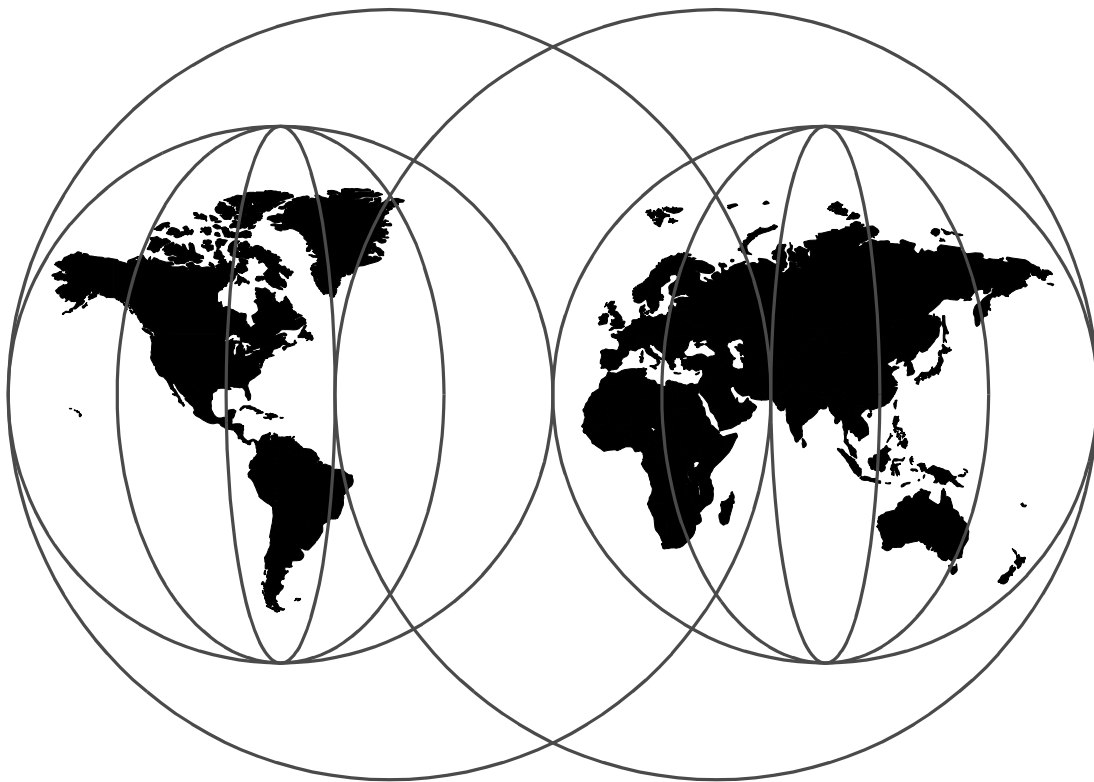


Tivoli Storage Manager SAN Tape Library Sharing

Roland Leins



International Technical Support Organization

<http://www.redbooks.ibm.com>

Take Note!

Before using this information and the product it supports, be sure to read the general information in “Special Notices” on page 25.

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This edition applies to Version 3 Release 7 of the Tivoli Storage Manager for AIX, Program Number 5697-TSM; Version 3 Release 7 of the Tivoli Storage Manager for HP-UX, Program Number 5697-TSM; Version 3 Release 7 of the Tivoli Storage Manager for Sun Solaris, Program Number 5697-TSM; Version 3 Release 7 of the Tivoli Storage Manager for Windows NT, Program Number 5697-TSM; Version 3 Release 7 of the Tivoli Storage Manager, S/390 Edition, Program Number 5697-TSO.

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Preface

Tivoli Storage Manager Version 3.7 exploits the Storage Area Network (SAN) technology for dynamic tape library sharing. With this function, multiple Tivoli Storage Manager servers can dynamically share library volume and tape drive resources of one physical tape library. Using the Fibre Channel technology of SANs, distances between the tape library and the Tivoli Storage Manager server can be extended.

This paper covers:

- SAN introduction
- Tivoli Storage Manager tape library sharing
- Tape library sharing configuration
- Tape library sharing utilization
- IBM 3494 tape library sharing

Who Wrote This Redpaper

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

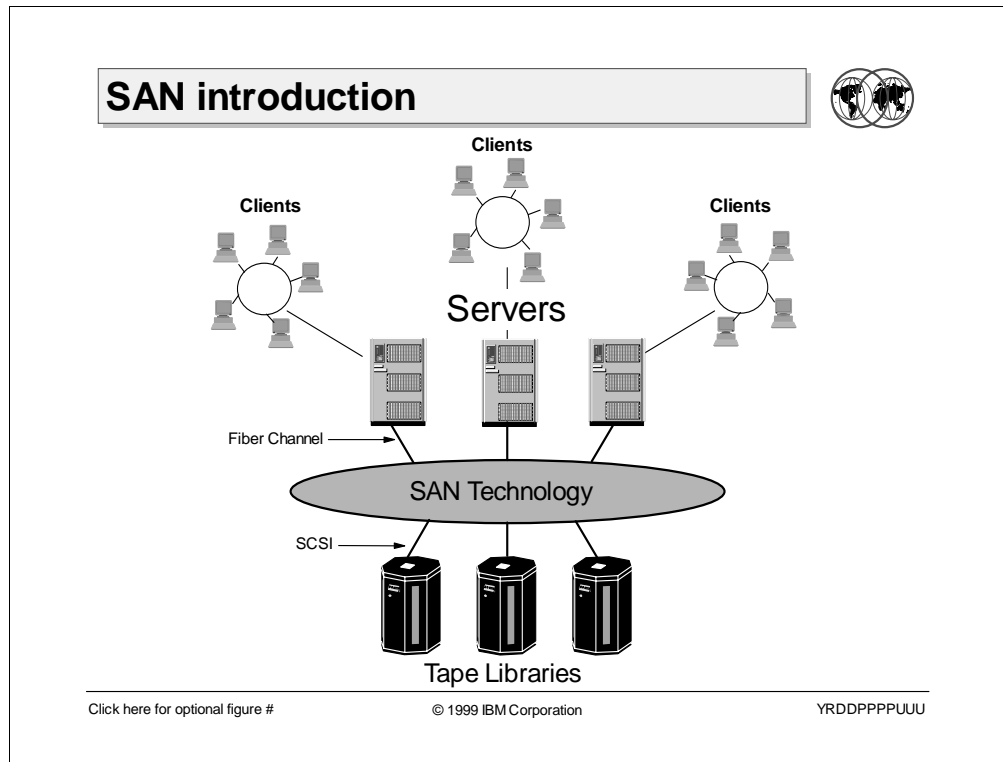
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1. SAN introduction

Storage Area Network (SAN) is a new architecture that puts storage on a separate dedicated network to allow businesses of all sizes to provide access to important data, regardless of operating systems, as a significant step towards helping customers cope with the explosive growth of information in the e-business age.

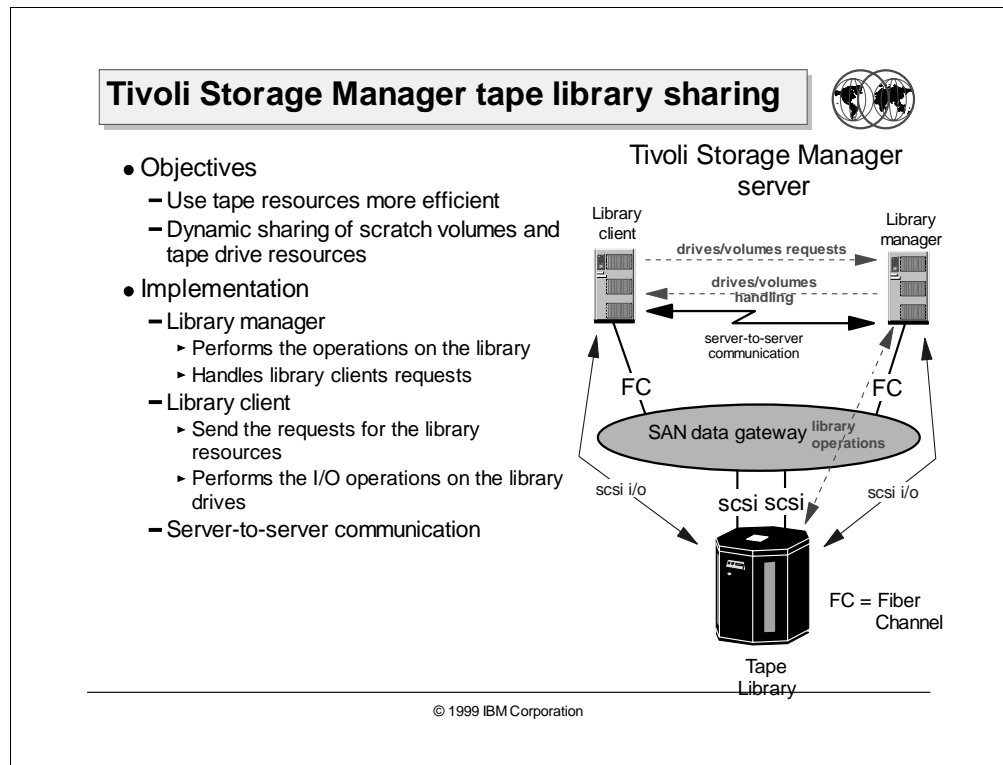


SANs create new methods of attaching storage to processors. These new methods promise great improvements in both availability and performance. Currently they are most commonly used to connect shared storage arrays to multiple processors, and are used by clustered servers for failover. They can create the opportunity for various servers to share tape drives and tape libraries. A SAN can be used to bypass traditional network bottlenecks. It supports direct, high speed data transfers between servers and storage devices in the following three ways:

- **Server to storage:** This is the traditional model of interaction with storage devices. The advantage is that the same storage device may be accessed serially or concurrently by multiple servers.
- **Server to server:** A Storage Area Network may be used for high-speed, high-volume communications between servers.
- **Storage to storage:** An example is a disk device backing up its data to a tape without processor intervention. It could also be remote device mirroring across the SAN.

The graphic shows an example of a server-to-storage configuration with Tivoli Storage Manager. In this example there are three Tivoli Storage Manager servers that can share the resources of three tape libraries. Each host sees the tape libraries like its own local devices, and if a Tivoli Storage Manager server is running on the host, the server can access the library resources as well, obtaining what is called the Tape Library Sharing function, the first important step towards the exploitation of SAN technology for the Tivoli Storage Management product set.

2. Tivoli Storage Manager tape library sharing



2.1 Objectives

In the past, the only way of dynamically sharing the capacity of a tape library was using server-to-server communication. This function allows for the building of a storage hierarchy across multiple Tivoli Storage Manager servers and sharing the storage capacity of one tape library between these servers. This means only one server has the library physically attached, but all the other servers can store their data on this library using a LAN connection.

Tivoli Storage Manager introduces the dynamically sharing of direct-connected tape libraries between servers to address the following goals:

- Use tape library resources more efficient using Tivoli Storage Manager. Until now, only static sharing of drives and the physical segmentation of a direct-connected tape library between two or more server systems was possible, without using external library manager programs.
- Optimizing the use of scratch tapes by dynamically sharing them across multiple Tivoli Storage Manager servers.

At the present time, the SAN tape library sharing function is available for Windows NT and Sun Solaris Tivoli Storage manager servers, and for a selected number of tape libraries. The current list of supported platforms and tape libraries is available at the following Web page:

http://www.tivoli.com/support/storage_mgr/san/overview.html

Tivoli Storage Manager SAN tape library sharing support is implemented for libraries that use SCSI commands to control the library robotics and the tape management. This does not include the IBM 3494. The IBM 3494 tape library can be shared today among multiple ADSTM V3.1 or Tivoli Storage Manager servers on a SAN using features of the 3494, ADSTM/Tivoli Storage Manager and a supported SAN configuration. Refer to Section 5., "IBM 3494 tape library sharing" on page 21 for more details.

2.2 Implementation

The architecture of SAN tape library sharing is structured after the design of the *External Library Manager* (ELM) interface that is currently implemented in the ADSTM server today. This architecture differentiates between the tape drives and the robotic device (the library). The drives are used by any hosts, but only one controls the robotic device.

The functionality of sharing tape libraries is split into two components: the library manager and the library client.

- Library manager

The task of the library manager is to physically control the library. All the communication with the library is done by this server. The library manager will also serialize the access to the tape drives, so that only one server is using a tape drive at the same time.

The checkin and checkout of volumes will be performed by the library manager. This server is the only server with a library inventory table for that library. The ownership is added to the inventory table to keep track which tape belongs to a certain library client.

This is the only server in the environment that knows all the volumes. The library manager can also use the library for its own purposes, without being a library client at the same time (no library client configuration is necessary on the manager)

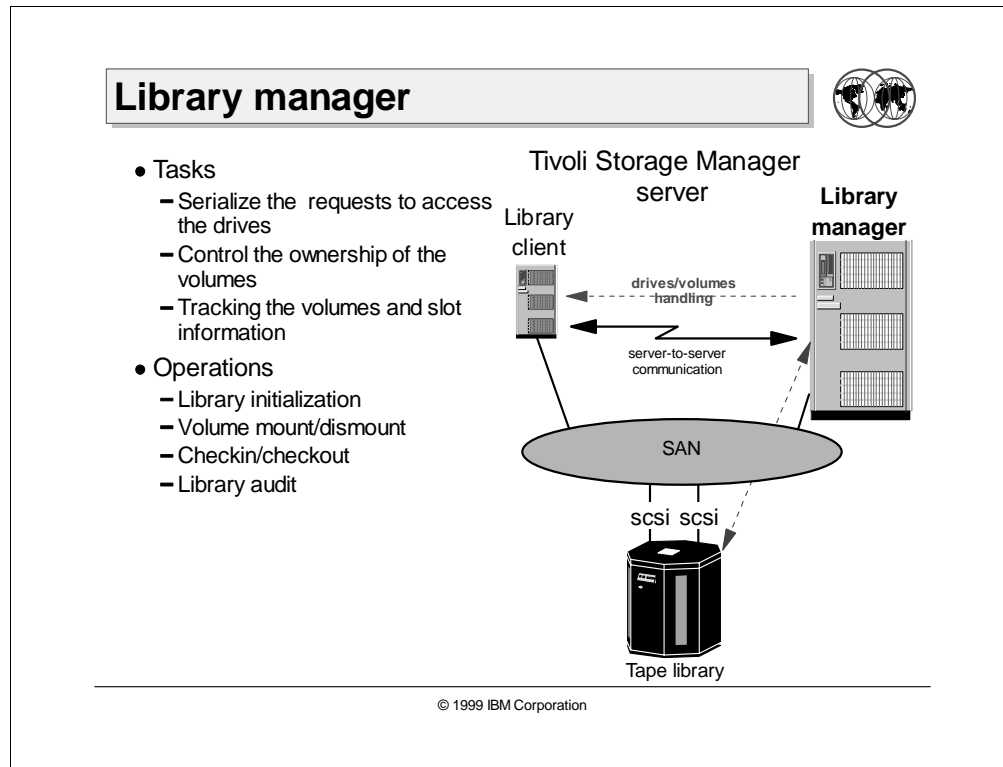
- Library client

The library client uses the library server for the handling of the physical hardware. The client sends the requests to the library manager, and afterwards reads or writes to the tape drive it was given access to.

To send requests from the library client to the library manager, and to send the response from the manager to the client, the server-to-server communication protocol is used. That means that a TCP/IP connection is necessary and the two Tivoli Storage Manager servers must be configured to each other. In an environment with multiple library clients, there is no need to have each Tivoli Storage Manager server configured to every other Tivoli Storage Manager server, because the communication has always been done directly with the library manager.

When using SAN tape library sharing for libraries with built-in capabilities to be partitioned into logical libraries (for example IBM 3570 and IBM 3575), the drives and scratch cartridges to be shared by Tivoli Storage Manager Version 3.7 servers must be configured into one logical library. However, the library can be partitioned to use the other partition of those libraries from another non-Tivoli Storage Manager server host or application.

2.3 Library manager



2.3.1 Library manager tasks

Sharing a tape library means that many hosts use the drives of a library for their operations at the same time. Because one drive can only be used by one host at the same time there has to be someone who controls the access to the physical devices. This is done by serializing the access to the devices.

In addition to the control of the devices the library manager also has to control the status, ownership and location of the volumes inside the tape library. The library manager is the only Tivoli Storage Manager server with the inventory information of the shared tape library. The library manager is the only Tivoli Storage Manager server who knows all volumes that are inside a library. No client has volumes checked in the library. The pool of scratch tapes is controlled by the library manager.

2.3.2 Library manager operations

The library manager is the only Tivoli Storage Manager server which performs operations to the library. The library clients only perform operations to the drives inside the library after they have been given access to the drives by the library manager.

- Library initialization

Since the library manager is the only Tivoli Storage Manager server which interacts with the library, the initialization will be done by this server during the start-up process of the server.

- Volume mount/dismount

The library manager can be contacted by the clients which send mount and demount requests. These requests will be carried out, and afterwards, a response will be sent to the clients.

- Checkin/checkout

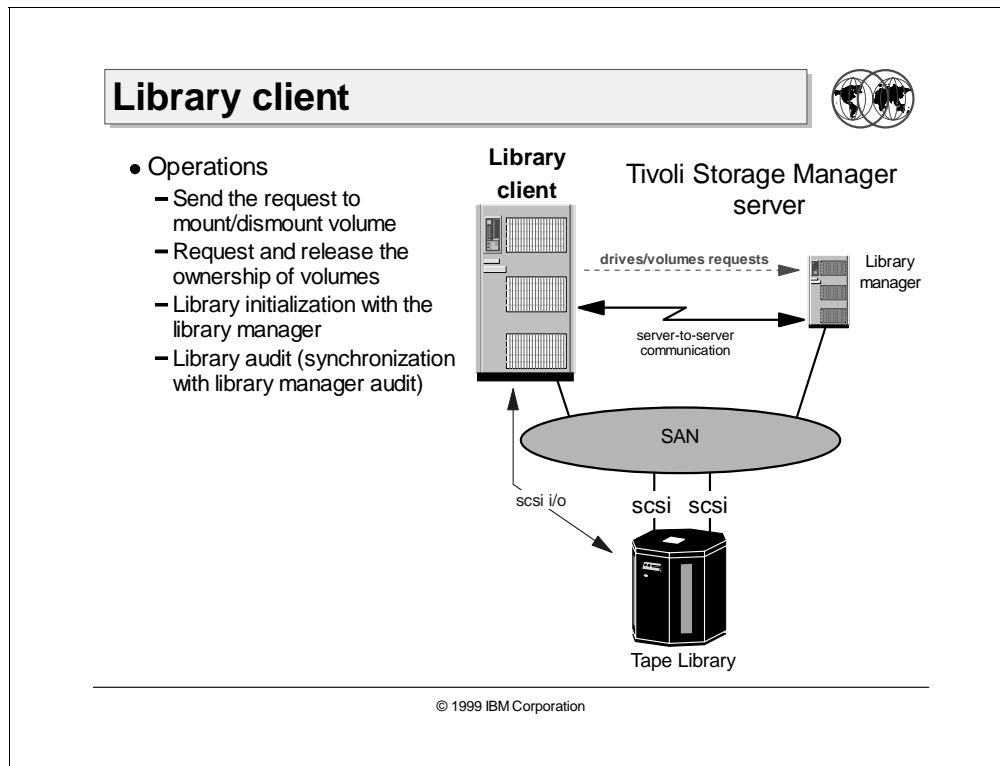
Only the library manager can insert and take out volumes. The clients do not have the right to perform a *checkin* or *checkout* command.

- Library audit

The library inventory is maintained only on the library manager. The audit process on the library manager checks the presence of the volumes and the actual slot locations.

For an example of a library manager configuration, see 3., “Tape library sharing configuration” on page 12.

2.4 Library client



No client has access to the library in the same way that it can control the gripper to mount a volume. The library client has to send a request to the library manager, which who controls the library and mounts volumes.

If a new volume is needed the client sends a request to the library manager. The library manager chooses a scratch tape and updates the ownership of the tape. After doing this a response is send to the client, and the client then can issue a mount request in order to use the volume.

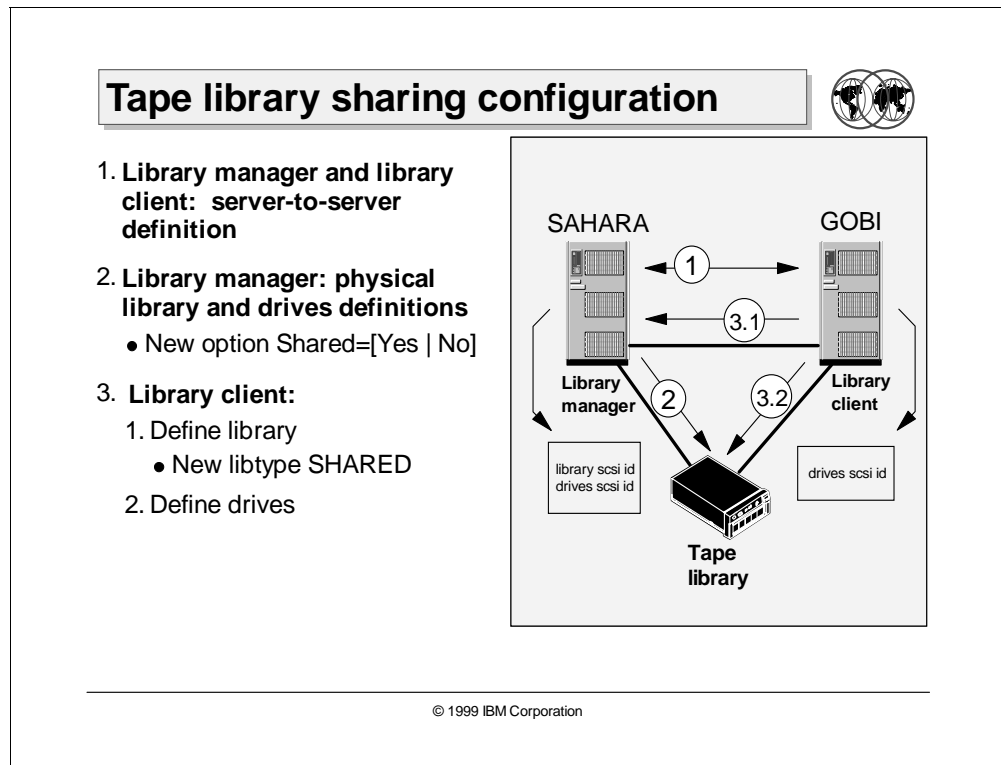
If a volume is not used any more, the client sends a release request to the library manager and the tape will be returned to the scratch pool.

When the library client Tivoli Storage Manager server is started an initialization with the library manager is performed in order to confirm that the library and drives can be used.

The audit library operations is used to update the library manager's inventory information. The client sends the library manager the name of the tapes it is using, so that the ownership can be updated.

The library client has no library inventory table for a shared library. Even so, storage pool volumes can be seen with the `query volume` command, and database backup volumes can be seen with the `query volhistory` command. The DRM volumes table can also be queried as for a non-shared library.

3. Tape library sharing configuration



In the following section, an example of an environment with a library manager and a library client will be set up. The example will illustrate the definitions required on two Tivoli Storage Manager servers. SAHARA is the library manager, while GOBI is the library client. To configure a tape library sharing environment, you must:

1. Establish a server-to-server communication for both servers.
2. Define the tape library and the drives to the library manager, specifying that the library will be shared with other Tivoli Storage Manager Servers
3. Define the library and the drives to the client:
 1. Define a library that points to the library manager, instead of the tape library.
 2. Define the drives with normal drives definition.

Note:

The definition of the device class objects on the library manager and library client is not influenced by the concept of library sharing. There is also no need for the names of the objects to match.

Since library sharing uses server-to-server communication for sending and receiving requests, the first step is to set up server-to-server communication between the two servers.

The second step is to define the library and drives on the library manager. The only difference from a normal library definition is the setting of the new parameter shared. This parameter has to be to yes.

The library client has to define a library of TYPE=SHARED and the name of the library has to be the same as defined on the library manager. After doing this, the drives which the library client has physical access to must be defined with the same name as on the library manager.

3.1 Physical device connection

To configure tape sharing for two or more servers, first, of all the drives and the library must be configured to the operating systems. The server that will be the library manager must have configured both the library scsi id and the drive scsi ids, while the library client servers must have configured only the drive scsi ids. See Table 1.

Table 1. Tape sharing - Hardware addressing

server	library function	library scsi id	drive scsi id
SAHARA	Library manager	LB3.1.0.2	MT2.0.0.2 MT3.0.0.2
GOBI	Library client	n/a	MT2.0.0.2 MT3.0.0.2


If a third server is added to the environment, this server acts as a library client. The configuration is the same as for the library client GOBI.

Note:

The names used for the definitions of the library and the drives on the library clients side must be the same as used on the library manager.

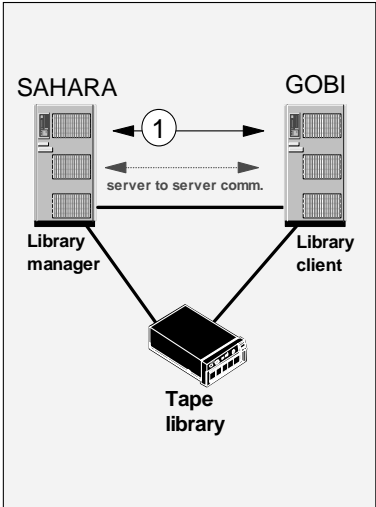
3.2 Server-to-server communication setup

Server-to-server communication setup



- Library manager and library client
 - SET SERVERNAME
 - SET SERVERPASSWORD
 - SET CROSSDEFINE
 - SET SERVERHLADDRESS
 - SET SERVERLLADDRESS
 - DEFINE SERVER (only on one server)

```
tsm: sahara> set servername sahara
tsm: sahara> set serverpassword sahara_passw
tsm: sahara> set crossdefine on
tsm: sahara> set serverhladdress
sahara_ipaddress
tsm: sahara>set serverlladdress sahara_tcpport
tsm: sahara> define server gobi gobi_passw
crossdefine=yes
```



SAHARA
Library manager

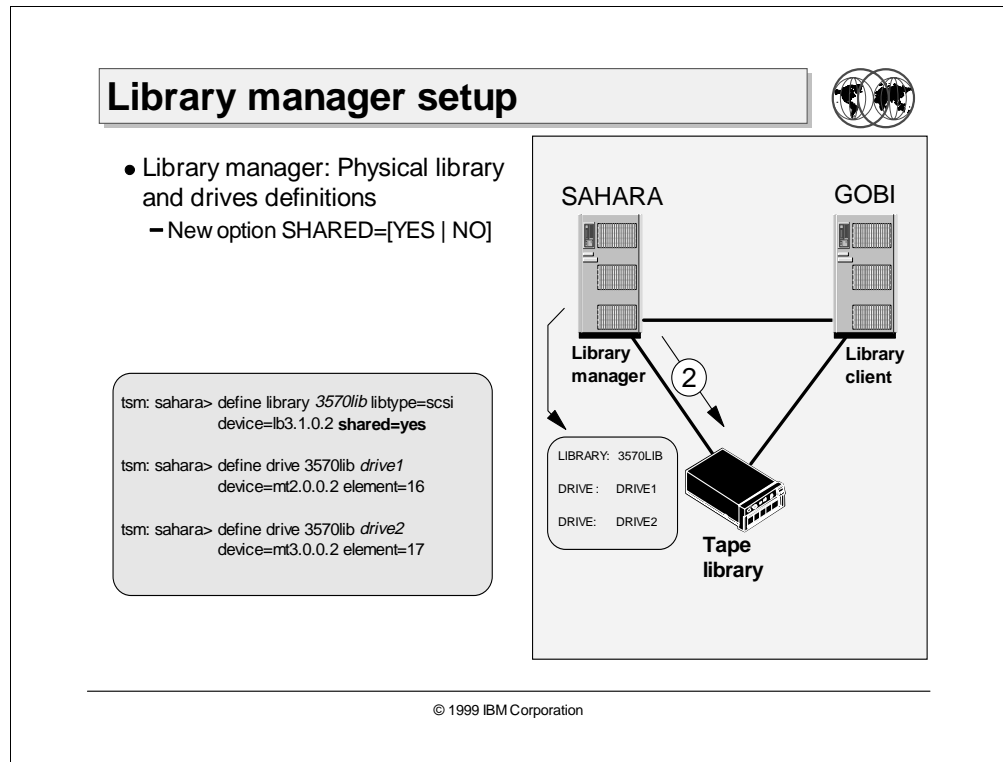
GOBI
Library client

Tape library

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To use the tape sharing configuration, the server-to-server communication must be established. Each library client must be defined to the library manager server and vice versa. It is not necessary that the library client knows the other library client servers. The graphics shows the SET and DEFINE commands used in SAHARA to define GOBI as a remote server, and to permit GOBI to autodefine SAHARA as a remote server.

3.3 Library manager setup



The second step is to configure the tape library to the Tivoli Storage Manager server that will act as the library manager.

Tivoli Storage Manager introduces a new option for the LIBRARY definition, SHARED=[YES | NO]. If the option is set to YES, the library will be shared with other Tivoli Storage Manager servers. This server will now manage the library and respond to the requests that the library clients will issue.

The graphic shows the `define library` command used to define a Magstar MP 3570 tape library.

Next to the library definition are the tape library drive definitions that permit the library manager to use the drives either for its environment or for the library clients' requests.

To view the library definitions, the `query library` command can be used, and the output shows a new field, Shared.

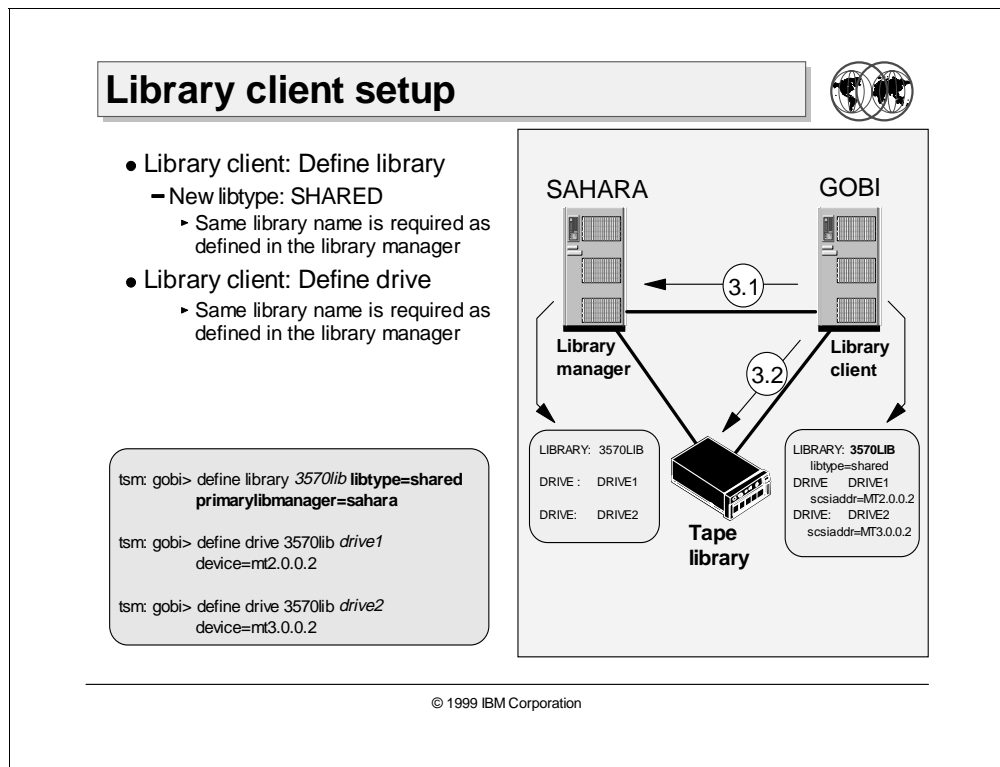
```

tsm: SAHARA>query libr format=detailed

      Library Name: 3570L
      Library Type: SCSI
      Device: LB3.1.0.2
      Private Category:
      Scratch Category:
      External Manager:
      RSM Media Type:
      Shared: Yes
      Primary Library Manager:
      Last Update by (administrator): ADMIN
      Last Update Date/Time: 10/28/1999 17:01:58

```

3.4 Library client setup



After all definitions have been made on the library manager, it is possible to define the library to the Tivoli Storage Manager server GOBI.


The new library type SHARED has been introduced to define a Tivoli Storage Manager server as a library client. While defining a library of libtype SHARED it is necessary to specify the controlling library manager with the parameter PRIMARYLIBMANGER. In this example the PRIMARYLIBMANAGER is Sahara.


```
tsm: GOBI>query library format=detailed

      Library Name: 3570L
      Library Type: SHARED
      Device:
      Private Category:
      Scratch Category:
      External Manager:
      RSM Media Type:
      Shared: No
      Primary Library Manager: SAHARA
      Last Update by (administrator): ADMIN
      Last Update Date/Time: 10/28/1999 17:11:37
```

As soon as the library is set up the tape drives can be defined to the library client. Within this definition the physical connection addresses of the tape drives are used. Because the addresses can differ from the addresses on the library manager the names of the drive objects have to be the same as on the library manager.

4. Tape library sharing utilization

Tape library sharing utilization 		
Server command	Library Manager	Library Client
QUERY LIBVOL	Shows the volumes that are checked into the library. If the volume status is private, also the owner server is shown	Not applicable
CHECKIN/CHECKOUT LIBVOL	Performs the commands to the library	Not applicable, but when a checkin operation must be performed because of a client restore a request is sent to the library manager.
MOVE MEDIA/MOVE DRMEDIA	Only valid for volumes used by the library manager himself	Ask the library manager to perform the operations. A checkout process will be generated on the library manager.
AUDIT LIBRARY	Performs the inventory synchronization with the physical library	Performs the inventory synchronization with the library manager
LABEL LIBVOLUME	Performs the labeling and checkin functions of the tapes as before	Not applicable

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The library commands were changed to reflect the different roles a Tivoli Storage Manager server can play. Some commands can only be used by the library manager (like checkin/checkout); others behave differently.

4.1 QUERY LIBVOLUME

The `query libvolume` command shows a different output if executed in the library manager server or in the library client.

The library manager knows all the volumes inserted in the tape library and, in case of private volumes, also who is the owner server, as reported in the sample output below:

```

tsm: SAHARA>query libvolume

Library Name  Volume Name  Status      Owner      Last Use    Home Element
-----
3570L         07D9A3      Scratch     Scratch    49
3570L         081DF3      Scratch     Scratch    45
3570L         083573      Scratch     Scratch    42
3570L         0838B5      Scratch     Scratch    37
3570L         083964      Scratch     Scratch    43
3570L         083983      Private    SAHARA     DbBackup    38
3570L         085E0A      Scratch     Scratch    41
3570L         086247      Private    SAHARA     Data        32
3570L         0863D3      Scratch     Scratch    47
3570L         08644C      Private    GOBI       Data        50
3570L         08645F      Private    GOBI       Data        46
3570L         0864CA      Private    SAHARA     BackupSet   48
3570L         08659E      Scratch     Scratch    39

```

The library client is not able to use this command, it knows only what volumes are used for data or database backup.

4.2 CHECKIN/CHECKOUT

Only the library manager is responsible to physically insert or take out the volumes from a tape library. For that reason, this server is able execute the `checkin/checkout libvolume` commands. The library client cannot use the commands for a shared library.

If the library client needs to access a tape that is not checked into the library a request is sent to the library manager. The following procedure describes what happens:

1. The library client sends the request to the manager.
2. The library manager sends a message at the console notifying that a volume is requested to be checked-in.
3. The library manager administrator replies to the request.
4. The library manager administrator issues the `checkin libvolume` command for the requested volume.
5. The library manager responds to the library client that the volume is mounted in the drive and can be used.

4.3 MOVE MEDIA/MOVE DRMEDIA

If, during a `move media` or `move drmedia` command, a checkout has to be performed, the library client sends a checkout request to the library manager, which then checks out the volume.

4.4 AUDIT LIBRARY

The `audit library` operation is different if is executed from the library manager or the library client.

The library manager performs the audit with the tape library, as usual, and synchronizes the inventory information with actual the inventory of the tape library.

The library client performs the audit with the library manager. The client sends a list of the volume names which it owns to the server, so that the value can be compared and updated on the library manager.

Note:

Always, the last client that claims the ownership of a volume will be inserted in the library manager's library inventory table.

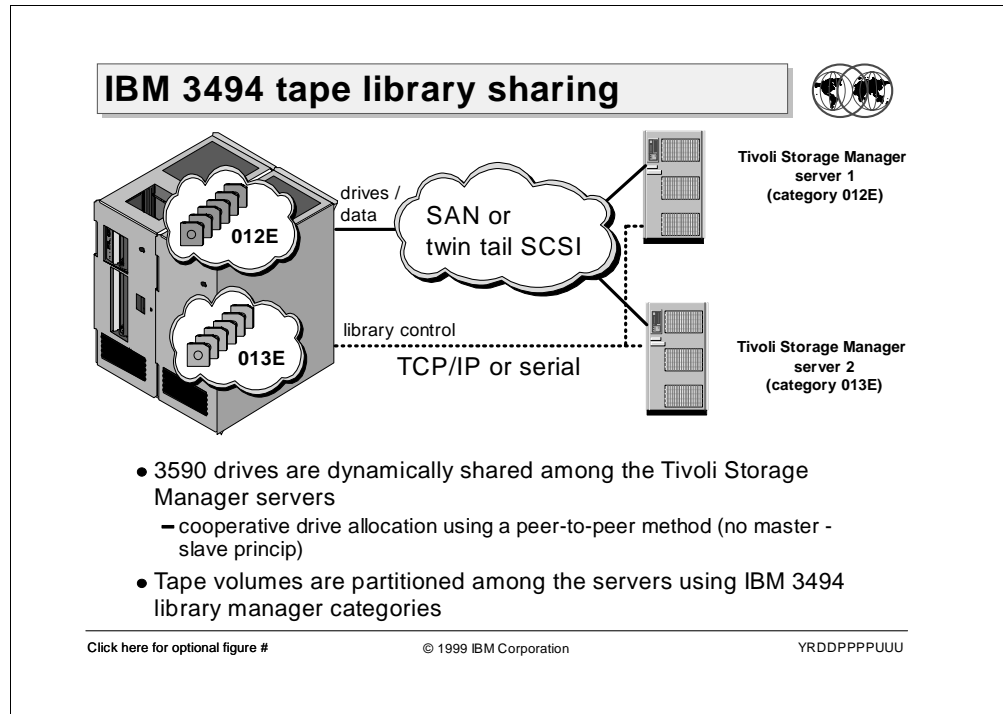
4.5 LABEL LIBVOLUME

The `label libvolume` command can be executed only by the library manager, because after the labeling, a checkin operation is performed.

4.6 QUERY MOUNT/DISMOUNT VOLUME

The `query mount` and `dismount volume` commands can be used by the library manager and the library client.

5. IBM 3494 tape library sharing



Sharing of the IBM 3494/3590 Tape Library does not require nor use the Tivoli Storage Manager 3.7 tape library sharing support. The 3494 can be shared among multiple ADSM/Tivoli Storage Manager servers or other applications that use the 3494 sharing capabilities (see *Guide to Sharing and Partitioning IBM Tape Library Dataservers*, SG24-4409). Furthermore, the 3590 tape drives in a 3494 can now be dynamically shared among multiple ADSM/Tivoli Storage Manager servers using either the SAN Data Gateway or the Auto-Share feature of the twin tailed tape drive. If the 3494/3590 is shared among Tivoli Storage Manager and applications that do not use the proper protocol, the results are unpredictable and can result in Tivoli Storage Manager over-writing data, or other ill-behaved applications can overwrite the Tivoli Storage Manager tapes.

The Tivoli Storage Manager server option 3494SHARED YES must be specified, if you are sharing the 3494 library with other applications including another ADSM/Tivoli Storage Manager server.

The IBM 3494/3590 Tape Library sharing has no single controlling server (like the library manager server of the Tivoli Storage Manager Version 3.7 tape library sharing solution) to control and serialize the access to the drives. Drive allocation happens cooperative on a peer-to-peer level. Together with IBM 3494s built-in capability to do tape cartridge allocation with the option of HA components (redundant library manager and accessors), Tivoli Storage Manager and the IBM 3494 tape library create the only known tape sharing solution with the capability to have no single-point-of-failure for the library control.

The IBM 3494/3590 Tape Library sharing does not support the dynamic sharing of tape volumes. All of the tape volumes have to be pre-assigned to the different applications which share the library, using 3494 library manager category codes.

5.1 3494 tape library sharing with SAN Data Gateway connected 3590

Today, without Tivoli Storage Manager 3.7, you can share a 3494 library with multiple ADSM/Tivoli Storage Manager servers with SAN Data Gateway connected 3590s. The 3494 does not require and is not supported by Tivoli Storage Manager 3.7 library sharing because the 3494 has its own library manager and does not support SCSI commands for library control.

The configuration (at a high level) for ADSM/Tivoli Storage Manager sharing of a 3494 consist of the Tivoli Storage Manager servers connected to a SAN Data Gateway. Connected to the SAN Data Gateway are the SCSI attached 3590 drives. The 3494 robotics command connection to the Tivoli Storage Manager servers is through a TCP/IP or serial connection.

The SAN data gateway supports reservation of a 3590 drive, once it is opened by a ADSM/Tivoli Storage manager server. This will cause the ADSM/Tivoli Storage manager server to see the drive as unavailable and cause the server to look for another available drive.

5.2 3494 tape library sharing with twin tail SCSI connected 3590

You can share a 3494 library with multiple ADSM/Tivoli Storage Manager servers with twin tail SCSI connected 3590s. The 3494 does not require and is not supported by Tivoli Storage Manager 3.7 library sharing because the 3494 has its own library manager and does NOT support SCSI commands for library control.

Some Tivoli Storage Manager server platforms today support the use of twin tail connected 3590 drives in a 3494 library. A key component is the ability of ADSM/Tivoli Storage Manager to look for available drives at mount time and to skip drives that are temporarily unavailable. This is supported on AIX, Sun Solaris, and Windows NT. With twin tail connections, multiple Tivoli Storage Manager servers can be SCSI connected to the 3590 drives in a 3494. The Tivoli Storage Manager servers could share the drives to which they are connected.

Dynamic sharing was not supported on the twin-tailed drive prior to the addition of the 3590 Auto-Share feature. This feature greatly reduces the risk of loss of a 3590 reservation due to SCSI hard reset conditions. This is accomplished by automatically taking the non-reserving 3590 SCSI port offline while reservation is active.

This twin tail connection support is restricted to only ADSM/Tivoli Storage Manager servers that use device drivers that have the above mentioned support implemented. Drive sharing with other applications is not predictable. Although the AS/400 Tivoli Storage Manager server has this support implemented, the AS/400 can take complete ownership of the drives at the OS level and can cause unpredictable results and therefor is not supported.

5.3 Tape volume partitioning

To partition the library volumes among the Tivoli Storage Manager servers, the servers have to be assigned unique 3494 categories for the tapes that each server would use. Each ADSM/Tivoli Storage Manager server sharing the library will use a unique 3494 category for its scratch and private tapes. Tapes checked into the library will have to be checked in by the ADSM/Tivoli Storage Manager server that will use them.

Special Notices

This publication is intended to help customers, consultants, IBM and Tivoli Business Partners and staff understand Tivoli Storage Manager Version 3.7. The information in this publication is not intended as the specification of any programming interfaces that are provided by Tivoli Storage Manager Version 3.7. See the PUBLICATIONS section of the IBM Programming Announcement for Tivoli Storage Manager Version 3.7. for more information about what publications are considered to be product documentation.

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