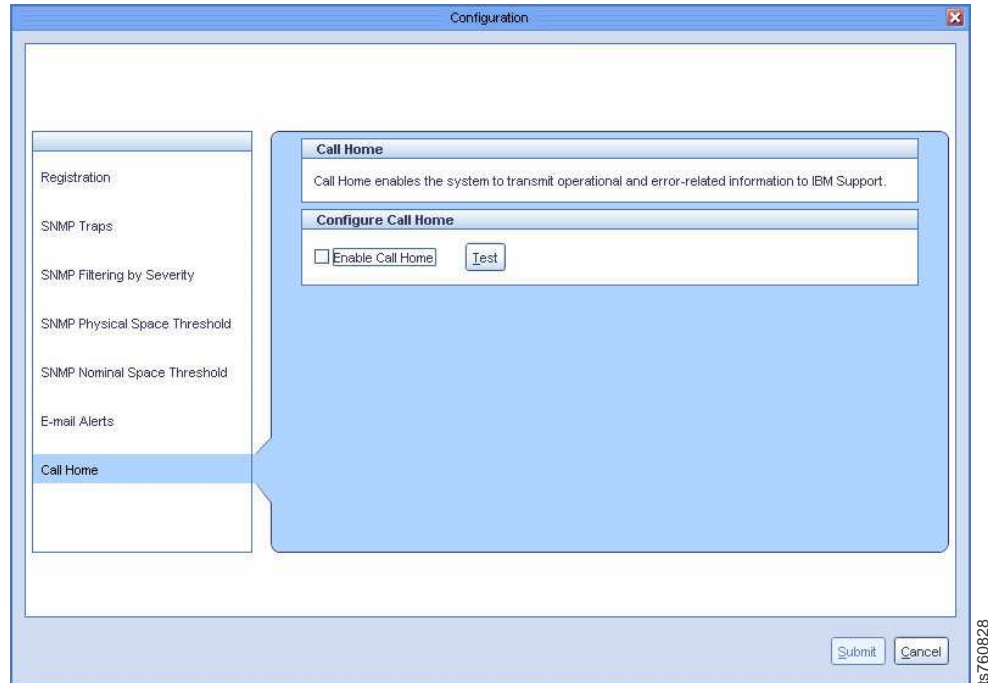


Figure 73. Call Home



If you did not enter a Country Code and Customer Number in the **Registration** window, warning notifications display at the top of the **Call Home** window. To remedy this situation, return to the **Registration** window and enter the missing information, and then continue to step 2.

2. Read the information provided in the **Call Home** pane to determine whether you want to use Call Home.
  - If you **do not** want to use Call Home, leave the **Enable Call Home** check box clear, and go on to "Starting the configuration process" on page 214.
  - If you **do** want to use Call Home, select the **Enable Call Home** check box, and then go on to step 3.
3. Click **Test** to verify that Call Home is configured correctly.

**Note:** The Call Home test can take up to 10 minutes to complete. While the test is in progress, the **Testing Call Home** dialog box displays.

4. Proceed accordingly, based on the outcome of the test:
  - If the **Call Home Test** dialog box (shown in Figure 74 on page 214) opens, the Call Home configuration is correct.

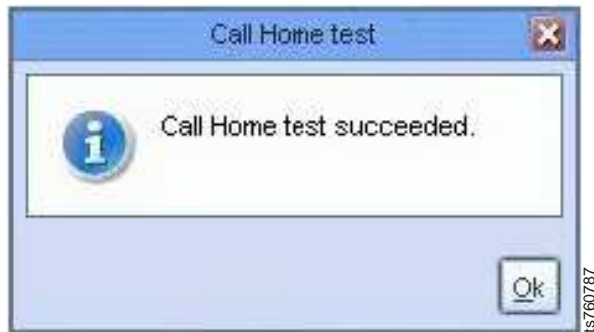


Figure 74. Call Home test succeeded


- a. Click **Ok** to close the **Call Home Test** dialog box and return to the **ProtectTIER Manager Configuration** menu window.
- b. Go on to “Starting the configuration process.”
- If an error message displays, the Call Home configuration is incorrect.
  - a. Resolve the problem that caused the error.
  - b. Repeat steps 3 on page 213 and 4 on page 213:
    - If the **Call Home Test Succeeded** dialog box (see Figure 74) opens, you resolved the problem.
      - 1) Click **Ok** to dismiss the dialog box.
      - 2) Go on to “Starting the configuration process.”
    - If you receive the same (or a different) error message, contact IBM for assistance. Refer to “Getting information, help, and service” on page xx, for guidelines and instructions.

## Starting the configuration process

### About this task

When you have finished with the menu, you can initiate the configuration process.

### Procedure


1. At the bottom of the active window, click **Submit**.  
The system configuration process begins. Configuration can take a few minutes to complete.
  -  During processing, you are unable to use ProtectTIER Manager to access the system being configured. However, by selecting **Run in Background**, you can access other systems while configuration is in progress.
2. The processing window closes when configuration is complete.

---

## Enabling or disabling Call Home from the Service Menu

Use the Service Menu to enable or disable the server's ability to place a Call Home call and alert IBM if a system problem occurs.

### About this task

-  If this is the first time Call Home is being enabled on the server, **you must** do so using the Configuration menu. See “Using the ProtectTIER Manager Configuration menu to enable IBM Call Home” on page 212.

## Accessing the Service Menu

### Procedure

1. If necessary, power-on the server and the monitor, and wait for the login prompt to display.
2. At the **login** prompt, type: **ptconfig** and press **<enter>**.
3. At the **Password** prompt, type: **ptconfig** and press **<enter>**  
The **Service Menu** displays.
4. Go to “Enabling Call Home” or “Disabling Call Home” on page 216.

## Enabling Call Home

### About this task

Use the procedure below to enable Call Home functionality.

### Procedure

1. On the **Service Menu**, select **Enable/Disable Call Home**. Type the corresponding number and press **<enter>**.  
The following messages, display:  
Getting Call Home state [ Done ]  
Call Home successfully set.
2. When the Call Home is currently Disabled, do you wish to enable it? (yes|no) prompt displays, type: **y <enter>**.  
The Configuring Call Home [ Done ] message displays.
3. When the Press the ENTER key to continue... message displays, press **<enter>**. You are returned to the **Service Menu**.
4. Select **Problem Alerting**.  
The system **Problem Alerting** contains the following options:
  - Enable/Disable Call Home - depending on your current Call Home state, select this option to either enable or disable Call Home
  - Send a Test Call Home
  - Configure Call Home Heartbeat frequency - sets how often the Call Home communication path is checked
  - Send a Heartbeat Call Home - this option checks the Call Home communication path
  - Enable/Disable Notification by email - depending on your current Notification by email state, select this option to either enable or disable Notification by email
  - Test Email Notification - sends a test email to verify email address
  - Activate Call Home Polling Function

```
-----  
ProtecTIER Service Menu running on rassmx  
Problem Alerting (...)  
-----  
1) Enable/Disable Call Home  
2) Send a Test Call Home  
3) Configure Call Home Heartbeat frequency  
4) Send a Heartbeat Call Home  
5) Enable/Disable Notification by email  
6) Test Email Notification  
7) Activate Call Home Polling Function  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

- 5. To exit the **Problem Alerting** menu, type: **E <enter>**.  
You are then returned to the server command prompt.

### **Disabling Call Home**

#### **About this task**

Use the procedure below to disable Call Home functionality.

#### **Procedure**

1. Access the Service Menu.
2. Select the **Enable/Disable Call Home** option, as described in step 1 on page 215, above.
3. When the Call Home is currently Disabled, do you wish to enable it? (yes|no) prompt displays, type: **y <enter>**.  
The Configuring Call Home [ Done ] message displays.
4. When the Press the ENTER key to continue... message displays, press **<enter>**. You are returned to the **Service Menu**.



---

## Part 5. Appendixes




---

## Appendix A. Verifying your replication configuration using the Replication Manager GUI

### About this task

This procedure describes how to use the Replication Manager GUI (installed on the ProtecTIER Manager workstation) to verify the success of the connection between one SOURCE server and the TARGET server. You can use this method to verify the single connection in a 1:1 configuration, or each SOURCE-to-TARGET connection in a many-to-one (2:1, 3:1, or 4:1) configuration.

Instructions for using ProtecTIER's Replication Network Performance Validation Utility (pt\_net\_perf\_util) are also provided as an alternative method of verifying your replication configuration. Use of this utility requires a higher level of technical expertise and familiarity with Linux. Note that in the pt\_net\_perf\_util instructions, the term "client" is used to indicate the SOURCE (Spoke) server in your replication configuration.

 The following procedure references the SOURCE server "Alexander" and the TARGET server "Idaho". These server names and their respective IP addresses are provided as *examples*, only. Your actual server names and IP address will differ.

### Procedure

1. Log into the PT Manager GUI, as described in "Logging in and out of the ProtecTIER Manager application" on page 29, return to this page, and go on to step 2.
2. In the left navigation pane, under the **Systems Management** heading, click the **Nodes** tab.
3. Click the name of the SOURCE server on which you configured replication, and then click **Login**.

*For example, click Idaho.*

The **Login to system** dialog box opens.

4. Login to the server:
  - If the **Username** and **Password** fields are already completed, click **Ok**, and go on to step 5.
  - Otherwise, do the following:
    - a. In the **Username** field, type: **ptadmin**.
    - b. In the **Password** field, type: **ptadmin**.
    - c. Click **Ok** and go on to step 5.
5. If the **Configuration Wizard** reminder dialog box displays, click **Ok** to dismiss the message and continue.
6. In the lower corner of the left-side navigation pane, click **Grids Management**. The display switches to **Grids Management** view and the **Add new ProtecTIER Grid Manager** dialog box opens. See Figure 75 on page 220.



Figure 75. Add new ProtecTIER Replication Manager

7. Click **Add**.

The **Add Replication Manager** dialog box opens. See Figure 76.

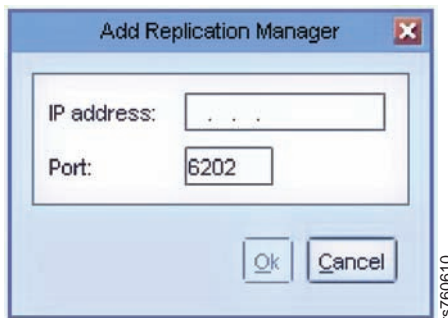


Figure 76. Add Replication Manager

8. In the **IP address** field, enter the local area network (LAN) IP address of the **TARGET (Hub)** server.

*For example, the LAN IP address for the TARGET server "Alexander" is: 9.11.201.56..*

9. Leave the **Port** field set to the default value.

10. Click **Ok**.

The **Login** dialog box opens.

11. Login to the **Replication Manager**:

- a. In the **Username** field, type: **gadmin**.

- b. In the **Password** field, type: **gadmin**.

12. Click **Ok**.

13. In the left-side navigation pane, click the **TARGET (Hub)** server.

*For example, click Alexander.*

The **Login to system** dialog box opens.

14. From the menu bar at the top of the window, click **Repository > Add Repository to Grid**.

15. When prompted, enter the IP address of one of the **SOURCE (Spoke)** server's replication ports. (Only one IP address is required.)

*For example, for the SOURCE server "Idaho", enter the replication IP address: 9.11.201.57..*

The **Login** dialog box opens.

16. Login to the server:

- a. In the **Username** field, type: **ptadmin**.

- b. In the **Password** field, type: **ptadmin**.

17. In the **Repositories** pane, right-click the repository of the SOURCE (Spoke) server.

18. Click **Connect Spoke to Hub**.

A diagram of your replication configuration displays, with arrows pointing from the SOURCE (Spoke) server to the TARGET (Hub) server.

For example, the grid configuration diagram for the SOURCE server Idaho, and the TARGET server Alexander, would look similar to the following:

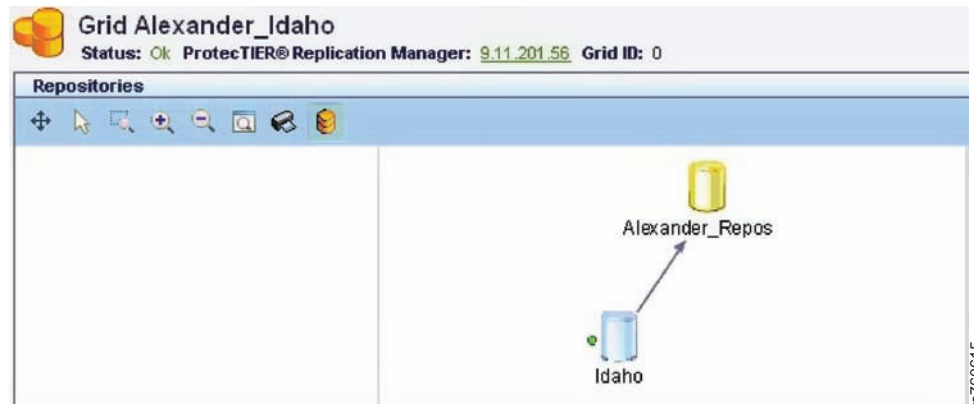


Figure 77. Replication Manager configuration grid diagram

19. Using the legend at the bottom of the window (see Figure 78, verify that the newly added system is online and correctly identified as a **Hub** (TARGET) or **non-Hub** (SOURCE (Spoke))).



Figure 78. Replication Manager legend

20. In the lower-right corner of the window, check for the presence of an exclamation point (!) on the **Replication Alerts** button:

- If no exclamation point exists, the replication configuration is problem-free.
- If an exclamation point is present, click the **Replication Alerts** button to view problem information.

Attempt to resolve the problem using the information provided in the **Alerts** window. For additional problem-resolution information, see Chapter 14, “Troubleshooting,” on page 179.

21. Proceed as appropriate:

- If you have only one SOURCE server and the TARGET server (in a 1:1 replication configuration), you can now define your replication policies and schedules. .
- If you have two, three, or four SOURCE servers (in a many-to-one replication configuration):
  - a. Repeat the procedures in Chapter 3, “Configuring replication,” on page 21 and Appendix A, “Verifying your replication configuration using the Replication Manager GUI,” on page 219, until you have configured and verified all of your SOURCE-to-TARGET combinations.
  - b. Define your replication policies and schedules. For more information, see “Creating a replication policy” on page 99.

---

## ProtectTIER Network Performance Validation Utility

The objective of the `pt_net_perf_util` is to test maximal network performance in order to discover potential performance bottlenecks. On VTL systems, the utility tests maximal replication performance between two future ProtectTIER VTL repositories by emulating the network usage patterns of the ProtectTIER Native Replication component. On OpenStorage systems, the utility tests network performance between an OpenStorage host and a ProtectTIER server to identify possible bottlenecks in a backup and restore scenario.

---

## ProtectTIER Replication Network Performance Validation Utility for VTL Systems

The objective of the VTL `pt_net_perf_util` utility is to test maximal replication performance between two future ProtectTIER VTL repositories by emulating the network usage patterns of the ProtectTIER Native Replication component. This utility can not predict replication performance, but it can discover performance bottlenecks.

### Before you begin

The requirements of this utility are as follows:

- Red Hat Linux version 5.6 or Red Hat Linux version 5.4
- Standard external utilities expected to be in the current path: ping, netstat, getopt, echo.

The `pt_net_perf_util` utility and the iperf tool are part of the ProtectTIER software installation. To test the replication performance, use the following tool:

- iperf 2.0.4  
`/usr/local/bin/iperf`

This utility has two modes of operation, client and server. The server has to be started before the client. Before running the utility, shut down all other programs on both the client and server ProtectTIER systems. The **client** is the ProtectTIER system that transmits the test data and the **server** is the ProtectTIER system that receives the data (also known as the **target** server). Based on the data sent by the client and received by the server, the script outputs key network parameter values which indicate certain attributes of the network. The goal of these tests is to benchmark the throughput of the network. The most important benchmark is the direction that replication actually takes place, that is, test the target as the server since the flow of data will be **to** that server from the client. However, it is also important to also test the reverse direction to measure the bandwidth performance during disaster recovery failback. Network bandwidth is not always the same in both directions.

Before you can run the utility you must configure the replication ports on both the source and destination servers and define static routes between them in both directions.

### About this task

In the following procedure, the goal is to test network performance between two machines on a WAN, **server1** and **server2**. Each test runs for five minutes. Since there are five tests, the process takes a total of 25 minutes.

Repeat these tests for each server and for each replication port on the server (two tests total per server, one for each replication port).

## Procedure

1. At the login prompt, log in with user name `ptconfig` and password `ptconfig`. Press Enter. On the command line, type `menu` and press Enter. The ProtecTIER Service Menu is displayed.

```
-----  
ProtecTIER Service Menu running on rassmx  
-----  
1) ProtecTIER Configuration (...)  
2) Manage ProtecTIER services (...)  
3) Health Monitoring (...)  
4) Problem Alerting (...)  
5) Version Information (...)  
6) Generate a service report  
7) Generate a system view  
8) Update ProtecTIER code  
  
E) Exit  
-----  
>>> Your choice?
```

2. Stop the VTFD services.
  - a. Select the option to **Manage ProtecTIER services**.
  - b. The **Manage ProtecTIER services** menu is displayed.

```
-----  
ProtecTIER Service Menu running on rassmx  
Manage ProtecTIER Services (...)  
-----  
1) Display services status  
2) Start all services  
3) Stop all services  
4) Stop ProtecTIER services only (including GFS)  
5) Stope VTFD service only (including GFS)  
6) Poweroff This Node  
7) Reboot This Node  
  
B) Back  
E) Exit  
-----  
>>> Your choice?
```

- c. Select the option to **Stop ProtecTIER services only (including GFS)**.

**Note:** You can also stop the VTFD services from the command line. From the command line on the server, type the following command and press Enter:

```
service vtfd stop
```

3. Wait for the services to stop. A message similar to the following displays:

```
Shutting down vtfd: [ OK ]
```

```
Please wait .....  
[root@austin ~]#
```

4. Start the server mode of the utility on **server1** by entering the following commands on the command line:

```
cd /opt/dtc/app/sbin  
./pt_net_perf_util -s
```

5. Start the client mode of the utility on **server2** by entering the following command on the command line:

```
cd /opt/dtc/app/sbin
./pt_net_perf_util -c <x.x.x.x> -t 300
```

Where <x.x.x.x> is the IP address of the server replication port.

6. The utility automatically performs the tests in sequence. The **client** output (**server2** in the example shown) looks similar to the following:

**Note:** In the sample output below the test ran for only 5 seconds instead of 300.

```
*** Latency
PING 9.5.53.33 (9.5.53.33) 56(84) bytes of data.

--- 9.5.53.33 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4001ms
rtt min/avg/max/mdev = 0.257/0.406/0.484/0.079 ms

*** Throughput - Default TCP
[ 3] 0.0- 5.0 sec 56.6 MBytes 94.8 Mbits/sec

*** Throughput - 1 TCP stream(s), 1MB send buffer
[ 3] 0.0- 5.0 sec 57.0 MBytes 95.0 Mbits/sec

*** Throughput - 16 TCP stream(s), 1MB send buffer
[SUM] 0.0- 5.8 sec 65.0 MBytes 94.3 Mbits/sec

*** Throughput - 127 TCP stream(s), 1MB send buffer
[SUM] 0.0-11.3 sec 127 MBytes 94.1 Mbits/sec

Number of TCP segments sent: 230536
Number of TCP retransmissions detected: 21 (0%)

Done.
```

See the next section for information about interpreting the results of the tests.

## Interpreting the results

The utility performs five foreground tests (Tests 1-5 below), and one background test (Test 6 below). The example outputs shown are from the client side. Each of the first five tests ran for 300 seconds (-t 300), while the last test monitored TCP performance during that time.

### Test 1: Latency

This test checks the nominal network link latency and packet loss. Example result:

```
*** Latency
PING 10.0.13.194 (10.0.13.194) 56(84) bytes of data.

--- 10.0.13.194 ping statistics ---
120 packets transmitted, 120 received, 0% packet loss, time 119060ms
rtt min/avg/max/mdev = 57.403/78.491/104.451/9.872 ms
```

Interpreting the results:

- The average round-trip-time (rtt) was 78.4 ms and there was 0% packet loss.
- The latency in WAN topologies can vary, but should never exceed 200 ms. Contact your network administrator if latency reports more than 200 ms, as it can significantly decrease replication throughput.
- Higher latency values can cause a major deterioration in replication throughput.
- Packet loss should be 0%. Any other value indicates a major network problem.



## Test 2: Throughput - default settings

This test checks maximal TCP throughput of a single data stream with default TCP settings. Example result:

```
*** Throughput - Default TCP
[ 3] 0.0-120.1 sec 2.41 GBytes 173 Mbits/sec
```

Interpreting the results:

- The test ran for 120.1 seconds, transferred 2.41 GB (2.24 GiB), with an average throughput of 173 Mbits/sec.

**Note:** 1 MByte = 1,048,576 bytes. 1 Mbit/sec = 1,000,000 bits/sec.

## Test 3: Throughput - single stream, 1 MB send buffer

This test checks maximal TCP throughput of a single data stream with a 1 MB (0.95 MiB) send buffer. Example result:

```
*** Throughput - 1 TCP stream(s), 1MB send buffer
[ 3] 0.0-120.0 sec 2.51 GBytes 180 Mbits/sec
```

Interpreting the results:

- The test ran for 120.0 seconds, transferred 2.51 GB (2.34 GiB), with an average throughput of 180 Mbits/sec.
- There might be an improvement here on high-latency links.

## Test 4: Throughput - 16 streams, 1 MB send buffer

Example result:

```
*** Throughput - 16 TCP stream(s), 1MB send buffer
[SUM] 0.0-121.4 sec 5.91 GBytes 418 Mbits/sec
```

Interpreting the results:

- The test ran for 121.4 seconds, transferred 5.91 GB (5.5 GiB), with an average throughput of 418 Mbits/sec.
- The extra streams yielded higher utilization of the connection.
- The Mbits/sec reported in this test is the maximum replication performance your system will achieve if you are using up to 2-3 cartridges in parallel.

## Test 5: Throughput - 127 streams, 1 MB send buffer

Example result:

```
*** Throughput - 127 TCP stream(s), 1MB send buffer
[SUM] 0.0-126.1 sec 8.08 GBytes 550 Mbits/sec
```

Interpreting the results:

- The test ran for 126.1 seconds, transferred 8.08 GB (7.53 GiB), with an average throughput of 550 Mbits/sec.
- TCP takes a while to reach its maximal throughput. Longer testing times, 300 seconds or more, produces more accurate results.
- The throughput value given by this test is the potential physical replication throughput for this system. It is directly affected by the available bandwidth, latency, packet loss, and retransmission rate.

- The Mbits/sec reported in this test is the maximum replication performance your system might achieve. If this number is lower than anticipated, contact your network administrator.

#### **Test 6: TCP Retransmissions versus Total TCP segments sent**

Example result:

```
Number of TCP segments sent: 1619061
Number of TCP retransmissions detected: 201038 (12%)
```

Interpreting the results:

- A total of 1619061 TCP segments were sent during the five tests, out of which, 201038 were lost and retransmitted.
- The retransmission rate imposes a direct penalty on the throughput, as the retransmission of these packets takes up bandwidth. The retransmission can be caused by the underlying network (for example, packet dropping by an overflowed router) or by the TCP layer itself (for example, retransmission due to packet reordering).
- Segment loss can be caused by each of the network layers.
- TCP retransmission larger than 2% can cause performance degradation and unstable network connectivity. Contact your network administrator to resolve this issue and reduce it to approximately 0%.

#### **What to do next**

You might want to run these tests again to test the reverse throughput in the network. To run the tests in reverse, change **server1** to the client and **server2** to the server and repeat the procedures.

---

## Appendix B. Planning for replication

Use the information in this appendix to plan your replication configuration.

### About this task

Here you will find overview information, guidelines, and planning tools, provided to help you understand the basic concepts of replication and assist you in the configuration process.

---

### Replication overview

This section provides a basic overview of replication configuration concepts and terminology.

Below is a list of points to keep in mind when planning for replication:

- Servers used for replication are designated as being either a SOURCE or a TARGET.
  - SOURCE servers are also referred to as Spokes.
  - TARGET servers are also referred to as Hubs.



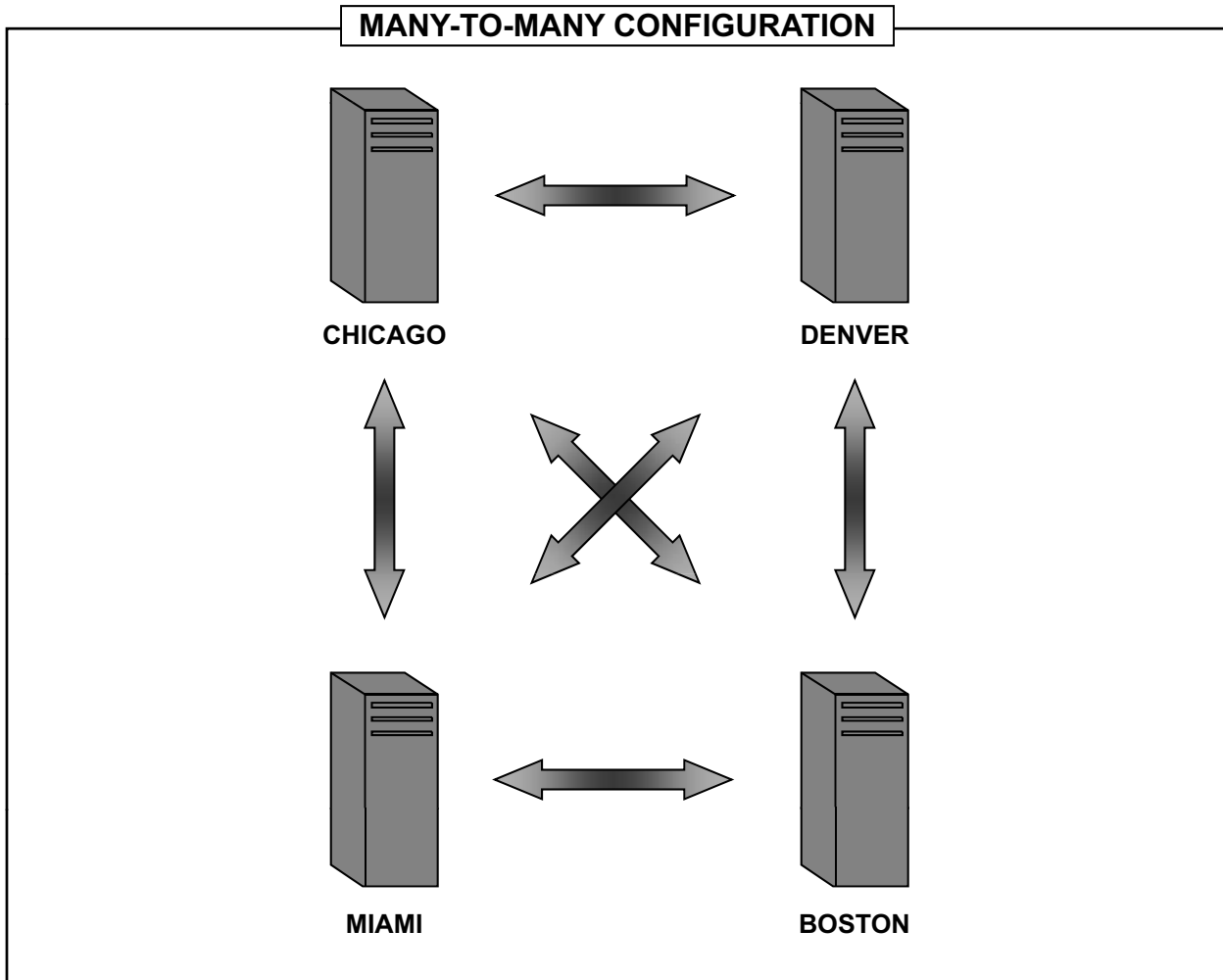
The terms SOURCE and SPOKE, and TARGET and HUB; are used interchangeably throughout the ProtecTIER graphical user interfaces (GUIs), command line prompts, and documentation.

- A replication configuration has only one TARGET server. All other servers in the configuration are SOURCE servers.
- The TS7610 or TS7620 Appliance Express supports configurations consisting of one TARGET server and *up to* four SOURCE servers.
- The SOURCE servers transmit an image of their data repository, file system configuration, and other system settings; to the TARGET server.
  - The SOURCE servers are used for day-to-day operations. They may be located in a single building or complex, or distributed among multiple “branch” offices or facilities.
  - The TARGET server resides in a remote location and is not used for daily transactions.
- All servers must be fully configured before they can be connected (via the Replication Manager application) to establish the replication network.
  - The replication network is also referred to as a grid.
- Once the grid, is established, the rules that determine how replication is performed can be established.
  - A set of replication rules is referred to as a policy.
- Once the policy is created, you can begin using replication.

The pages that follow further explain the above concepts, and illustrate the relationships among the SOURCE and TARGET servers. The M:1 examples and illustrations depict the maximum SOURCE-to-TARGET configuration (4:1):

## OVERVIEW

In an OpenStorage environment, each server that is configured for replication can replicate with up to three other servers. This type of replication configuration is called Many-to-Many. You use the ProtecTIER Replication Manager application to connect the servers to each other and define a replication grid. Multiple grids can be established, with a limit of four servers per grid.



The replication servers can reside in a single building or complex, or be distributed among multiple offices or facilities. They can exist in different parts of town, in different states, or even in different countries. As long as the servers are able to communicate over your Ethernet replication network, there is no restriction on proximity.

During replication, each server transmits an image of its data repository, file system configuration, and other system settings; to one or more servers in its grid. In the event of data corruption or a hardware failure, you can retrieve the stored image from one of the servers with which the affected server replicates, and restore the affected server to its previous configuration with minimal risk of data loss.

Figure 79. M:1 replication overview

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---

## Examples

Refer to the examples to learn what network settings information you will need to configure your **SOURCE** and **TARGET** servers.

The example sheets that follow indicate what information is required to configure the **SOURCE** (Spoke) and **TARGET** (Hub) servers in a M:1 configuration. The examples also explain how to determine what you are being prompted for as you complete the replication configuration options on the ProtectTIER Configuration Menu, and where to find the corresponding information.

# Examples

## M:1 Replication Setup NETWORK SETTINGS

Before you can configure the **SOURCE** and **TARGET** servers for replication, you must obtain the information shown below for **each** server's Replication Ports (ETH1 and ETH2). You will use this information as you use options on the **PT Configuration Menu** to configure the system for replication.

**Note:** The IP Address, Network Netmask, Gateway Address, and Hostname, values used below are for **example** only. The actual values for your **SOURCE** and **TARGET** servers will differ.

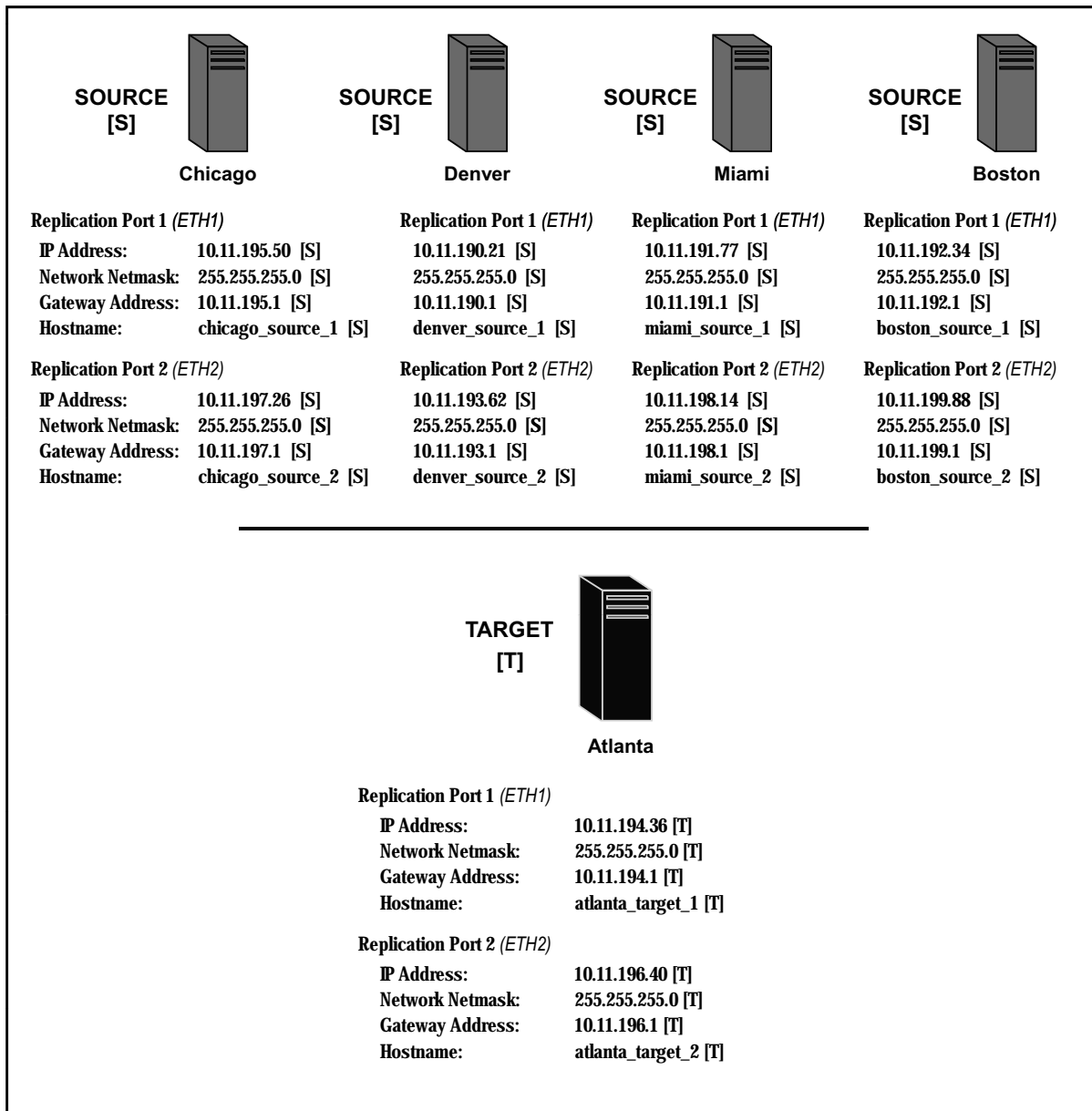


Figure 80. Network settings example

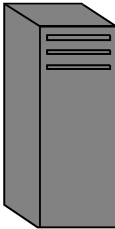
## M:1 Replication Setup

### UPDATE REPLICATION NETWORK

Using the **Update Replication Network** option, you will specify the network settings for the replication ports of your **SOURCE** servers by entering each server's IP Address, Network Netmask, Gateway Address, and Hostname in response to the option's prompts. You will complete this option on each **SOURCE** server at its respective location. You *will not* complete this option on the **TARGET** server.

The scenario below demonstrates how you would respond to the **Update Replication Network** prompts. The scenario contains **example** network settings for one **SOURCE** server. You would respond to the prompts in the same manner for each additional **SOURCE** server, substituting each server's unique network settings. Your actual responses to the prompts will differ.

**SOURCE**  
[S]



**Chicago**

**Replication Port 1 (ETH1)**  
IP Address: 10.11.195.50 [S]  
Network Netmask: 255.255.255.0 [S]  
Gateway Address: 10.11.195.1 [S]  
Hostname: chicago\_source\_1 [S]

**Replication Port 2 (ETH2)**  
IP Address: 10.11.197.26 [S]  
Network Netmask: 255.255.255.0 [S]  
Gateway Address: 10.11.197.1 [S]  
Hostname: chicago\_source\_2 [S]

**Update Replication Network** prompts and example responses for the **SOURCE** server, above:

```
Replication Port 1, IP Address: 10.11.195.50 [S]
Replication Port 1, Netmask: 255.255.255.0 [S]
Replication Port 1, Hostname:  chicago_source_1 [S]

Replication Port 2, IP Address: 10.11.197.26 [S]
Replication Port 2, Netmask: 255.255.255.0 [S]
Replication Port 2, Hostname:  chicago_source_2 [S]
```

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Figure 81. Update replication network example

## M:1 Replication Setup

### CONFIGURE STATIC ROUTES

Using the **Configure Static Routes** option, you will specify the path that the replicated data will follow during transmission between the **SOURCE** and **TARGET** servers. This path is called the **static route**.

**Important!** You must complete this option on each **SOURCE** server at its respective location, and on the **TARGET** server at its location.

**Tip:** In the **Configure Static Routes** prompts, the term “target” refers to the remote server’s Network Address and Netmask (not necessarily the replication **TARGET** server.) Also, you will be prompted to enter the Target Network Address, which represents the server’s starting network address. To determine the starting network address, simply replace the digits after the last (.) in the server’s IP Address, with a zero (0). For example: you would change the IP Address: 10.33.125.45 to: 10.33.125.0

The scenario below shows how you would respond to the **Configure Static Routes** prompts. The scenario contains example network settings for one **SOURCE** server and the **TARGET** server. You would respond to the prompts in the same manner for each additional **SOURCE** server, substituting each server’s unique network settings. Your actual responses to the prompts will differ.

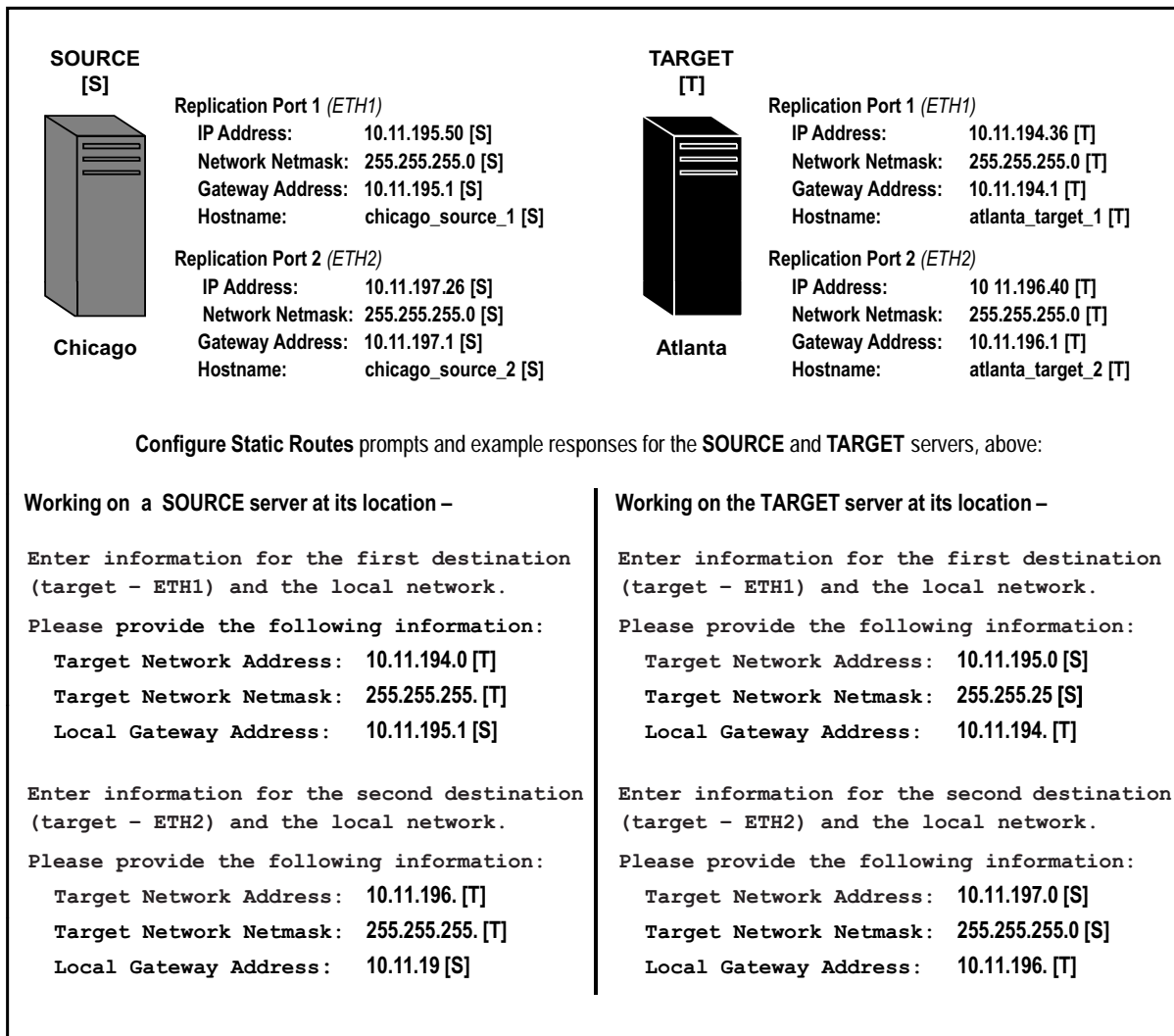



Figure 82. Configure static routes example



## Worksheets

Use the completed worksheets as a guide when responding to the menu prompts during M:1 replication configuration.

Complete the worksheets with the necessary information about your **SOURCE** (Spoke) and **TARGET** (Hub) servers. You will use the completed worksheets as a guide when responding to the system prompts during replication configuration.


 It is strongly recommended that the worksheets be filled out, in advance, by someone with extensive knowledge of your organization's network and TCP/IP configuration. This will ensure that the information is technically accurate and readily available during replication setup.

### M:1 Replication Setup

#### TARGET SERVER UPDATE REPLICATION NETWORK WORKSHEET

Use the blank spaces below to write in your **TARGET** server's **Server Name**; and the **IP Address**, **Network Netmask**, **Gateway Address**, and **Hostname** for your **TARGET** server's replication ports. You will use this information as you complete the **Update Replication Network** option on the **PT Configuration Menu**.

Refer to *Example 1. Network Settings*, for a reminder of the information required to complete this worksheet.

|                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>TARGET</b><br/>[T]</p> <br><hr/> <p>Server Name</p> | <p><b>My TARGET server's network settings –</b></p> <p><b>Replication Port 1 (ETH1)</b></p> <p><b>IP Address:</b> _____ [T]</p> <p><b>Network Netmask:</b> _____ [T]</p> <p><b>Gateway Address:</b> _____ [T]</p> <p><b>Hostname:</b> _____ [T]</p> <p><b>Replication Port 2 (ETH2)</b></p> <p><b>IP Address:</b> _____ [T]</p> <p><b>Network Netmask:</b> _____ [T]</p> <p><b>Gateway Address:</b> _____ [T]</p> <p><b>Hostname:</b> _____ [T]</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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Figure 83. Update replication network worksheet – TARGET

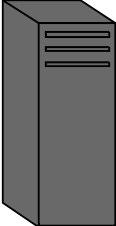
## M:1 Replication Setup

### SOURCE SERVER UPDATE REPLICATION NETWORK WORKSHEET

Use the blank spaces below to write in one **SOURCE** server's **Server Name**; and the **IP Address**, **Network Netmask**, **Gateway Address**, and **Hostname** of that server's replication ports. You will use this information as you complete the **Update Replication Network** option on the **PT Configuration Menu**.

**Tip:** Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

Refer to *Example 1. Network Settings*, for a reminder of the information required to complete this worksheet.

|                                                                                   |                                              |
|-----------------------------------------------------------------------------------|----------------------------------------------|
| <b>SOURCE</b><br>[S]                                                              | <b>My SOURCE server's network settings –</b> |
|  | <b>Replication Port 1 (ETH1)</b>             |
| <hr style="width: 150px; margin: 0 auto;"/>                                       | <b>IP Address:</b> _____ [S]                 |
| <b>Server Name</b>                                                                | <b>Network Netmask:</b> _____ [S]            |
|                                                                                   | <b>Gateway Address:</b> _____ [S]            |
|                                                                                   | <b>Hostname:</b> _____ [S]                   |
|                                                                                   | <b>Replication Port 2 (ETH2)</b>             |
|                                                                                   | <b>IP Address:</b> _____ [S]                 |
|                                                                                   | <b>Network Netmask:</b> _____ [S]            |
|                                                                                   | <b>Gateway Address:</b> _____ [S]            |
|                                                                                   | <b>Hostname:</b> _____ [S]                   |

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Figure 84. Update replication network worksheet – SOURCE 1



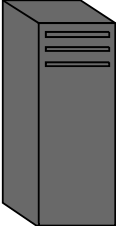
## M:1 Replication Setup

### SOURCE SERVER UPDATE REPLICATION NETWORK WORKSHEET

Use the blank spaces below to write in one **SOURCE** server's **Server Name**; and the **IP Address**, **Network Netmask**, **Gateway Address**, and **Hostname** of that server's replication ports. You will use this information as you complete the **Update Replication Network** option on the **PT Configuration Menu**.

**Tip:** Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

Refer to *Example 1. Network Settings*, for a reminder of the information required to complete this worksheet.

|                                                                                   |                                              |
|-----------------------------------------------------------------------------------|----------------------------------------------|
| <b>SOURCE</b><br>[S]                                                              | <b>My SOURCE server's network settings –</b> |
|  | <b>Replication Port 1 (ETH1)</b>             |
|                                                                                   | <b>IP Address:</b> _____ [S]                 |
|                                                                                   | <b>Network Netmask:</b> _____ [S]            |
|                                                                                   | <b>Gateway Address:</b> _____ [S]            |
|                                                                                   | <b>Hostname:</b> _____ [S]                   |
| <hr/> <b>Server Name</b>                                                          | <b>Replication Port 2 (ETH2)</b>             |
|                                                                                   | <b>IP Address:</b> _____ [S]                 |
|                                                                                   | <b>Network Netmask:</b> _____ [S]            |
|                                                                                   | <b>Gateway Address:</b> _____ [S]            |
|                                                                                   | <b>Hostname:</b> _____ [S]                   |

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Figure 86. Update replication network worksheet – SOURCE 3

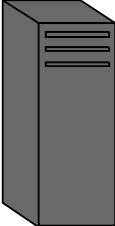
## M:1 Replication Setup

### SOURCE SERVER UPDATE REPLICATION NETWORK WORKSHEET

Use the blank spaces below to write in one **SOURCE** server's **Server Name**; and the **IP Address**, **Network Netmask**, **Gateway Address**, and **Hostname** of that server's replication ports. You will use this information as you complete the **Update Replication Network** option on the **PT Configuration Menu**.

**Tip:** Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

Refer to *Example 1. Network Settings*, for a reminder of the information required to complete this worksheet.

|                                                                                   |                                              |
|-----------------------------------------------------------------------------------|----------------------------------------------|
| <b>SOURCE</b><br>[S]                                                              | <b>My SOURCE server's network settings –</b> |
|  | <b>Replication Port 1 (ETH1)</b>             |
|                                                                                   | <b>IP Address:</b> _____ [S]                 |
|                                                                                   | <b>Network Netmask:</b> _____ [S]            |
|                                                                                   | <b>Gateway Address:</b> _____ [S]            |
|                                                                                   | <b>Hostname:</b> _____ [S]                   |
| <hr/> <b>Server Name</b>                                                          | <b>Replication Port 2 (ETH2)</b>             |
|                                                                                   | <b>IP Address:</b> _____ [S]                 |
|                                                                                   | <b>Network Netmask:</b> _____ [S]            |
|                                                                                   | <b>Gateway Address:</b> _____ [S]            |
|                                                                                   | <b>Hostname:</b> _____ [S]                   |

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Figure 87. Update replication network worksheet – SOURCE 4

## M:1 Replication Setup

### CONFIGURE STATIC ROUTES WORKSHEET

Use the blank spaces below to write in the information required to complete the **Configure Static Routes** option on the **PT Configuration Menu**.

**Important!** The **Configure Static Routes** option must be completed on each **SOURCE** server *and* on the **TARGET** server, at their respective locations.

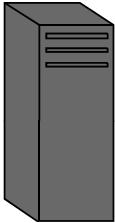
Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

**Tip:** In the prompts below, the term *Target Network Address* refers to the server's starting network address. To determine the starting network address, replace the digits after the last (.) in the server's IP Address, with a zero (0). See the related **Tip:** in *Example 3. Configure Static Routes* for more information.

Refer to your completed *Network Settings Worksheets* for the IP Address, Network Netmask, and Gateway Address, of the **SOURCE** and **TARGET** servers' replication ports.

**Working at a SOURCE server at its location –**

**SOURCE**  
[S]



Enter information for the first destination (target - ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

Enter information for the second destination (target - ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

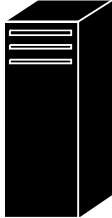
---

Server Name \_\_\_\_\_

**Working at the TARGET server at its location –**

**TARGET**  
[T]



Enter information for the first destination (target - ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

Enter information for the second destination (target - ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

---

Server Name \_\_\_\_\_

Figure 88. Configure static routes worksheet – SOURCE 1 and TARGET

## M:1 Replication Setup

### CONFIGURE STATIC ROUTES WORKSHEET

Use the blank spaces below to write in the information required to complete the **Configure Static Routes** option on the **PT Configuration Menu**.

**Important!** The **Configure Static Routes** option must be completed on each **SOURCE** server *and* on the **TARGET** server, at their respective locations.

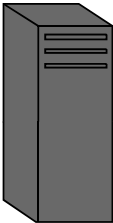
Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

**Tip:** In the prompts below, the term *Target Network Address* refers to the server's starting network address. To determine the starting network address, replace the digits after the last (.) in the server's IP Address, with a zero (0). See the related **Tip:** in *Example 3. Configure Static Routes* for more information.

Refer to your completed *Network Settings Worksheets* for the IP Address, Network Netmask, and Gateway Address, of the **SOURCE** and **TARGET** servers' replication ports.

**Working at a SOURCE server at its location –**

**SOURCE**  
[S]



Enter information for the first destination (target – ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

Enter information for the second destination (target – ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

---

Server Name \_\_\_\_\_

**Working at the TARGET server at its location –**

Enter information for the first destination (target – ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

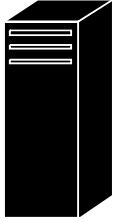
Enter information for the second destination (target – ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

**TARGET**  
[T]




---

Server Name \_\_\_\_\_

Figure 89. Configure static routes worksheet – SOURCE 2 and TARGET

## M:1 Replication Setup

### CONFIGURE STATIC ROUTES WORKSHEET

Use the blank spaces below to write in the information required to complete the **Configure Static Routes** option on the **PT Configuration Menu**.

**Important!** The **Configure Static Routes** option must be completed on each **SOURCE** server *and* on the **TARGET** server, at their respective locations.

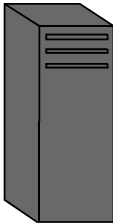
Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

**Tip:** In the prompts below, the term *Target Network Address* refers to the server's starting network address. To determine the starting network address, replace the digits after the last (.) in the server's IP Address, with a zero (0). See the related **Tip:** in *Example 3. Configure Static Routes* for more information.

Refer to your completed *Network Settings Worksheets* for the IP Address, Network Netmask, and Gateway Address, of the **SOURCE** and **TARGET** servers' replication ports.

**Working at a SOURCE server at its location –**

**SOURCE**  
[S]



Enter information for the first destination (target - ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

Enter information for the second destination (target - ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

---

Server Name \_\_\_\_\_

**Working at the TARGET server at its location –**

Enter information for the first destination (target - ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

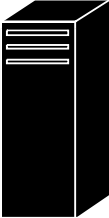
Enter information for the second destination (target - ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

**TARGET**  
[T]




---

Server Name \_\_\_\_\_

Figure 90. Configure static routes worksheet – SOURCE 3 and TARGET



## M:1 Replication Setup

### CONFIGURE STATIC ROUTES WORKSHEET

Use the blank spaces below to write in the information required to complete the **Configure Static Routes** option on the **PT Configuration Menu**.

**Important!** The **Configure Static Routes** option must be completed on each **SOURCE** server *and* on the **TARGET** server, at their respective locations.

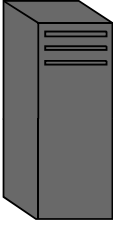
Fill out a separate worksheet for each **SOURCE** server in your replication network. Individual worksheets are provided to accommodate entries for up to four **SOURCE** servers. Depending upon your replication environment, you may not need to complete all four worksheets.

**Tip:** In the prompts below, the term *Target Network Address* refers to the server's starting network address. To determine the starting network address, replace the digits after the last (.) in the server's IP Address, with a zero (0). See the related **Tip:** in *Example 3. Configure Static Routes* for more information.

Refer to your completed *Network Settings Worksheets* for the IP Address, Network Netmask, and Gateway Address, of the **SOURCE** and **TARGET** servers' replication ports.

**Working at a SOURCE server at its location –**

**SOURCE**  
[S]



Enter information for the first destination (target – ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

Enter information for the second destination (target – ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [T]

Target Network Netmask: \_\_\_\_\_ [T]

Local Gateway Address: \_\_\_\_\_ [S]

---

Server Name \_\_\_\_\_

**Working at the TARGET server at its location –**

Enter information for the first destination (target – ETH1) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

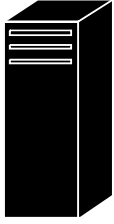
Enter information for the second destination (target – ETH2) and the local network.

Target Network Address: \_\_\_\_\_ [S]

Target Network Netmask: \_\_\_\_\_ [S]

Local Gateway Address: \_\_\_\_\_ [T]

**TARGET**  
[T]




---

Server Name \_\_\_\_\_

Figure 91. Configure static routes worksheet – SOURCE 4 and TARGET



## Appendix C. Worldwide time zone codes

Use the information in the following table to help you set the system's time zone.

### Time zone codes

The following table lists all of the worldwide time zone codes and the associated time zone descriptions. Additional information about the time zone is located in the Comments column.

| Code | Time zone                      | Comments                                                            |
|------|--------------------------------|---------------------------------------------------------------------|
| AD   | Europe/Andorra                 |                                                                     |
| AE   | Asia/Dubai                     |                                                                     |
| AF   | Asia/Kabul                     |                                                                     |
| AG   | America/Antigua                |                                                                     |
| AI   | America/Anguilla               |                                                                     |
| AL   | Europe/Tirane                  |                                                                     |
| AM   | Asia/Yerevan                   |                                                                     |
| AN   | America/Curacao                |                                                                     |
| AO   | Africa/Luanda                  |                                                                     |
| AQ   | Antarctica/McMurdo             | McMurdo Station, Ross Island                                        |
| AQ   | Antarctica/South_Pole          | Amundsen-Scott Station, South Pole                                  |
| AQ   | Antarctica/Rothera             | Rothera Station, Adelaide Island                                    |
| AQ   | Antarctica/Palmer              | Palmer Station, Anvers Island                                       |
| AQ   | Antarctica/Mawson              | Mawson Station, Holme Bay                                           |
| AQ   | Antarctica/Davis               | Davis Station, Vestfold Hills                                       |
| AQ   | Antarctica/Casey               | Casey Station, Bailey Peninsula                                     |
| AQ   | Antarctica/Vostok              | Vostok Station, S Magnetic Pole                                     |
| AQ   | Antarctica/DumontDUrville      | Dumont-d'Urville Station, Terre Adelie                              |
| AQ   | Antarctica/Syowa               | Syowa Station, E Ongul I                                            |
| AR   | America/Argentina/Buenos_Aires | Buenos Aires (BA, CF)                                               |
| AR   | America/Argentina/Cordoba      | most locations (CB, CC, CN, ER, FM, LP, MN, NQ, RN, SA, SE, SF, SL) |
| AR   | America/Argentina/Jujuy        | Jujuy (JY)                                                          |
| AR   | America/Argentina/Tucuman      | Tucuman (TM)                                                        |
| AR   | America/Argentina/Catamarca    | Catamarca (CT), Chubut (CH)                                         |
| AR   | America/Argentina/La_Rioja     | La Rioja (LR)                                                       |
| AR   | America/Argentina/San_Juan     | San Juan (SJ)                                                       |
| AR   | America/Argentina/Mendoza      | Mendoza (MZ)                                                        |
| AR   | America/Argentina/Rio_Gallegos | Santa Cruz (SC)                                                     |
| AR   | America/Argentina/Ushuaia      | Tierra del Fuego (TF)                                               |
| AS   | Pacific/Pago_Pago              |                                                                     |

| Code | Time zone             | Comments                                           |
|------|-----------------------|----------------------------------------------------|
| AT   | Europe/Vienna         |                                                    |
| AU   | Australia/Lord_Howe   | Lord Howe Island                                   |
| AU   | Australia/Hobart      | Tasmania - most locations                          |
| AU   | Australia/Currie      | Tasmania - King Island                             |
| AU   | Australia/Melbourne   | Victoria                                           |
| AU   | Australia/Sydney      | New South Wales - most locations                   |
| AU   | Australia/Broken_Hill | New South Wales - Yancowinna                       |
| AU   | Australia/Brisbane    | Queensland - most locations                        |
| AU   | Australia/Lindeman    | Queensland - Holiday Islands                       |
| AU   | Australia/Adelaide    | South Australia                                    |
| AU   | Australia/Darwin      | Northern Territory                                 |
| AU   | Australia/Perth       | Western Australia - most locations                 |
| AU   | Australia/Eucla       | Western Australia - Eucla area                     |
| AW   | America/Aruba         |                                                    |
| AX   | Europe/Mariehamn      |                                                    |
| AZ   | Asia/Baku             |                                                    |
| BA   | Europe/Sarajevo       |                                                    |
| BB   | America/Barbados      |                                                    |
| BD   | Asia/Dhaka            |                                                    |
| BE   | Europe/Brussels       |                                                    |
| BF   | Africa/Ouagadougou    |                                                    |
| BG   | Europe/Sofia          |                                                    |
| BH   | Asia/Bahrain          |                                                    |
| BI   | Africa/Bujumbura      |                                                    |
| BJ   | Africa/Porto-Novo     |                                                    |
| BL   | America/St_Barthlemy  |                                                    |
| BM   | Atlantic/Bermuda      |                                                    |
| BN   | Asia/Brunei           |                                                    |
| BO   | America/La_Paz        |                                                    |
| BR   | America/Noronha       | Atlantic islands                                   |
| BR   | America/Belem         | Amapa, E Para                                      |
| BR   | America/Fortaleza     | NE Brazil (MA, PI, CE, RN, PB)                     |
| BR   | America/Recife        | Pernambuco                                         |
| BR   | America/Araguaina     | Tocantins                                          |
| BR   | America/Maceio        | Alagoas, Sergipe                                   |
| BR   | America/Bahia         | Bahia                                              |
| BR   | America/Sao_Paulo     | S & SE Brazil (GO, DF, MG, ES, RJ, SP, PR, SC, RS) |
| BR   | America/Campo_Grande  | Mato Grosso do Sul                                 |
| BR   | America/Cuiaba        | Mato Grosso                                        |
| BR   | America/Porto_Velho   | W Para, Rondonia                                   |
| BR   | America/Boa_Vista     | Roraima                                            |

| Code | Time zone             | Comments                                                                    |
|------|-----------------------|-----------------------------------------------------------------------------|
| BR   | America/Manaus        | E Amazonas                                                                  |
| BR   | America/Eirunepe      | W Amazonas                                                                  |
| BR   | America/Rio_Branco    | Acre                                                                        |
| BS   | America/Nassau        |                                                                             |
| BT   | Asia/Thimphu          |                                                                             |
| BW   | Africa/Gaborone       |                                                                             |
| BY   | Europe/Minsk          |                                                                             |
| BZ   | America/Belize        |                                                                             |
| CA   | America/St_Johns      | Newfoundland Time, including SE Labrador                                    |
| CA   | America/Halifax       | Atlantic Time - Nova Scotia (most places), PEI                              |
| CA   | America/Glace_Bay     | Atlantic Time - Nova Scotia - places that did not observe DST 1966-1971     |
| CA   | America/Moncton       | Atlantic Time - New Brunswick                                               |
| CA   | America/Goose_Bay     | Atlantic Time - Labrador - most locations                                   |
| CA   | America/Blanc-Sablon  | Atlantic Standard Time - Quebec - Lower North Shore                         |
| CA   | America/Montreal      | Eastern Time - Quebec - most locations                                      |
| CA   | America/Toronto       | Eastern Time - Ontario - most locations                                     |
| CA   | America/Nipigon       | Eastern Time - Ontario & Quebec - places that did not observe DST 1967-1973 |
| CA   | America/Thunder_Bay   | Eastern Time - Thunder Bay, Ontario                                         |
| CA   | America/Iqaluit       | Eastern Time - east Nunavut - most locations                                |
| CA   | America/Pangnirtung   | Eastern Time - Pangnirtung, Nunavut                                         |
| CA   | America/Resolute      | Eastern Time - Resolute, Nunavut                                            |
| CA   | America/Atikokan      | Eastern Standard Time - Atikokan, Ontario and Southampton I, Nunavut        |
| CA   | America/Rankin_Inlet  | Central Time - central Nunavut                                              |
| CA   | America/Winnipeg      | Central Time - Manitoba & west Ontario                                      |
| CA   | America/Rainy_River   | Central Time - Rainy River & Fort Frances, Ontario                          |
| CA   | America/Regina        | Central Standard Time - Saskatchewan - most locations                       |
| CA   | America/Swift_Current | Central Standard Time - Saskatchewan - midwest                              |
| CA   | America/Edmonton      | Mountain Time - Alberta, east British Columbia & west Saskatchewan          |
| CA   | America/Cambridge_Bay | Mountain Time - west Nunavut                                                |
| CA   | America/Yellowknife   | Mountain Time - central Northwest Territories                               |
| CA   | America/Inuvik        | Mountain Time - west Northwest Territories                                  |
| CA   | America/Dawson_Creek  | Mountain Standard Time - Dawson Creek & Fort Saint John, British Columbia   |
| CA   | America/Vancouver     | Pacific Time - west British Columbia                                        |
| CA   | America/Whitehorse    | Pacific Time - south Yukon                                                  |
| CA   | America/Dawson        | Pacific Time - north Yukon                                                  |
| CC   | Indian/Cocos          |                                                                             |

| Code | Time zone             | Comments                                                         |
|------|-----------------------|------------------------------------------------------------------|
| CD   | Africa/Kinshasa       | west Dem. Rep. of Congo                                          |
| CD   | Africa/Lubumbashi     | east Dem. Rep. of Congo                                          |
| CF   | Africa/Bangui         |                                                                  |
| CG   | Africa/Brazzaville    |                                                                  |
| CH   | Europe/Zurich         |                                                                  |
| CI   | Africa/Abidjan        |                                                                  |
| CK   | Pacific/Rarotonga     |                                                                  |
| CL   | America/Santiago      | most locations                                                   |
| CL   | Pacific/Easter        | Easter Island & Sala y Gomez                                     |
| CM   | Africa/Douala         |                                                                  |
| CN   | Asia/Shanghai         | east China - Beijing, Guangdong, Shanghai, etc.                  |
| CN   | Asia/Harbin           | Heilongjiang (except Mohe), Jilin                                |
| CN   | Asia/Chongqing        | central China - Sichuan, Yunnan, Guangxi, Shaanxi, Guizhou, etc. |
| CN   | Asia/Urumqi           | most of Tibet & Xinjiang                                         |
| CN   | Asia/Kashgar          | west Tibet & Xinjiang                                            |
| CO   | America/Bogota        |                                                                  |
| CR   | America/Costa_Rica    |                                                                  |
| CU   | America/Havana        |                                                                  |
| CV   | Atlantic/Cape_Verde   |                                                                  |
| CX   | Indian/Christmas      |                                                                  |
| CY   | Asia/Nicosia          |                                                                  |
| CZ   | Europe/Prague         |                                                                  |
| DE   | Europe/Berlin         |                                                                  |
| DJ   | Africa/Djibouti       |                                                                  |
| DK   | Europe/Copenhagen     |                                                                  |
| DM   | America/Dominica      |                                                                  |
| DO   | America/Santo_Domingo |                                                                  |
| DZ   | Africa/Algiers        |                                                                  |
| EC   | America/Guayaquil     | mainland                                                         |
| EC   | Pacific/Galapagos     | Galapagos Islands                                                |
| EE   | Europe/Tallinn        |                                                                  |
| EG   | Africa/Cairo          |                                                                  |
| EH   | Africa/El_Aaiun       |                                                                  |
| ER   | Africa/Asmara         |                                                                  |
| ES   | Europe/Madrid         | mainland                                                         |
| ES   | Africa/Ceuta          | Ceuta & Melilla                                                  |
| ES   | Atlantic/Canary       | Canary Islands                                                   |
| ET   | Africa/Addis_Ababa    |                                                                  |
| FI   | Europe/Helsinki       |                                                                  |
| FJ   | Pacific/Fiji          |                                                                  |

| Code | Time zone              | Comments                                                      |
|------|------------------------|---------------------------------------------------------------|
| FK   | Atlantic/Stanley       |                                                               |
| FM   | Pacific/Truk           | Truk (Chuuk) and Yap                                          |
| FM   | Pacific/Ponape         | Ponape (Pohnpei)                                              |
| FM   | Pacific/Kosrae         | Kosrae                                                        |
| FO   | Atlantic/Faroe         |                                                               |
| FR   | Europe/Paris           |                                                               |
| GA   | Africa/Libreville      |                                                               |
| GB   | Europe/London          |                                                               |
| GD   | America/Grenada        |                                                               |
| GE   | Asia/Tbilisi           |                                                               |
| GF   | America/Cayenne        |                                                               |
| GG   | Europe/Guernsey        |                                                               |
| GH   | Africa/Accra           |                                                               |
| GI   | Europe/Gibraltar       |                                                               |
| GL   | America/Godthab        | most locations                                                |
| GL   | America/Danmarkshavn   | east coast, north of Scoresbysund                             |
| GL   | America/Scoresbysund   | Scoresbysund / Ittoqqortoormiit                               |
| GL   | America/Thule          | Thule / Pituffik                                              |
| GM   | Africa/Banjul          |                                                               |
| GN   | Africa/Conakry         |                                                               |
| GP   | America/Guadeloupe     |                                                               |
| GQ   | Africa/Malabo          |                                                               |
| GR   | Europe/Athens          |                                                               |
| GS   | Atlantic/South_Georgia |                                                               |
| GT   | America/Guatemala      |                                                               |
| GU   | Pacific/Guam           |                                                               |
| GW   | Africa/Bissau          |                                                               |
| GY   | America/Guyana         |                                                               |
| HK   | Asia/Hong_Kong         |                                                               |
| HN   | America/Tegucigalpa    |                                                               |
| HR   | Europe/Zagreb          |                                                               |
| HT   | America/Port-au-Prince |                                                               |
| HU   | Europe/Budapest        |                                                               |
| ID   | Asia/Jakarta           | Java & Sumatra                                                |
| ID   | Asia/Pontianak         | west & central Borneo                                         |
| ID   | Asia/Makassar          | east & south Borneo, Celebes, Bali, Nusa Tenggara, west Timor |
| ID   | Asia/Jayapura          | Irian Jaya & the Moluccas                                     |
| IE   | Europe/Dublin          |                                                               |
| IL   | Asia/Jerusalem         |                                                               |
| IM   | Europe/Isle_of_Man     |                                                               |

| Code | Time zone          | Comments                                          |
|------|--------------------|---------------------------------------------------|
| IN   | Asia/Calcutta      |                                                   |
| IO   | Indian/Chagos      |                                                   |
| IQ   | Asia/Baghdad       |                                                   |
| IR   | Asia/Tehran        |                                                   |
| IS   | Atlantic/Reykjavik |                                                   |
| IT   | Europe/Rome        |                                                   |
| JE   | Europe/Jersey      |                                                   |
| JM   | America/Jamaica    |                                                   |
| JO   | Asia/Amman         |                                                   |
| JP   | Asia/Tokyo         |                                                   |
| KE   | Africa/Nairobi     |                                                   |
| KG   | Asia/Bishkek       |                                                   |
| KH   | Asia/Phnom_Penh    |                                                   |
| KI   | Pacific/Tarawa     | Gilbert Islands                                   |
| KI   | Pacific/Enderbury  | Phoenix Islands                                   |
| KI   | Pacific/Kiritimati | Line Islands                                      |
| KM   | Indian/Comoro      |                                                   |
| KN   | America/St_Kitts   |                                                   |
| KP   | Asia/Pyongyang     |                                                   |
| KR   | Asia/Seoul         |                                                   |
| KW   | Asia/Kuwait        |                                                   |
| KY   | America/Cayman     |                                                   |
| KZ   | Asia/Almaty        | most locations                                    |
| KZ   | Asia/Qyzylorda     | Qyzylorda (Kyzylorda, Kzyl-Orda)                  |
| KZ   | Asia/Aqtobe        | Aqtobe (Aktobe)                                   |
| KZ   | Asia/Aqtau         | Atyrau (Atirau, Gur'yev), Mangghystau (Mankistau) |
| KZ   | Asia/Oral          | West Kazakhstan                                   |
| LA   | Asia/Vientiane     |                                                   |
| LB   | Asia/Beirut        |                                                   |
| LC   | America/St_Lucia   |                                                   |
| LI   | Europe/Vaduz       |                                                   |
| LK   | Asia/Colombo       |                                                   |
| LR   | Africa/Monrovia    |                                                   |
| LS   | Africa/Maseru      |                                                   |
| LT   | Europe/Vilnius     |                                                   |
| LU   | Europe/Luxembourg  |                                                   |
| LV   | Europe/Riga        |                                                   |
| LY   | Africa/Tripoli     |                                                   |
| MA   | Africa/Casablanca  |                                                   |
| MC   | Europe/Monaco      |                                                   |
| MD   | Europe/Chisinau    |                                                   |



| Code | Time zone           | Comments                                                 |
|------|---------------------|----------------------------------------------------------|
| ME   | Europe/Podgorica    |                                                          |
| MF   | America/Marigot     |                                                          |
| MG   | Indian/Antananarivo |                                                          |
| MH   | Pacific/Majuro      | most locations                                           |
| MH   | Pacific/Kwajalein   | Kwajalein                                                |
| MK   | Europe/Skopje       |                                                          |
| ML   | Africa/Bamako       |                                                          |
| MM   | Asia/Rangoon        |                                                          |
| MN   | Asia/Ulaanbaatar    | most locations                                           |
| MN   | Asia/Hovd           | Bayan-Olgii, Govi-Altai, Hovd, Uvs, Zavkhan              |
| MN   | Asia/Choibalsan     | Dornod, Sukhbaatar                                       |
| MO   | Asia/Macau          |                                                          |
| MP   | Pacific/Saipan      |                                                          |
| MQ   | America/Martinique  |                                                          |
| MR   | Africa/Nouakchott   |                                                          |
| MS   | America/Montserrat  |                                                          |
| MT   | Europe/Malta        |                                                          |
| MU   | Indian/Mauritius    |                                                          |
| MV   | Indian/Maldives     |                                                          |
| MW   | Africa/Blantyre     |                                                          |
| MX   | America/Mexico_City | Central Time - most locations                            |
| MX   | America/Cancun      | Central Time - Quintana Roo                              |
| MX   | America/Merida      | Central Time - Campeche, Yucatan                         |
| MX   | America/Monterrey   | Central Time - Coahuila, Durango, Nuevo Leon, Tamaulipas |
| MX   | America/Mazatlan    | Mountain Time - S Baja, Nayarit, Sinaloa                 |
| MX   | America/Chihuahua   | Mountain Time - Chihuahua                                |
| MX   | America/Hermosillo  | Mountain Standard Time - Sonora                          |
| MX   | America/Tijuana     | Pacific Time                                             |
| MY   | Asia/Kuala_Lumpur   | peninsular Malaysia                                      |
| MY   | Asia/Kuching        | Sabah & Sarawak                                          |
| MZ   | Africa/Maputo       |                                                          |
| NA   | Africa/Windhoek     |                                                          |
| NC   | Pacific/Noumea      |                                                          |
| NE   | Africa/Niamey       |                                                          |
| NF   | Pacific/Norfolk     |                                                          |
| NG   | Africa/Lagos        |                                                          |
| NI   | America/Managua     |                                                          |
| NL   | Europe/Amsterdam    |                                                          |
| NO   | Europe/Oslo         |                                                          |
| NP   | Asia/Katmandu       |                                                          |

| Code | Time zone            | Comments                     |
|------|----------------------|------------------------------|
| NR   | Pacific/Nauru        |                              |
| NU   | Pacific/Niue         |                              |
| NZ   | Pacific/Auckland     | most locations               |
| NZ   | Pacific/Chatham      | Chatham Islands              |
| OM   | Asia/Muscat          |                              |
| PA   | America/Panama       |                              |
| PE   | America/Lima         |                              |
| PF   | Pacific/Tahiti       | Society Islands              |
| PF   | Pacific/Marquesas    | Marquesas Islands            |
| PF   | Pacific/Gambier      | Gambier Islands              |
| PG   | Pacific/Port_Moresby |                              |
| PH   | Asia/Manila          |                              |
| PK   | Asia/Karachi         |                              |
| PL   | Europe/Warsaw        |                              |
| PM   | America/Miquelon     |                              |
| PN   | Pacific/Pitcairn     |                              |
| PR   | America/Puerto_Rico  |                              |
| PS   | Asia/Gaza            |                              |
| PT   | Europe/Lisbon        | mainland                     |
| PT   | Atlantic/Madeira     | Madeira Islands              |
| PT   | Atlantic/Azores      | Azores                       |
| PW   | Pacific/Palau        |                              |
| PY   | America/Asuncion     |                              |
| QA   | Asia/Qatar           |                              |
| RE   | Indian/Reunion       |                              |
| RO   | Europe/Bucharest     |                              |
| RS   | Europe/Belgrade      |                              |
| RU   | Europe/Kaliningrad   | Moscow-01 - Kaliningrad      |
| RU   | Europe/Moscow        | Moscow+00 - west Russia      |
| RU   | Europe/Volgograd     | Moscow+00 - Caspian Sea      |
| RU   | Europe/Samara        | Moscow+01 - Samara, Udmurtia |
| RU   | Asia/Yekaterinburg   | Moscow+02 - Urals            |
| RU   | Asia/Omsk            | Moscow+03 - west Siberia     |
| RU   | Asia/Novosibirsk     | Moscow+03 - Novosibirsk      |
| RU   | Asia/Krasnoyarsk     | Moscow+04 - Yenisei River    |
| RU   | Asia/Irkutsk         | Moscow+05 - Lake Baikal      |
| RU   | Asia/Yakutsk         | Moscow+06 - Lena River       |
| RU   | Asia/Vladivostok     | Moscow+07 - Amur River       |
| RU   | Asia/Sakhalin        | Moscow+07 - Sakhalin Island  |
| RU   | Asia/Magadan         | Moscow+08 - Magadan          |
| RU   | Asia/Kamchatka       | Moscow+09 - Kamchatka        |

| Code | Time zone             | Comments                                       |
|------|-----------------------|------------------------------------------------|
| RU   | Asia/Anadyr           | Moscow+10 - Bering Sea                         |
| RW   | Africa/Kigali         |                                                |
| SA   | Asia/Riyadh           |                                                |
| SB   | Pacific/Guadalcanal   |                                                |
| SC   | Indian/Mahe           |                                                |
| SD   | Africa/Khartoum       |                                                |
| SE   | Europe/Stockholm      |                                                |
| SG   | Asia/Singapore        |                                                |
| SH   | Atlantic/St_Helena    |                                                |
| SI   | Europe/Ljubljana      |                                                |
| SJ   | Arctic/Longyearbyen   |                                                |
| SK   | Europe/Bratislava     |                                                |
| SL   | Africa/Freetown       |                                                |
| SM   | Europe/San_Marino     |                                                |
| SN   | Africa/Dakar          |                                                |
| SO   | Africa/Mogadishu      |                                                |
| SR   | America/Paramaribo    |                                                |
| ST   | Africa/Sao_Tome       |                                                |
| SV   | America/El_Salvador   |                                                |
| SY   | Asia/Damascus         |                                                |
| SZ   | Africa/Mbabane        |                                                |
| TC   | America/Grand_Turk    |                                                |
| TD   | Africa/Ndjamena       |                                                |
| TF   | Indian/Kerguelen      |                                                |
| TG   | Africa/Lome           |                                                |
| TH   | Asia/Bangkok          |                                                |
| TJ   | Asia/Dushanbe         |                                                |
| TK   | Pacific/Fakaofu       |                                                |
| TL   | Asia/Dili             |                                                |
| TM   | Asia/Ashgabat         |                                                |
| TN   | Africa/Tunis          |                                                |
| TO   | Pacific/Tongatapu     |                                                |
| TR   | Europe/Istanbul       |                                                |
| TT   | America/Port_of_Spain |                                                |
| TV   | Pacific/Funafuti      |                                                |
| TW   | Asia/Taipei           |                                                |
| TZ   | Africa/Dar_es_Salaam  |                                                |
| UA   | Europe/Kiev           | most locations                                 |
| UA   | Europe/Uzhgorod       | Ruthenia                                       |
| UA   | Europe/Zaporozhye     | Zaporozh'ye, E Lugansk / Zaporizhia, E Luhansk |
| UA   | Europe/Simferopol     | central Crimea                                 |

| Code | Time zone                      | Comments                                                                |
|------|--------------------------------|-------------------------------------------------------------------------|
| UG   | Africa/Kampala                 |                                                                         |
| UM   | Pacific/Johnston               | Johnston Atoll                                                          |
| UM   | Pacific/Midway                 | Midway Islands                                                          |
| UM   | Pacific/Wake                   | Wake Island                                                             |
| US   | America/New_York               | Eastern Time                                                            |
| US   | America/Detroit                | Eastern Time - Michigan - most locations                                |
| US   | America/Kentucky/Louisville    | Eastern Time - Kentucky - Louisville area                               |
| US   | America/Kentucky/Monticello    | Eastern Time - Kentucky - Wayne County                                  |
| US   | America/Indiana/Indianapolis   | Eastern Time - Indiana - most locations                                 |
| US   | America/Indiana/Vincennes      | Eastern Time - Indiana - Daviess, Dubois, Knox & Martin Counties        |
| US   | America/Indiana/Knox           | Eastern Time - Indiana - Starke County                                  |
| US   | America/Indiana/Winamac        | Eastern Time - Indiana - Pulaski County                                 |
| US   | America/Indiana/Marengo        | Eastern Time - Indiana - Crawford County                                |
| US   | America/Indiana/Vevay          | Eastern Time - Indiana - Switzerland County                             |
| US   | America/Chicago                | Central Time                                                            |
| US   | America/Indiana/Tell_City      | Central Time - Indiana - Perry County                                   |
| US   | America/Indiana/Petersburg     | Central Time - Indiana - Pike County                                    |
| US   | America/Menominee              | Central Time - Michigan - Dickinson, Gogebic, Iron & Menominee Counties |
| US   | America/North_Dakota/Center    | Central Time - North Dakota - Oliver County                             |
| US   | America/North_Dakota/New_Salem | Central Time - North Dakota - Morton County (except Mandan area)        |
| US   | America/Denver                 | Mountain Time                                                           |
| US   | America/Boise                  | Mountain Time - south Idaho & east Oregon                               |
| US   | America/Shiprock               | Mountain Time - Navajo                                                  |
| US   | America/Phoenix                | Mountain Standard Time - Arizona                                        |
| US   | America/Los_Angeles            | Pacific Time                                                            |
| US   | America/Anchorage              | Alaska Time                                                             |
| US   | America/Juneau                 | Alaska Time - Alaska panhandle                                          |
| US   | America/Yakutat                | Alaska Time - Alaska panhandle neck                                     |
| US   | America/Nome                   | Alaska Time - west Alaska                                               |
| US   | America/Adak                   | Aleutian Islands                                                        |
| US   | Pacific/Honolulu               | Hawaii                                                                  |
| UY   | America/Montevideo             |                                                                         |
| UZ   | Asia/Samarkand                 | west Uzbekistan                                                         |
| UZ   | Asia/Tashkent                  | east Uzbekistan                                                         |
| VA   | Europe/Vatican                 |                                                                         |
| VC   | America/St_Vincent             |                                                                         |
| VE   | America/Caracas                |                                                                         |
| VG   | America/Tortola                |                                                                         |
| VI   | America/St_Thomas              |                                                                         |

| <b>Code</b> | <b>Time zone</b>    | <b>Comments</b> |
|-------------|---------------------|-----------------|
| VN          | Asia/Saigon         |                 |
| VU          | Pacific/Efate       |                 |
| WF          | Pacific/Wallis      |                 |
| WS          | Pacific/Apia        |                 |
| YE          | Asia/Aden           |                 |
| YT          | Indian/Mayotte      |                 |
| ZA          | Africa/Johannesburg |                 |
| ZM          | Africa/Lusaka       |                 |
| ZW          | Africa/Harare       |                 |



## Appendix D. Country codes

Use the information in the Country codes table to convert a country to a two-character code. For example, code for Spain = es.

If you are planning to enable the Call Home feature, you must enter your country code (see Table 43) on the **Registration** page of the **ProtecTIER Manager Configuration** menu.

Table 43. Country codes

| Country             | Code | Country               | Code | Country                     | Code | Country                  | Code | Country                        | Code |
|---------------------|------|-----------------------|------|-----------------------------|------|--------------------------|------|--------------------------------|------|
| Afghanistan         | af   | Cook Islands          | ck   | Iceland                     | is   | Nauru                    | nr   | Solomon Islands                | sb   |
| Albania             | al   | Costa Rica            | cr   | India                       | in   | Nepal                    | np   | Somalia                        | so   |
| Algeria             | dz   | Croatia               | hr   | Indonesia                   | id   | Netherlands              | nl   | South Africa                   | za   |
| American Samoa      | as   | Cuba                  | cu   | Iran                        | ir   | Netherlands Antilles     | an   | South Korea                    | kr   |
| Andorra             | ad   | Cyprus                | cy   | Iraq                        | iq   | Neutral Zone             | nt   | Spain                          | es   |
| Angola              | ao   | Czech Republic        | cz   | Ireland                     | ie   | New Caledonia (French)   | nc   | Sri Lanka                      | lk   |
| Anguilla            | ai   | Denmark               | dk   | Israel                      | il   | New Zealand              | nz   | Sudan                          | sd   |
| Antarctica          | aq   | Djibouti              | dj   | Italy                       | it   | Nicaragua                | ni   | Suriname                       | sr   |
| Antigua and Barbuda | ag   | Dominica              | dm   | Ivory Coast (Cote D'Ivoire) | ci   | Niger                    | ne   | Svalbard and Jan Mayen Islands | sj   |
| Argentina           | ar   | Dominican Republic    | do   | Jamaica                     | jm   | Nigeria                  | ng   | Swaziland                      | sz   |
| Armenia             | am   | East Timor            | tp   | Japan                       | jp   | Niue                     | nu   | Sweden                         | se   |
| Aruba               | aw   | Ecuador               | ec   | Jordan                      | jo   | Norfolk Island           | nf   | Switzerland                    | ch   |
| Australia           | au   | Egypt                 | eg   | Kazakhstan                  | kz   | North Korea              | kp   | Syria                          | sy   |
| Austria             | at   | El Salvador           | sv   | Kenya                       | ke   | Northern Mariana Islands | mp   | Tajikistan                     | tj   |
| Azerbaijan          | az   | Equatorial Guinea     | gq   | Kiribati                    | ki   | Norway                   | no   | Taiwan                         | tw   |
| Bahamas             | bs   | Eritrea               | er   | Kuwait                      | kw   | Oman                     | om   | Tanzania                       | tz   |
| Bahrain             | bh   | Estonia               | ee   | Kyrgyzstan                  | kg   | Pakistan                 | pk   | Thailand                       | th   |
| Bangladesh          | bd   | Ethiopia              | et   | Laos                        | la   | Palau                    | pw   | Togo                           | tg   |
| Barbados            | bb   | Falkland Islands      | fk   | Latvia                      | lv   | Panama                   | pa   | Tokelau                        | tk   |
| Belarus             | by   | Faroe Islands         | fo   | Lebanon                     | lb   | Papua New Guinea         | pg   | Tonga                          | to   |
| Belgium             | be   | Fiji                  | fj   | Lesotho                     | ls   | Paraguay                 | py   | Trinidad and Tobago            | tt   |
| Belize              | bz   | Finland               | fi   | Liberia                     | lr   | Peru                     | pe   | Tunisia                        | tn   |
| Benin               | bj   | Former Czechoslovakia | cs   | Libya                       | ly   | Philippines              | ph   | Turkey                         | tr   |
| Bermuda             | bm   | Former USSR           | su   | Liechtenstein               | li   | Pitcairn Island          | pn   | Turkmenistan                   | tm   |
| Bhutan              | bt   | France                | fr   | Lithuania                   | lt   | Poland                   | pl   | Turks and Caicos Islands       | tc   |

Table 43. Country codes (continued)

| Country                        | Code | Country                     | Code | Country             | Code | Country                            | Code | Country                    | Code |
|--------------------------------|------|-----------------------------|------|---------------------|------|------------------------------------|------|----------------------------|------|
| Bolivia                        | bo   | France (European Territory) | fx   | Luxembourg          | lu   | Polynesia (French)                 | pf   | Tuvalu                     | tv   |
| Bosnia-Herzegovina             | ba   | French Guyana               | gf   | Macau               | mo   | Portugal                           | pt   | Uganda                     | ug   |
| Botswana                       | bw   | French Southern Territories | tf   | Macedonia           | mk   | Puerto Rico                        | pr   | Ukraine                    | ua   |
| Bouvet Island                  | bv   | Gabon                       | ga   | Madagascar          | mg   | Qatar                              | qa   | United Arab Emirates       | ae   |
| Brazil                         | br   | Gambia                      | gm   | Malawi              | mw   | Reunion (French)                   | re   | United Kingdom             | uk   |
| British Indian Ocean Territory | io   | Georgia                     | ge   | Malaysia            | my   | Romania                            | ro   | United States of America   | us   |
| Brunei Darussalam              | bn   | Germany                     | de   | Maldives            | mv   | Russian Federation                 | ru   | Uruguay                    | uy   |
| Bulgaria                       | bg   | Ghana                       | gh   | Mali                | ml   | Rwanda                             | rw   | USA Minor Outlying Islands | um   |
| Burkina Faso                   | bf   | Gibraltar                   | gi   | Malta               | mt   | S. Georgia & S. Sandwich Isles     | gs   | Uzbekistan                 | uz   |
| Burundi                        | bi   | Great Britain               | gb   | Marshall Islands    | mh   | Saint Helena                       | sh   | Vanuatu                    | vu   |
| Cambodia                       | kh   | Greece                      | gr   | Martinique (French) | mq   | Saint Kitts & Nevis Anguilla       | kn   | Vatican City State         | va   |
| Cameroon                       | cm   | Greenland                   | gl   | Mauritania          | mr   | Saint Lucia                        | lc   | Venezuela                  | ve   |
| Canada                         | ca   | Grenada                     | gd   | Mauritius           | mu   | Saint Pierre and Miquelon          | pm   | Vietnam                    | vn   |
| Cape Verde                     | cv   | Guadeloupe (French)         | gp   | Mayotte             | yt   | Saint Tome (Sao Tome) and Principe | st   | Virgin Islands (British)   | vg   |
| Cayman Islands                 | ky   | Guam (USA)                  | gu   | Mexico              | mx   | Saint Vincent & Grenadines         | vc   | Virgin Islands (USA)       | vi   |
| Central African Republic       | cf   | Guatemala                   | gt   | Micronesia          | fm   | Samoa                              | ws   | Wallis and Futuna Islands  | wf   |
| Chad                           | td   | Guinea                      | gn   | Moldavia            | md   | San Marino                         | sm   | Western Sahara             | eh   |
| Chile                          | cl   | Guinea Bissau               | gw   | Monaco              | mc   | Saudi Arabia                       | sa   | Yemen                      | ye   |
| China                          | cn   | Guyana                      | gy   | Mongoliar           | mn   | Senegal                            | sn   | Yugoslavia                 | yu   |
| Christmas Island               | cx   | Haiti                       | ht   | Montserrat          | ms   | Seychelles                         | sc   | Zaire                      | zr   |
| Cocos (Keeling) Islands        | cc   | Heard and McDonald Islands  | hm   | Morocco             | ma   | Sierra Leon                        | sl   | Zambia                     | zm   |
| Colombia                       | co   | Honduras                    | hn   | Mozambique          | mz   | Singapore                          | sg   | Zimbabwe                   | zw   |
| Comoros                        | km   | Hong Kong                   | hk   | Myanmar             | mm   | Slovak Republic                    | sk   |                            |      |
| Congo                          | cg   | Hungary                     | hy   | Namibia             | na   | Slovenia                           | si   |                            |      |



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---

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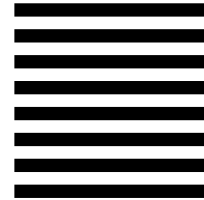
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