



# IBM Tivoli Training Tivoli Storage Manager 5.5

## *Preventing backup failures with storage pool automation*



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Slide 1

Welcome to the IBM Education Assistant training for IBM Tivoli Storage Manager version 5.5. This module covers the prevention of backup failures by ensuring there is available space with the automation of storage pool maintenance tasks. In this training, Tivoli Storage Manager is also referred to as TSM.

## Objectives

Upon completion of this module, you should be able to:

- Describe and schedule data expiration.
- Describe and schedule reclamation of space on tapes.
- Describe and schedule data migration.

### Slide 2 **Objectives**

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Describe and schedule data expiration.

Describe and schedule reclamation of space on tapes.

Describe and schedule data migration.

## Preventing backup failures

**ANS1311E ANS1329S ANR0522W**

Server out of data storage space during backup

- Data reduction; only back up necessary files
- Automate storage pool management (expiration, reclamation, and migration)
- Allocate additional space to the storage pool
- Allocate more scratch tapes

### Slide 3 Preventing Backup Failures

Common error messages seen for backup failures, are ANS1311E, ANS1329S, and ANR0522W. These are for Server out of data storage space during backup.

Various issues such as lack of storage pool space, lack of tapes, hardware problems or configuration problems can cause these messages .

To prevent the Server out of data storage space errors, consider the following actions:

- Data reduction; only back up necessary files
- Automate storage pool management such as expiration, migration, and reclamation
- Allocate additional space to the storage pool
- Allocate more scratch tapes

This IBM Education Assistant module covers the prevention of backup failures by ensuring there is available space with the automation of storage pool maintenance tasks.

## Expiration

**Expiration** is the process by which files are identified for deletion because their expiration date or retention period has passed. Backed up or archived files are marked expired by IBM Tivoli Storage Manager based on the criteria defined in the backup or archive copy group.

Files expire under the following conditions:

- You delete the files from the client nodes
- You expire the files manually by using the EXPIRE command on the client
- A backup version of a file exceeds the number of inactive versions allowed by policy (specified in backup copy group)
- An archived file exceeds how long archived copies are kept, specified in the archive copy group
- A backup set exceeds its specified retention time

### Slide 4 Expiration

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Files expire under the following conditions:

You delete the files from the client nodes

You expire the files manually by using the EXPIRE command on the client

A backup version of a file exceeds the number of inactive versions allowed by policy (specified in backup copy group)

An archived file exceeds how long archived copies are kept, specified in the archive copy group

A backup set exceeds its specified retention time

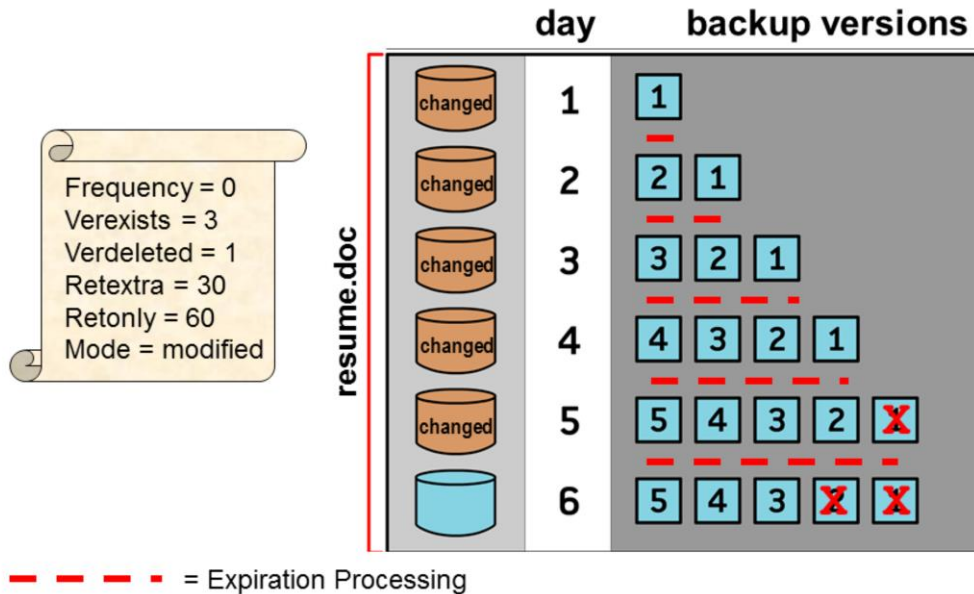
**Note:** A base file is not eligible for expiration until all of its dependent subfiles have been expired.

Also, an archive file is not eligible for expiration if there is a deletion hold on it. If a file is not held, it will be handled according to existing expiration processing.

The server deletes expired files from the server database only during expiration processing.

After expired files are deleted from the database, the server can reuse the space in the storage pools that was occupied by expired files. You should ensure that expiration processing runs periodically to allow the server to reuse space.

## Example of expiration processing: Versions exist



### Slide 5 Example of Expiration Processing: Versions Exist

The slide shows the life cycle of a backed up client file as it is stored in a TSM storage pool.

A scheduled incremental backup is run every evening, followed by expire inventory.

The copy group values for this file are:

- Frequency = 0
- Verexists = 3 (Maximum)
- Verdeleted = 1
- Retextra = 30 (File exists on workstation)
- Retonly = 60 (File deleted from workstation)
- Mode = modified

On day 1 the file is created. That evening it is backed up and expire inventory is run. The file would be marked as active.

On day 2, the file is changed, backed up, and expiration is run. The backup for day 2 becomes active. The backup from day 1 becomes inactive.

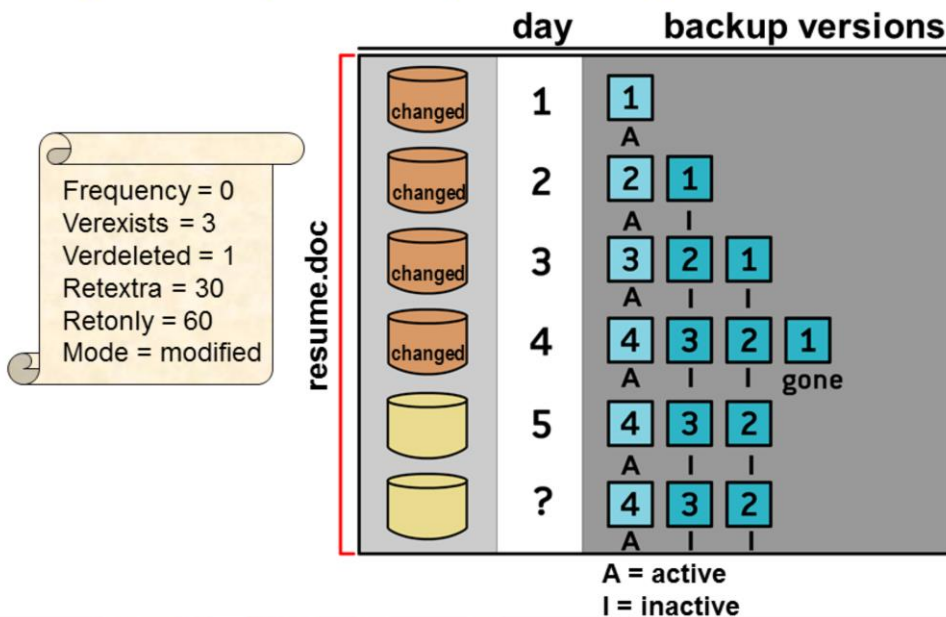
On day 3, the file is changed, backed up, and expiration is run. The backup for day 3 becomes active. The backups from days 1 and 2 become inactive. Since Versions Exist is set to 3, no files have expired and nothing has been removed during expiration processing.

On day 4, the file is changed, backed up, and expiration is run. The backup for day 4 becomes active. The backups from days 1, 2, and 3 become inactive. Because we are only keeping three versions of the file, the backup from day 1 (the 4th backup) expires and is removed during expiration processing.

On day 5, the file is changed, backed up, and expiration is run becomes the active file. The backups from days 1, 2, and 3 become inactive. Because we are only keeping three versions of the file, the backup from day 2 also expires and is removed during expiration processing.

On day 6, the file is not changed or backed up. Because we have three versions of the file after expiration on day 5, there is no change. The file from day 5 is active and the files from days 4 and 3 are inactive. We have 3 versions of the file.

## Example of expiration processing: Retain extra



### Slide 6 Example of Expiration Processing: Retain Extra

We are using the same copy group parameters as previously.

A scheduled incremental backup is run every evening, followed by expire inventory.

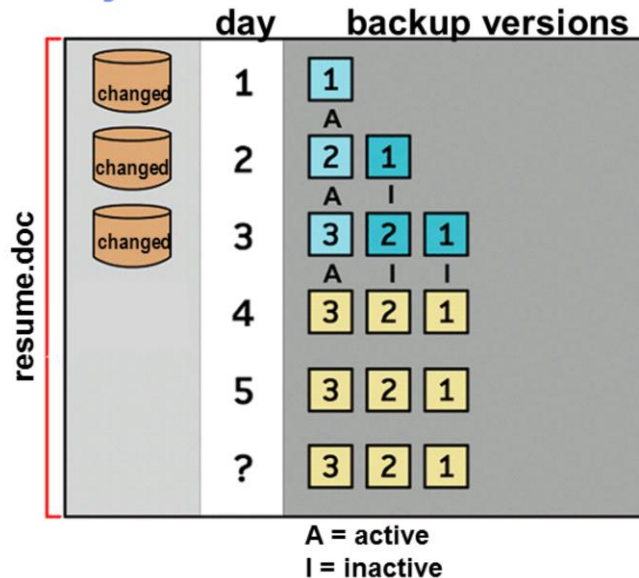
Note that backup 1 on day 4 is gone because we are keeping only 3 versions based on VERExist=3. Notice, too, that the file goes unchanged after day 4. In this case, can you predict the results for day 33?

On day 33, only one version remains. This is because RETAINEXTRA is set to 30. If you always want three versions RETAINEXTRA needs to be NO LIMIT.

Can you predict when backup 2 would expire? Backup 2 would expire on day 33 because it became inactive on day 3 and you would add 30 days based on RETEXTRA=30.

## Example of expiration processing: Versions deleted and retain only

Frequency = 0  
 Verexists = 3  
 Verdeleted = 1  
 Retextra = 30  
 Retonly = 60  
 Mode = modified



### Slide 7 Example of Expiration Processing: Versions Deleted and Retain Only

We are using the same copy group parameters as previously.

A scheduled incremental backup is run every evening, followed by expire inventory.

What happens if the file is removed from the client workstation on the morning of day 4?

Backup 3 will become inactive if the file is deleted.

How many extra copies will be there after the incremental backup on day 4?

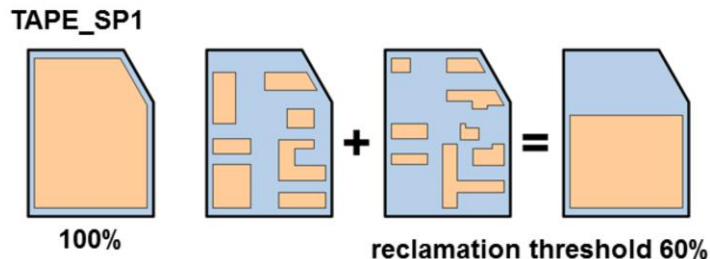
To determine this, notice that VERDELETED is set to 1. This means that backups 1 and 2 will be removed.

Can you predict when the only backup will expire and be removed?

The only backup will expire and be removed on day 64 because RETONLY is set to 60.

## Reclamation

Reclamation is a process of consolidating the remaining data from many sequential access volumes onto fewer new sequential access volumes. Lower threshold = more tapes; faster reclamation. Higher threshold = fewer tapes, longer reclamation.



- Use the **RECLAIM STGPOOL** command to initiate an automatic drive reclamation for a sequential access primary or copy storage pool.
- Empty tapes move back to scratch or private pools.
- Reclamation of an active-data pool recovers space used by inactive and deleted files.

### Slide 8 Reclamation

Reclamation is a process of consolidating the remaining data from many sequential-access volumes onto fewer, new sequential-access volumes. A lower threshold results in more tapes and faster reclamation. A higher threshold results in fewer tapes and longer reclamation.

When the percentage of reclaimable space on a volume exceeds the reclamation threshold set for the storage pool, the volume is eligible for reclamation. The server checks whether reclamation is needed at least once per hour and begins space reclamation for eligible volumes. You can set a reclamation threshold for each sequential-access storage pool when you define or update the pool. During space reclamation, the server copies files that remain on eligible volumes to other volumes.

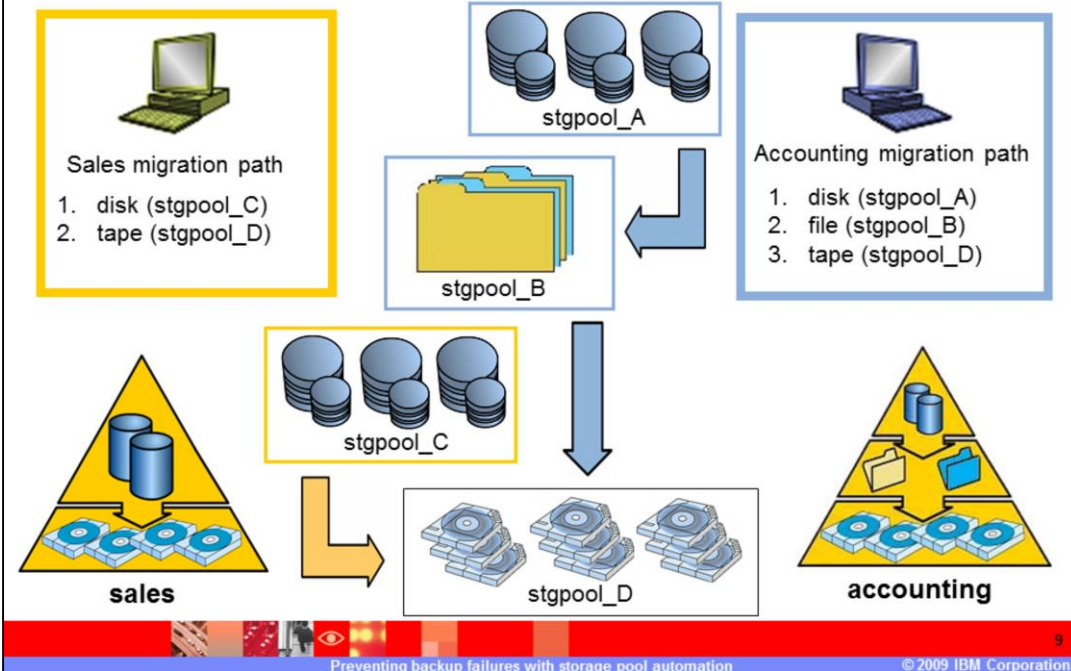
The `reclaim stgpool` command enables you to manually drive reclamation for a sequential-access primary or copy storage pool.

When multiple volumes are eligible for reclamation, Tivoli Storage Manager reclaims the eligible volumes in random order.

Space within aggregate files is also reclaimed during the reclamation process. An aggregate is a physical file that contains multiple logical files backed up or archived from a client in a single transaction. Unused space from expired or deleted logical files is removed as the aggregate file is copied to another volume during reclamation.



## Automatic data movement: Migration



### Slide 9 Automatic Data Movement: Migration

Automatic data movement between storage pools is used to balance the performance and cost of different storage devices while ensuring adequate free space to satisfy new space allocations. This process is known as migration.

For each storage pool, you define low and high migration thresholds. Migration thresholds are based on a percentage of the storage pool's total data capacity.

The low threshold identifies the amount of free space needed to satisfy the daily processing requirements of your business.

The high threshold is used to trigger migration and ensure that enough free space is available while migration is performed. The difference between the high and low thresholds indicates the approximate amount of data that will be migrated.

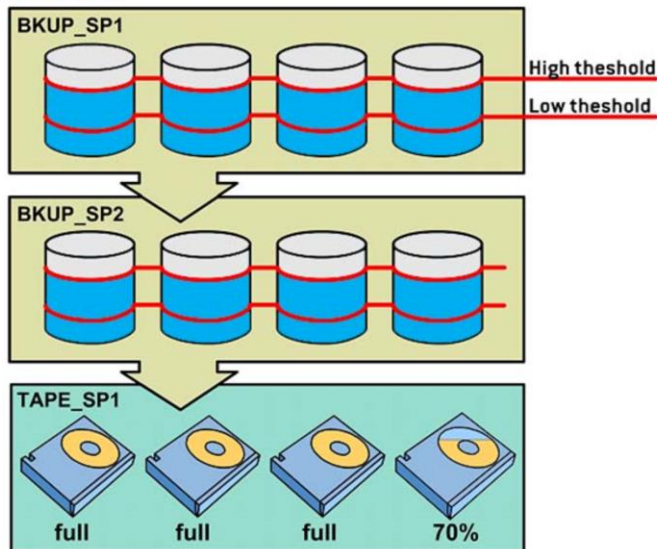
To reduce tape mounts and to use the space on tape volumes most effectively (when collocation is not used), ensure that the amount of data that is migrated from a disk storage pool is a multiple of the capacity of a tape volume in the next storage pool.

This slide shows two scenarios. On the left, the Sales department's data is written first to disk (storage pool C, the primary storage pool), then migrates to tape (storage pool D). On the right, the Accounting department's data is backed up to disk (storage pool A, the primary storage pool), then migrates to file (storage pool B), then migrates to tape (storage pool D).

## Storage pool migration

When the high threshold is reached, files are migrated to the specified next-in-chain storage pool.

Migration ends when the amount of space used in the storage pool reaches the low migration threshold.



### Slide 10 Storage Pool Migration

No migration occurs if there is no next storage pool. Tivoli Storage Manager first identifies which client node has backed up or migrated the largest single file space, or has archived files that occupy the most space. When the server identifies that client node, the server migrates all files from every file space belonging to that client.

When the high threshold is reached, files are migrated to the specified next-in-chain storage pool. Migration ends when the amount of space used in the storage pool reaches the low migration threshold.

The migration applies to those files whose number of days in the storage pool exceeds the value specified by the migration delay, or MIGDELAY parameter, specified during the define or update storage pool commands.

After the files for the first client node are migrated to the next storage pool, the server checks the low migration threshold for the storage pool to determine if the migration process should be stopped. If the amount of space used in the storage pool is now below the low migration threshold, migration ends. If not, using the same criteria as previously described, Tivoli Storage Manager chooses another client node, and the migration process continues.

If the value for migration continue, or MIGCONTINUE, has been set to YES, then Tivoli Storage Manager continues the migration process based on how long the files have been in the storage pool. This is also specified during the define or update storage pool commands.

The oldest files are migrated first until the low migration threshold is reached. If the value for MIGCONTINUE has been set to NO, then the migration process ends, and a warning message will be issued to the administrator.

If multiple migration processes are running (controlled by the MIGPROCESS parameter of the define stgpool command), the files for more than one node may be chosen for migration at the same time.

If the cache option is enabled during the define or update storage pool commands, files that are migrated remain on disk storage (that is, the files are cached) until space is needed for new files. You can enable caching by specifying CACHE=YES when you define or update a disk storage pool. When caching is enabled, the migration process leaves behind duplicate copies of files on disk after the server migrates these files to subordinate storage pools in the storage hierarchy.

The copies remain in the disk storage pool, but in a cached state, so that subsequent retrieval requests can be satisfied quickly. However, if space is needed to store new data in the disk storage pool, cached files are erased and the space they occupied is used for the new data.

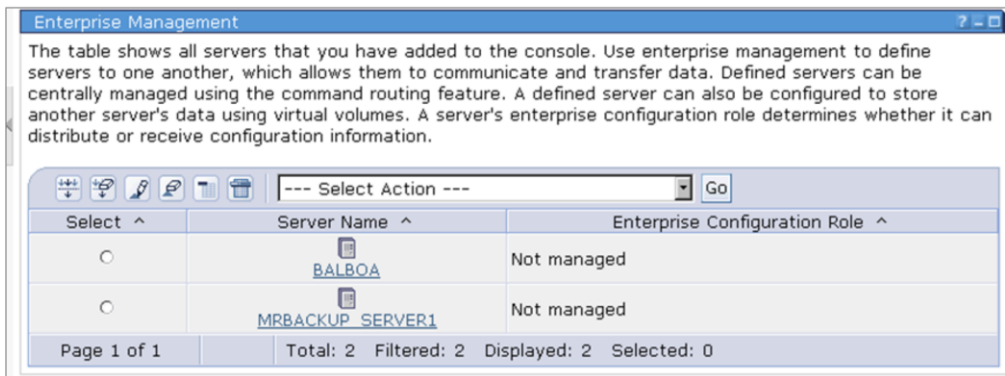
The advantage of using a cache for a disk storage pool is that caching can improve how quickly the server retrieves some files. When you use a cache, a copy of the file remains on fast disk storage after the server migrates the primary file to another storage pool. You may want to consider using a disk storage pool with caching enabled for storing space-managed files that are frequently accessed by clients.

However, using a cache has some important disadvantages, such as:

- It can increase the time for client backup operations to complete.
- It can require more space for the Tivoli Storage Manager database.



The migrate stgpool command allows you to manually run migration for a random-access or sequential-access primary storage pool.

## How to automate storage pool maintenance



The screenshot shows the Enterprise Management console. At the top, there is a title bar "Enterprise Management" with a help icon and a close button. Below the title bar is a text area explaining the table's purpose: "The table shows all servers that you have added to the console. Use enterprise management to define servers to one another, which allows them to communicate and transfer data. Defined servers can be centrally managed using the command routing feature. A defined server can also be configured to store another server's data using virtual volumes. A server's enterprise configuration role determines whether it can distribute or receive configuration information."

Below the text area is a toolbar with several icons and a dropdown menu labeled "--- Select Action ---" with a "Go" button.

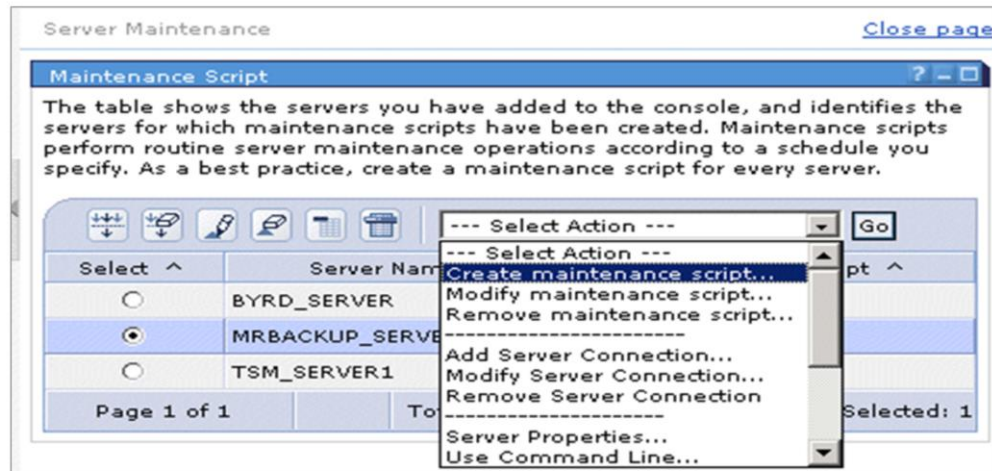
Select ^	Server Name ^	Enterprise Configuration Role ^
<input type="radio"/>	 <a href="#">BALBOA</a>	Not managed
<input type="radio"/>	 <a href="#">MRBACKUP_SERVER1</a>	Not managed

Page 1 of 1      Total: 2   Filtered: 2   Displayed: 2   Selected: 0

### Slide 11 How to Automate Storage Pool Maintenance

Select **Server Maintenance** in the Tivoli Storage Manager tree, and the Server Maintenance page will display as shown.

## Selecting the specific server and task



Server Maintenance [Close page](#)

**Maintenance Script** ? - □

The table shows the servers you have added to the console, and identifies the servers for which maintenance scripts have been created. Maintenance scripts perform routine server maintenance operations according to a schedule you specify. As a best practice, create a maintenance script for every server.

Select ^	Server Name	pt ^
<input type="radio"/>	BYRD_SERVER	
<input checked="" type="radio"/>	MRBACKUP_SERVE	
<input type="radio"/>	TSM_SERVER1	

Page 1 of 1 To Selected: 1

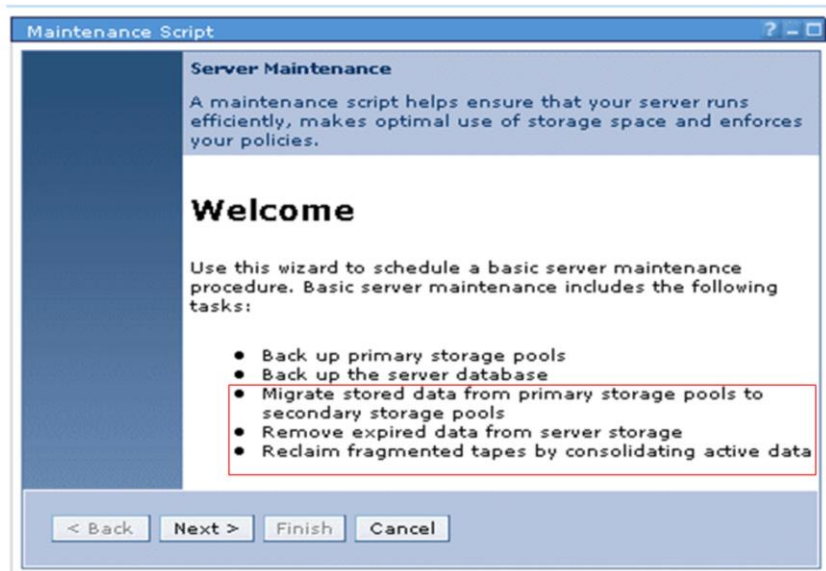
--- Select Action --- Go

- Select Action ---
- Create maintenance script...
- Modify maintenance script...
- Remove maintenance script...
- 
- Add Server Connection...
- Modify Server Connection...
- Remove Server Connection
- 
- Server Properties...
- Use Command Line...

### Slide 12 Selecting the Specific Server and Task

Select the server you want to make the script for, and from the Select Action menu select **Create maintenance script**. The options to modify and to remove a script are also available from the same menu.

## Server maintenance scripts



### Slide 13 Server Maintenance Scripts

While backing up the server database and storage pools are vital server maintenance processes, this training module is focused on stored data migration, expiration, and reclamation.

Here, the Server Maintenance wizard appears. Click Next.

## Maintenance tasks



### Slide 14 Maintenance Tasks

This is a close up of the left pane of the wizard. It shows the sequence of processes that will be scheduled.

Click Next to progress through the screens.

# Migrate stored data

The screenshot shows a web-based configuration interface for migrating stored data. The window title is 'Server Maintenance' and the page is titled 'Migrate Stored Data'. On the left, a navigation pane lists several options: 'Back Up Server Database', 'Back Up Storage Pools', 'Migrate Stored Data' (which is selected), 'Expire Stored Data', 'Reclaim Tapes', and 'Schedule Maintenance'. The main content area is titled 'Migrate Stored Data' and contains the following text: 'By regularly migrating data from one storage pool to another, you maintain free space in the first storage pool. For example, migrate data from the storage pool that uses your fastest disk device to a tape storage pool, freeing space for new data to be stored in the disk storage pool. Including this task will create a more comprehensive maintenance script, but it is not required.' Below this text is a section titled 'Back Up Storage Pools' with the instruction 'Select the storage pools to migrate. Use Shift + click to select more than one.' A list box contains one entry, 'BACKUPPOOL'. Further down, there are two configuration sections: 'Perform migration until the data remaining in the storage pool occupies this percentage of its total capacity.' with a text input field containing '0', and 'Cancel the process after it has run for the following amount of time. In some cases, migration will continue for a short time after the process is cancelled.' with a text input field for minutes. At the bottom of the window are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'. The footer of the slide features a red banner with the text 'Preventing backup failures with storage pool automation' and '© 2009 IBM Corporation' on the right side, along with the number '15'.

## Slide 15 Migrate Stored Data

Select the storage pool to migrate, set the migration threshold, and set the amount of time the process can run before it is canceled. Click **Next** to continue.

## Using the administration center for migration, the general screen

The screenshot displays the 'DISKPOOL Properties (TSM\_SERVER1)' window. On the left is a navigation pane with tabs for 'General', 'Migration', 'Volumes', and 'Advanced options'. The 'General' tab is selected, showing a description of storage pools and several configuration fields:

- Storage pool name:** DISKPOOL
- Storage pool description:** default disk stg pool
- Storage pool type:** Primary, random access
- Next storage pool:** LASTINCHAIN (dropdown menu)
- Device class name:** DISK

### Slide 16 Using the Administration Center for Migration, the General Screen

Select the Next storage pool.



## Using the administration center for migration, migration threshold

DISKPOOL Properties (TSM\_SERVER1)

**Migration**

Primary storage pools are typically arranged in a hierarchy, with data migrating from one media type to another. It is often most efficient and cost-effective to initially store data on disk and then migrate it to tape.

Migration high threshold: 90 %      Migration low threshold: 70 %

Number of parallel processes to use during migration: 1

Minimum amount of time to retain a file in the storage pool before migrating it: 0 days

Ignore the minimum retention time if the low migration threshold has not been reached

Leave a copy of the files in the storage pool after migration (caching)

### Slide 17 Using the Administration Center for Migration, Migration Threshold

Click Storage Devices in the Tivoli Storage Manager tree.

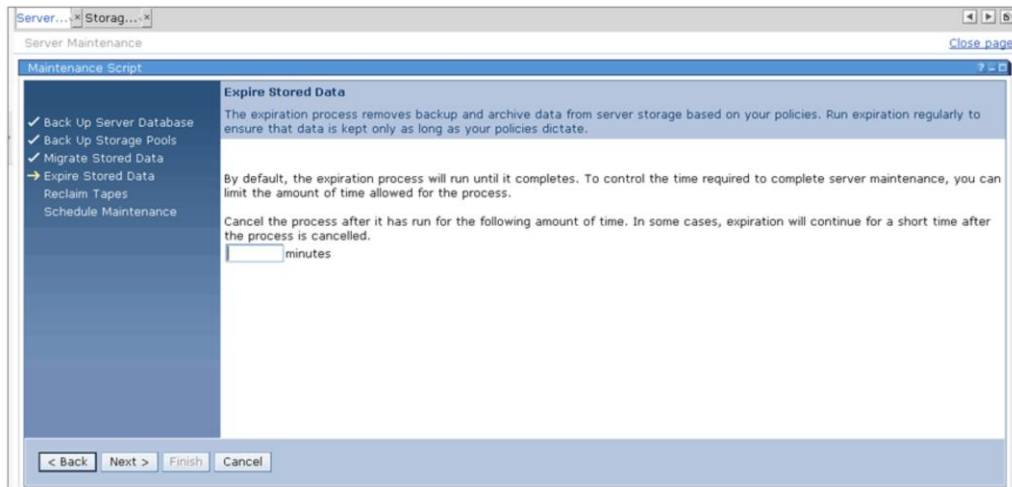
In the Servers table, select a server.

Click Select Action, select View Storage Pools.

In the server's storage pools portlet, click a storage pool name.

In the storage pool's properties notebook, click the Migration tab.

## Expire stored data



### Slide 18 Expire Stored Data

If you want to limit the amount of time allowed for the expiration process, set that value here, and click **Next** to continue.

# Reclamation

Server Maintenance Close page

Maintenance Script

- ✓ Back Up Server Database
- ✓ Back Up Storage Pools
- ✓ Migrate Stored Data
- ✓ Expire Stored Data
- Reclaim Tapes
- Schedule Maintenance

### Reclaim Tapes

Tapes eventually get fragmented because users' files expire or are deleted. The reclamation process takes the valid data from fragmented tapes and consolidates the data onto a smaller number of tapes. Tapes are returned to scratch status for reuse by the server. Including this task will create a more comprehensive maintenance script, but it is not required.

**i** Reclamation can only be run for primary storage pools that use sequential media. There are no eligible storage pools defined for the server. Click Next to continue creating the maintenance script.

Select the storage pools for which to run reclamation. Use Shift + click to select more than one.

-- Not defined --

By default, tapes will be reclaimed when unused space reaches 50% of capacity. To improve performance, consider increasing this value if your storage pools contain a large number of empty tapes.

Reclaim a tape when unused space on it reaches this percentage of capacity.

50 % capacity occupied

By default, the reclamation process will run until it completes. To control the amount of time the server spends performing maintenance, you can limit the amount of time allowed for the process. Limiting the amount of time can cause the process to be cancelled before it completes.

Cancel the process after it has run for the following amount of time. In some cases, reclamation processing will continue for a short time after the process is cancelled.

minutes

< Back   Next >   Finish   Cancel



## Slide 19 Reclamation

Select the storage pool to run reclamation for, set the percent of unused space which will be the trigger to start the reclamation process, and set the amount of time the process is allowed to run.

## Schedule maintenance

Server... | Stora... | Server Maintenance | Close page

Maintenance Script

- ✓ Back Up Server Database
- ✓ Back Up Storage Pools
- ✓ Migrate Stored Data
- ✓ Expire Stored Data
- ✓ Reclaim Tapes
- Schedule Maintenance

**Schedule Maintenance**

Run the maintenance script regularly. You might want to start by running it daily, and then adjust the frequency according to your system's needs.

When do you want to start this maintenance procedure?

12/6/08 1:33:36 PM

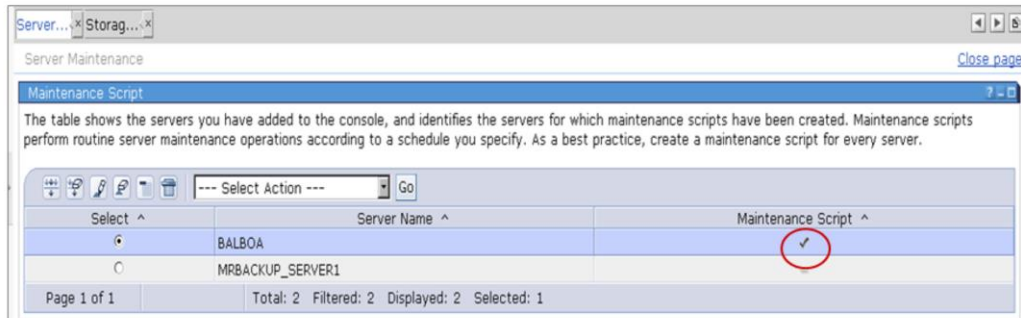
Sunday  Tuesday  Thursday  Saturday  
 Monday  Wednesday  Friday

< Back Next > Finish Cancel

### Slide 20 **Schedule Maintenance**

Set the schedule for the script, including date and time, and click **Finish**.

# Finish



Server Maintenance [Close page](#)

**Maintenance Script** ? -

The table shows the servers you have added to the console, and identifies the servers for which maintenance scripts have been created. Maintenance scripts perform routine server maintenance operations according to a schedule you specify. As a best practice, create a maintenance script for every server.

--- Select Action --- Go

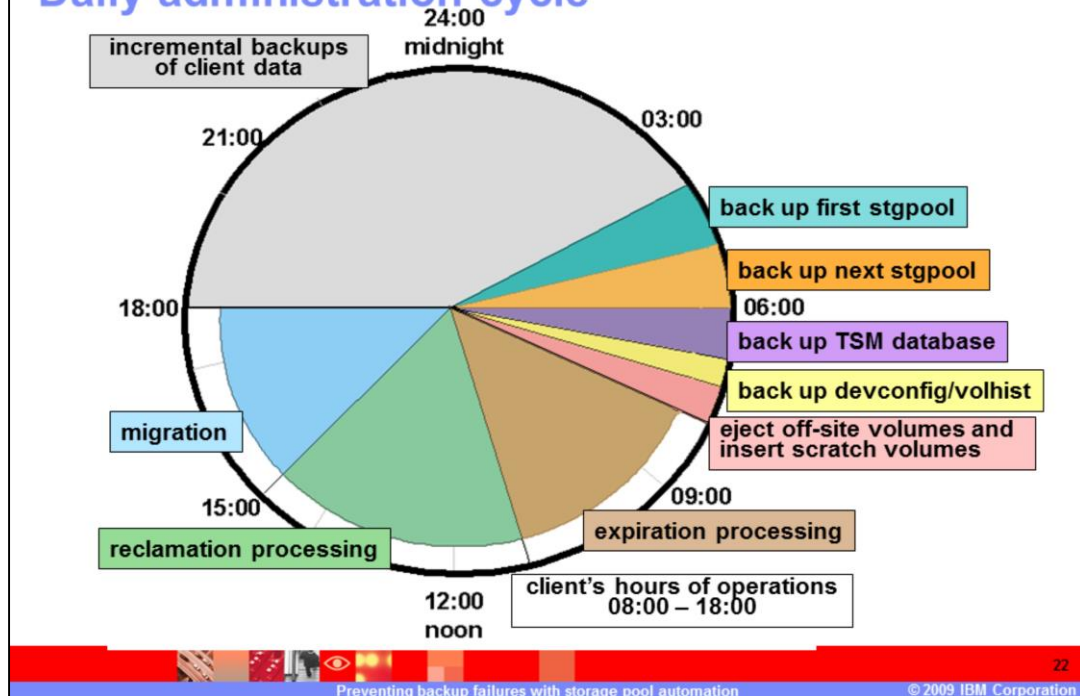
Select ^	Server Name ^	Maintenance Script ^
<input checked="" type="radio"/>	BALBOA	<input checked="" type="checkbox"/>
<input type="radio"/>	MRBACKUP_SERVER1	<input type="checkbox"/>

Page 1 of 1 Total: 2 Filtered: 2 Displayed: 2 Selected: 1

## Slide 21 Finish

The check mark under the Maintenance Script heading indicates a maintenance script has been created for this server.

## Daily administration cycle



### Slide 22 Daily Administration Cycle

This is one example of the daily operations of an IBM Tivoli Storage Manager administrator. In this example, data files are backed up during the night. Once the backups are complete, the administrative tasks begin.

The storage pools are backed up in order, starting with the primary storagepool. Next, the database is backed up, followed by the devconfig and volhist files being backed up.

The administrator would then remove off-site volumes and insert the scratch volumes.

Finally, expiration, then reclamation, and finally, migration are run.

## Training roadmap for IBM Tivoli Storage Manager

<http://www.ibm.com/software/tivoli/education/index.html>



### Slide 23 Training Roadmap for *IBM Tivoli Storage Manager*

If you go to [www.ibm.com/software/tivoli/education/edu\\_prd.html](http://www.ibm.com/software/tivoli/education/edu_prd.html) this will take you to the training page, where you can access the training list for Tivoli Storage Manager version 5.5.

## Summary

You should be able to:

- Describe and schedule data expiration
- Describe and schedule reclamation of space on tapes
- Describe and schedule data migration

### Slide 24 **Summary**

You should be able to:

Describe and schedule data expiration.

Describe and schedule reclamation of space on tapes.

Describe and schedule data migration.



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