IBM Spectrum **Archive**

Introduction to
IBM Spectrum Scale™ ILM
# and IBM Spectrum Archive™

Agenda

➔ **Spectrum Scale ILM**

Spectrum Archive

Integration of Spectrum Archive with Spectrum Scale
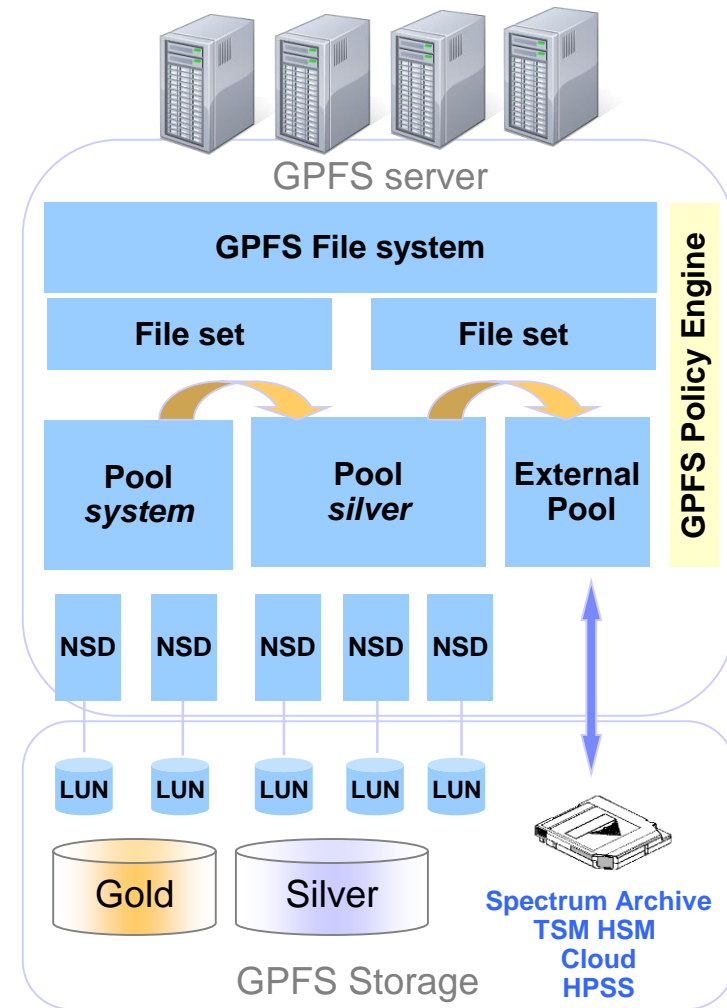
Spectrum Scale and Information Lifecycle Management

- Spectrum Scale supports Information Lifecycle Management
  - ILM means storing data on the most appropriate medium over the lifecycle
- Key techniques to manage storage cost comprise:
  - **Initial placement** of files on the most appropriate storage medium
  - **Automated based migration** during the lifetime of the files based on age, size, etc.
  - Transparent file access in in the original name space
- ILM provides cost efficiency, especially for longer data lifecycles

Spectrum Scale cluster

Storage Network

Spectrum Scale storage

Tape
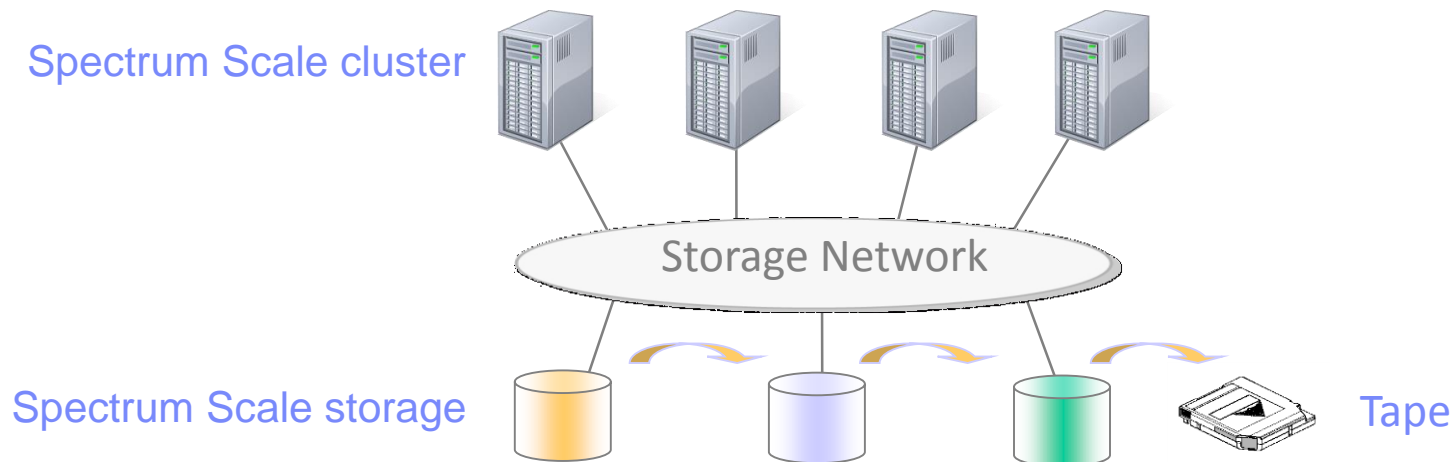
Spectrum Scale ILM tools

- Files stored in file system and underlying pools
  - Pool is a collection of disks of the same type

- Placement policy controls where files are placed
  - Files are placed in pools
  - Placement policy is applied during file creation

- Migration policies control transparent migration of files from one pool to another
  - Applied during life cycle
  - Migrated files can be transparently accessed
  - Files can also be migrated to tape

- Policy engine applies and executes policies

GPFS server

GPFS File system

File set | **File set**

GPFS Policy Engine

Pool *system* | **Pool** *silver* | **External Pool**

NSD NSD NSD NSD NSD

LUN LUN LUN LUN LUN

Gold Silver

Spectrum Archive TSM HSM Cloud HPSS

GPFS Storage

GPFS storage pools

- Two types of Storage Pools: Internal and External

- **Internal pool** – allows placement and migration
  - A collection of disks or arrays with similar properties that are managed together
  - Every file system has at least a "system" pool
    - o GPFS file system metadata is only stored in "system" pool
    - o Maximum of 8 storage pools are possible per file system

- **External pool** – allows migration
  - External pool is an interface (script) to an external application
  - Scripts supported for Spectrum Archive, TSM HSM, Cloud Object Storage or HPSS
  - External application is invoked by policy engine or by command

- Pools are designated by names
  - Pool name "system" is reserved for the standard pool

GPFS policies and rules

- A **policy** is a set of rules that describes the life cycle of files

- Each **rule** defines selection criteria for files and operation to be applied
  - File selection based on file attributes (name, size, age, ...)
  - Operation can be placement, migration, deletion, encryption, list, ...

- A policy can include a mix of different rules

Active and scheduled policies

- One active policy can be configured for a file system
  - Is automatically invoked based on rule type and definitions
  - Active ILM policy for each file system can include:
    - File placement rules
    - Threshold migration rules (space triggers)

- One or more scheduled policies can be run for a file system
  - Are invoked manually or via scheduler
  - Scheduled policies include migration rules
    - Based on file attribute (size, age)

- Active migration policies must be threshold based and simple
- Scheduled migration policies do not require threshold and can be more advanced

GPFS policy engine

- Policy engine evaluates and applies policy rules by:
    - Selecting files based on criteria defined in rules
    - Initiating an action defined by the rules (placement, migration)

- Policy engine runs in three phases on multiple GPFS nodes
    1. Metadata scan: reading directory file metadata from inodes
    2. Rule evaluation: matching file metadata against rules (top down) and selecting file
    3. File operation: performing the action (placement, migration, etc.)

Starting GPFS policy engine

- Active policy for a file system is configured with command: `mmchpolicy`
  - Starts policy engine automatically for placement and threshold based migration

  ```
  mmchpolicy filesystem policyfile [-I yes|test]
  ```

  - When threshold is reached `mmapplypolicy` is invoked via callback

- Scheduled policy for a file system is invoked with command:

  ```
  mmapplypolicy filesystem -P policyfile [-I yes|test| defer]
  ```

GUI integration of ILM in R4.2

- **GUI intuitively allows to manage placement and migration policies**
  - Including syntax and prerequisite check, displays rules

Agenda

Spectrum Scale ILM

➔ **Spectrum Archive**

Integration of Spectrum Archive with Spectrum Scale

Spectrum Archive Architecture

- Spectrum Archive integrates with Spectrum Scale as tape tier
  - Spectrum Scale provides global name space
  - Spectrum Archive migrates data to tape

- Each Spectrum Archive node has tape drives
  - Supports up to two libraries, one per node

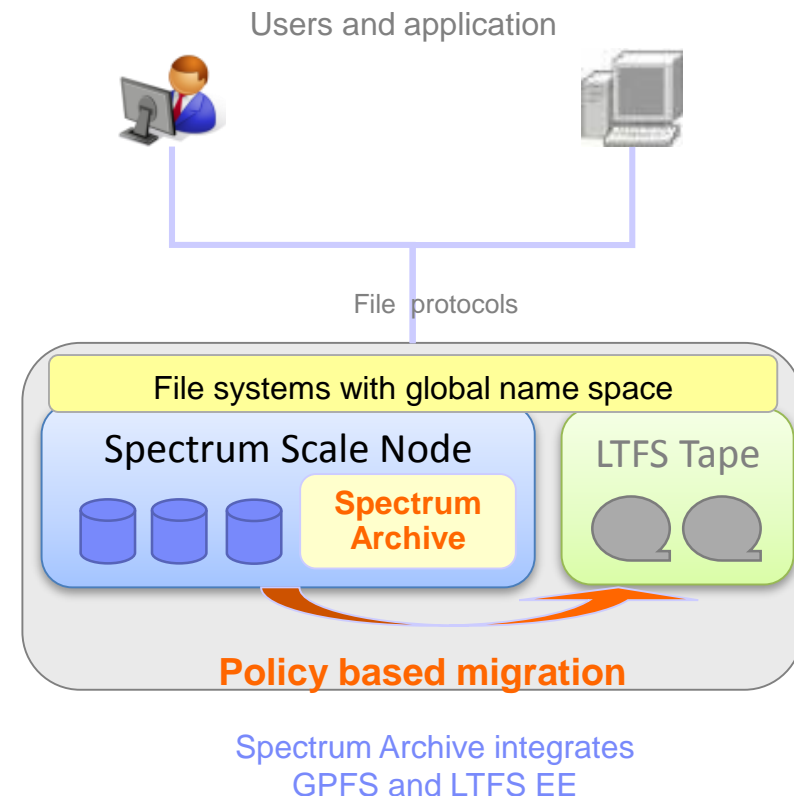- Files are (pre-) migrated from disk to tape
  - Based on policies or file lists
  - Supports multiple copies on distinct tapes

- Files are recalled on access or by command
  - Supports tape optimized recalls

- Tapes can be exported and imported

- Workload is distributed across nodes

Users and application

File protocols

File systems with global name space

Spectrum Scale Node

Spectrum Archive

LTFS Tape

Policy based migration

Spectrum Archive integrates
GPFS and LTFS EE

Spectrum Archive - deployment options

On NSD server

User & App

Spectrum Archive on NSD server

TCP/IP Network

Storage Network

Disk

On NSD client

User & App

TCP/IP Network

Spectrum Archive on NSD client

SAN

TCP/IP Network

NSD server

Storage Network

Storage

With Elastic Storage Server

User & App

TCP/IP Network

Spectrum Archive on NSD client

SAN

TCP/IP Network

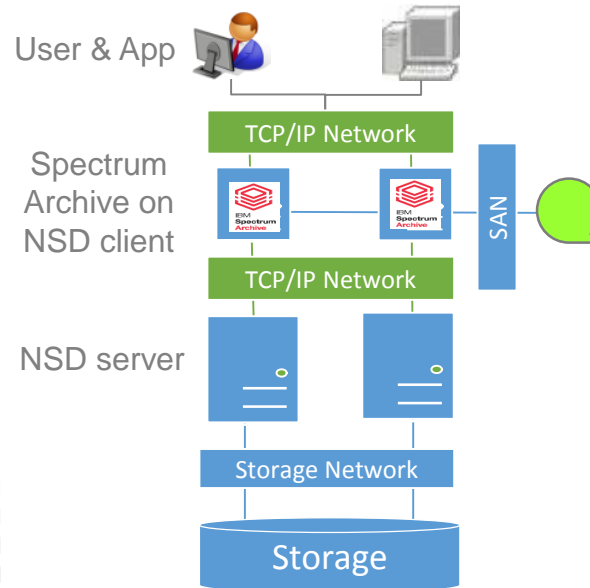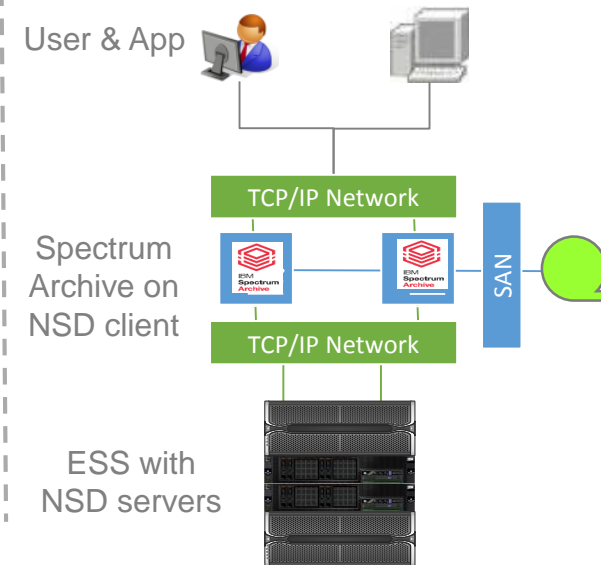ESS with NSD servers
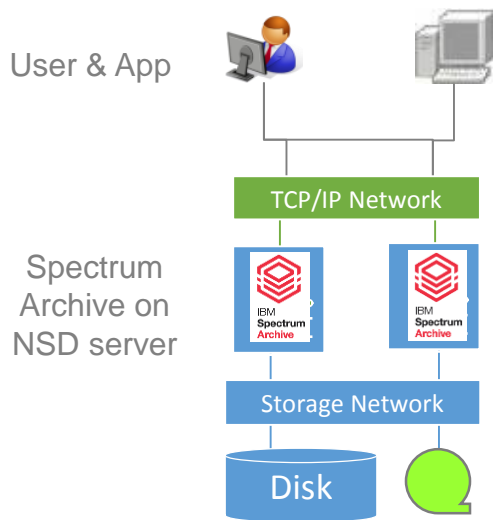
- Spectrum Archive on NSD server
- Direct SAN access disk and tape
- Requires less infrastructure

- Spectrum Archive on NSD client connected to NSD server / ESS
- LAN access to disk, SAN access to tape
- Requires more infrastructure

Spectrum Archive – configuration options

Single Node

User & App

Single Spectrum Archive node on NSD server

TCP/IP Network

Storage Network

Disk

Lib 1
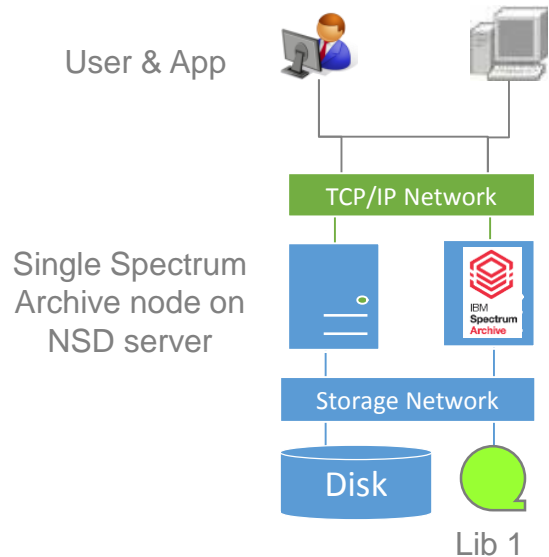
- Single Spectrum Archive node
- Less high availability
- Cost effictive

Multi-node single library

TCP/IP Network

Storage Network

Disk

Lib 1
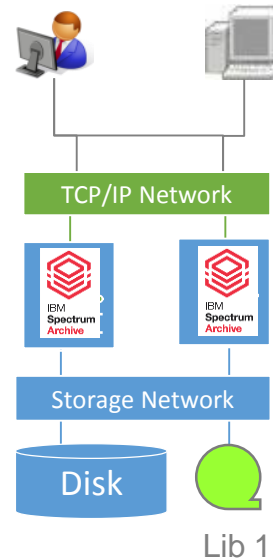
- Multiple Spectrum Archive nodes, one library
- Better high availability
- Scalable performance

Multi-node, two libraries

TCP/IP Network

Storage Network

Disk

Lib 1

Disk

Lib 2
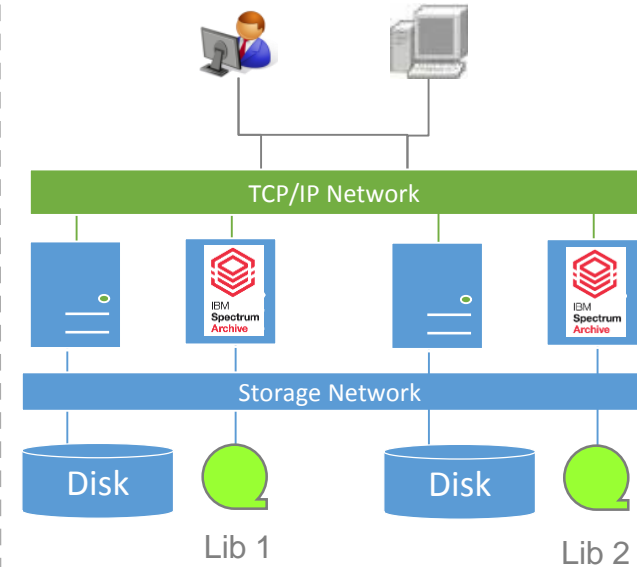
- Multiple Spectrum Archive nodes, two libraries, can stretch over sites
- Better high availability,
- Better disaster protection

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Spectrum Archive functional overview

Users and Applications

User data

Global name space

GPFS Node 1   ## GPFS Node 2

User file system

LTFS EE   LTFS EE

LTFS Metadata

Node group 1   Node Group 2

Migration with optional copy to other tape

Rebuild file system

Recall with option for bulk recall

Import (only creates stubs in GPFS)

Pool 1   Pool 2

Library 1   Library 2

Export with option to keep stub in GPFS

Tape management: reclamation (free space) and reconcilation (synchronize)

Spectrum Archive object: technology outlook

- File systems interfaces for tiered storage systems are <u>blessing and cure</u>
  - Transparent access is a blessing, however user have no awareness of data on tape

- Solution: Integrate tape awareness with OpenStack Swift API
  - Let the user / app control migration and recall and execute it efficiently

	IceTier Swiftbrowser (Frankfurt)					admin:admin
Containers						
Name	Objects	Archived	Size	On disk	On tape	+
▣ newcont	2	1	82,6 KB	57,7 KB	24,9 KB	⌄
▣ testcont	2	1	130,2 KB	128,9 KB	1,3 KB	⌄
		Total size on disk: 186,6 KB			🗑 Delete container	
		Total size on tape: 26,2 KB			➤ Migrate container	
					↻ Recall container	

- "Swift associated project": <u>SwiftHLM middleware</u>
  - Session 3) Object Storage und Swift HLM – 11:00 – 12:00

Agenda

Spectrum Scale ILM

Spectrum Archive

➔**Integration of Spectrum Archive with Spectrum Scale**

Spectrum Scale and Spectrum Archive integration

- **Spectrum Archive is external pool in Spectrum Scale file system**
  - Performs migration and recall on LTFS formatted tapes

- **Policy engine can be used to identify files based on attributes and invokes Spectrum Archive for migration**
  - List of files can also be migrated using commands.

- **Access to files is transparent**
  - Upon access file is recalled

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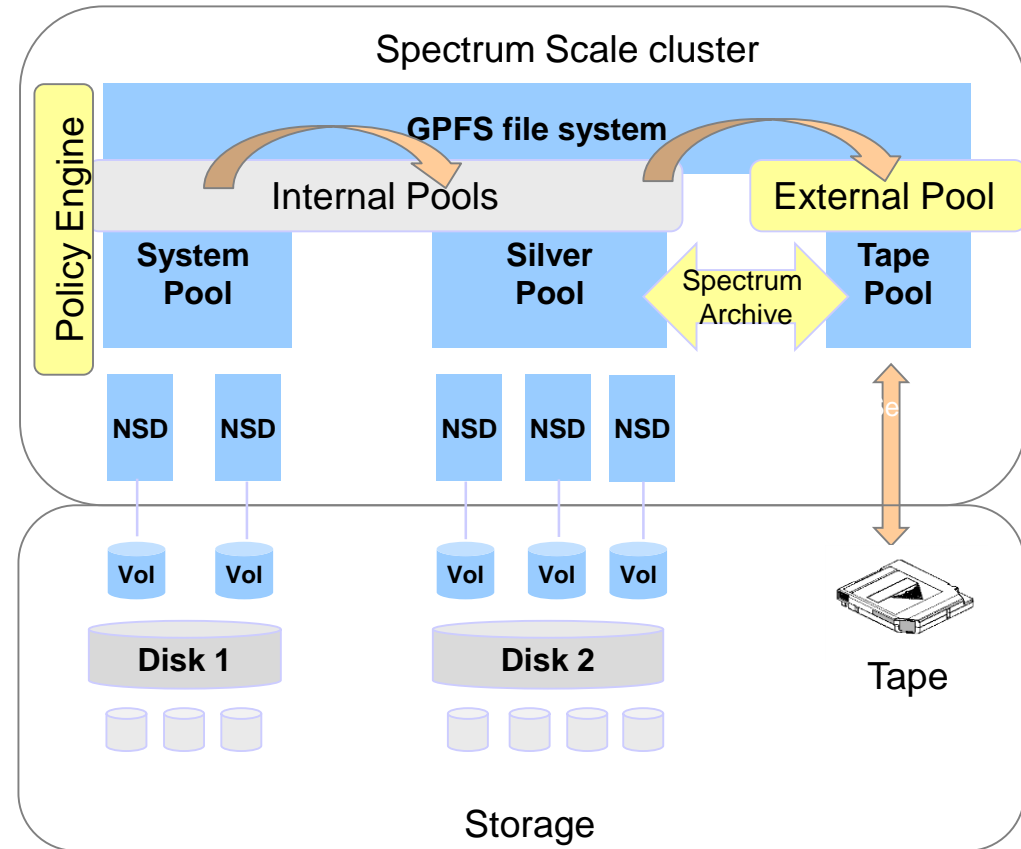
Example for active migration policy with threshold

- **Migration based on threshold**
  - Register callback to trigger migration on lowdiskspace

    ```
    mmaddcallback MIGRATION --command /usr/lpp/mmfs/bin/mmstartpolicy
    --event lowDiskSpace,noDiskSpace --parms "%eventName %fsName
    -N ltfsnodes -m 3 -B 1000 -s /workdir --single-instance"
    ```

  - Create policy text file:

    ```
    RULE EXTERNAL POOL 'ltfs'
    EXEC '/opt/ibm/ltfsee/bin/ltfsee' OPTS '-p Pool1@lib1 Pool2@lib2'

    RULE 'eesysmig' MIGRATE FROM POOL 'system' THRESHOLD(80,60) TO
    POOL 'ltfs' WHERE (KB_ALLOCATED > 0)
    RULE 'default' set pool 'system'
    ```

  - Set the policy for the file system

    ```
    mmchpolicy <file-system> policyfile.txt -t "system policy" -I yes
    ```

Example for scheduled migration without threshold

- **Migration based on schedules**
    - Create policy text file:

    ```
    RULE EXTERNAL POOL 'ltfs'
    EXEC '/opt/ibm/ltfsee/bin/ltfsee' OPTS '-p Pool1@lib1 Pool2@lib2'

    RULE 'eeschedmig' MIGRATE TO POOL 'ltfs' WHERE (KB_ALLOCATED > 0)
    AND (DAYS(CURRENT_TIMESTAMP) - DAYS(MODIFICATION_TIME) > 2)
    ```

    - Run the policy:

    ```
    mmapplypolicy <file-system> -P policyfile -m 3 -N ltfsnodes -s
    /workdir --single-instance
    ```

    - Schedule the policy via system scheduler

General guidance for policies with Spectrum Archive

- **Threshold based migration is last line of defense**
  - Size file system to not run full and use schedule policies to move files periodically
  - Policies for threshold based migration should be simple

- **Policies for scheduled migration can be more sophisticated**
  - Use file attributes (`KB_ALLOCATED`, `ACCESS_TIME`, `MODIFICATION_TIME`, `NAME`)

- **Default WEIGHT Parameter: `KB_ALLOCATED`**
  - Consider changing to e.g. `ACCESS_TIME` or `NOT(FILE_HEAT)`

- **Do not migrate file from certain directories (.SpaceMan, .snapshot, .ltfsee)**

- **Consider limits of maximum number of files in queue**
  - Migrate. < 30.000; recall < 15.000

Considerations with other Spectrum Scale functions

- **Using snapshots can cause transparent recalls of files**
  - When migrated files that are in snapshots are deleted

- **Using AFM with Spectrum Archive is not supported (yet)**
  - Certain use cases are being tested (SW and DR mode)

- **Using Spectrum Archive and TSM HSM in the same cluster is not supported**

- **Integration with „mmbackup" is rudimentary**
  - No inline backup
  - With release 4.2 and above mmbackup skips migrated files
  - Use Spectrum Protect for Space Management (HSM) alternatively

Learn all about migration policies for Spectrum Archive

IBM Spectrum Scale™ Archiving Policies

An introduction to GPFS policies for file archiving
with Linear Tape File System Enterprise Edition

Version 4

- Spectrum Scale ILM Policy Guide
  http://w3-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102642

What to learn more about Spectrum Scale and Spectrum Archive?

- **Spectrum Scale Standard hands-on workshop**
  - Learn about architecture & concepts, installation and configuration, ILM, CES, AFM, Backup, ...
  - https://academy.avnet.com/de/training/course/141611

- **Spectrum Scale Advanced hands-on workshop**
  - Learn about architecture & concepts, monitoring, configuration parameters, tools and problem determination ....
  - https://academy.avnet.com/de/training/course/136736

- **Spectrum Archive Standard hands-on workshop**
  - Learn about ILM concepts, installation and configuration, using policies, ...
  - https://academy.avnet.com/de/training/course/141610

→We also offer customized workshops according to your needs !

Links and references

- LTFS format specification ISO standard 20919:16
  http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=69458
- LTFS format specification SNIA standard
  http://www.snia.org/sites/default/files/LTFS_Format_2.2.0_Technical_Position.pdf
- LTFS home page
  http://www-03.ibm.com/systems/storage/tape/ltfs/index.html
- Spectrum Archive EE knowledge Center:
  http://www.ibm.com/support/knowledgecenter/ST9MBR/welcome?lang=en
- Redbook: LTFS EE 1.1.1.2
  http://www.redbooks.ibm.com/redpieces/abstracts/sg248143.html
- Redbook: Spectrum Archive 1.2
  www.redbooks.ibm.com/redpieces/abstracts/sg248333.html?Open
- Redbook: Spectrum Archive with Spectrum Scale Object:
  http://www.redbooks.ibm.com/abstracts/redp5237.html?Open
- Whitepaper: Spectrum Archive solution and use cases
  https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102504
- Whitepaper: Spectrum Protect HSM with Spectrum Scale AFM:
  https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/Tivoli%20Storage%20Manager/page/Configuring%20IBM%20Spectrum%20Scale%20Active%20File%20Management
- LTFS SDE Info center
  http://publib.boulder.ibm.com/infocenter/ltfs/cust/index.jsp
- LTFS LE Infocenter:
  http://pic.dhe.ibm.com/infocenter/ltfsle/cust/index.jsp
- LTFS Redbook: Installation and configuration
  http://www.redbooks.ibm.com/abstracts/sg248090.html?Open
- Whitepaper: Using LTFS
  http://public.dhe.ibm.com/common/ssi/ecm/en/tsl03109usen/TSL03109USEN.PDF
- LTFS software and IBM Device driver:
  http://www-933.ibm.com/support/fixcentral/
- Almaden Research
  http://www.almaden.ibm.com/storagesystems/projects/ltfs/
- The top Youtube videos:
  LTFS customer reference: https://www.youtube.com/watch?v=6s_hjzuI9Y4

  LTFS Intro: http://www.youtube.com/watch?v=Qtd4CrajCYs

  Bamm TV: http://www.youtube.com/watch?v=X82sC97yQeE

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