Accelerate for IBM Storage: Open Systems Tape, What's New

Carl Reasoner and Reena Patel
Tape SMEs
Agenda

- Why Tape?
- LTO8 Tape drive
- LTO8 media options
- Availability of LTO8 media
- Open Systems Tape Portfolio
- Spectrum Archive enhancements
65 years of tape innovations

In tape drive technology and software

- 1952 IBM 726: 1st magnetic tape drive
- 1964 IBM 2104: 1st read/back drive
- 1984 IBM 3480: 1st cartridge drive
- 1999 IBM 3590E: 2000 LTO Gen1
- 2002 LTO Gen2
- 2004 LTO Gen3
- 2007 LTO-4
- 2010 LTO-5
- 2011 TS1140 (3592 G4)
- 2014 TS1150 (3592 G5)
- 2017 TS1155 (3592 55F)

In tape automation and virtualization

- 1962 IBM Tractor System
- 1992 IBM 3495
- 1994 IBM 3494
- 2000 TS3200 TS3300
- 2005 TS7510 VTL
- 2007 TS7520
- 2008 TS7530
- 2008 TS7650G
- 2009 TS7650 Appliance
- 2010 TS7610 TS7680
- 2011 TS7740 TS7770
- 2014 TS4500 3584 Gen 4
Tape Evolution – Denser, Faster, and Cheaper

**EARLY DAYS**

IBM 726 Tape System, announced on May 21, 1952

2 million digits in single 8-inch reel

**TODAY**

IBM TS1155 Tape System, announced on May 8, 2017

15 TB in palm of your hand (45TB with 3:1 compression)

Sustained I/O Rate @ 360 MB/s

**FUTURE**

Research Prototype
Press release on August, 2017

Equivalent to 330 TB in single tape
What Tape Does Best

**Long term storage:** Infrequently accessed data

**Multiple copies:** Near-line and offline data

**Protection:** Security and compliance

**Cost Reduction:** Reduce space and lower power

**Defensibility:** Unaffected by viral attacks
IBM Tape: Reliable and cost-effective solutions for new workloads

Cloud

Media and Entertainment

Genomics

Big data and analytics

Digital Video Surveillance (DVS)

Internet of Things (IoT)
IBM is #1 in the world for branded total tape revenue share 15 years running!

- IBM is the worldwide branded tape revenue share leader:
  - #1 in total branded tape storage revenue share
  - #1 in total branded tape drive revenue share
  - #1 in total branded tape automation revenue share

Others includes: Fujitsu; NEC; Hitachi; Toshiba; and Qualstar
LTO Ultrium 8 Tape Drives

Highlights:
- Delivers increased capacity:
  - 12 TB native and 30 TB with 2.5:1 compression
  - Full High Maximum data rate = 360 MB/s
  - Half High Maximum data rate = 300 MB/s
- Read/write support of LTO-7 media (BaFe)
- Offered in Full High FC, Half High FC and SAS (HH and SAS not available in TS4500)
- Support to write-once-read-many (WORM) cartridges
- Tunnel Magnetoresistive head (TMR)
  - Improved tape interface, extended life and corrosion resistance
- Available for IBM branded solutions:
  - TS4500, TS4300, TS2900, TS2280, TS3500*, TS3100/3200*, TS3310*

Features:
- Encryption – AME and AES-256 standard support
- IBM Spectrum Archive™ support - Linear Tape File System™ format

* Available only as drive upgrade
IBM LTO 8 drives offer:

- Tunnel Magnetoresistive head (TMR)
  - Improved tape interface, extended life and corrosion resistance
- Flangeless rollers
  - Minimize tape edge damage and debris buildup
- Advanced Servo Channel
  - Enables very accurate head positioning
- 1 GB buffer
  - Properly caches high data rate
- 12 speeds
  - Minimize backhitching and enhance performance
- SkipSynch
  - Allows writing to tape without backhitch (a.k.a. virtual backhitch)
LTO 8 Media

- LTO 8 Media provides native 12 TB capacity
- LTO M8-type media provides native 9 TB capacity
  - “New LTO generation 7 cartridges initialized as LTO-8 Type M media will be able to store up to 22.5TB* of data.”
  - LTO-8 Type M media is media manufactured and logoed as LTO Ultrium 7 media but labelled with a barcode label ending with the last 2 characters “M8”
    - The TS3500 tape library only supports pre-initialized M8 cartridges.
    - LTO9 tape drives will not be able to read M8 media
Downward Media Compatibility

- **LTO 8 Drive** LTO-8 and LTO-8M-type media
  - Read/write support of LTO-7 media (BaFe)

<table>
<thead>
<tr>
<th>Media / Density Type</th>
<th>Barcode Label</th>
<th>Cartridge Packaging &amp; Silkscreen</th>
<th>Native Capacity</th>
<th>Drive Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>L8</td>
<td>xxxxxxxL8</td>
<td>LTO Ultrium 8</td>
<td>12 TB</td>
<td>LTO-8</td>
</tr>
<tr>
<td>M8</td>
<td>xxxxxxxM8</td>
<td>LTO Ultrium 7</td>
<td>9 TB</td>
<td>LTO-8</td>
</tr>
<tr>
<td>L7</td>
<td>xxxxxxxL7</td>
<td>LTO Ultrium 7</td>
<td>6 TB</td>
<td>LTO-7, LTO-8</td>
</tr>
</tbody>
</table>

- **LTO 7 Drive** LTO-7 media
  - Read/write support of LTO-6 media
  - Read support of LTO-5 media

- **LTO 6 Drive** LTO-6 media
  - Read/write support of LTO-5 media
  - Read support of LTO-4 media

- **LTO 5 Drive** LTO-5 media
  - Read/write support of LTO-4 media
  - Read support of LTO-3 media
IBM M8 Tape Media - What is it?

- M8 Media is an LTO7 tape media cartridge that supports 9 TB of capacity
  - Only new, unused LTO-7 cartridges may be initialized as M8 media.
  - Only supported by an LTO8 Tape drive
  - Once a cartridge is initialized as M8, it may not be changed back to a 6 TB LTO-7 cartridge.
  - LTO-7 drives are not capable of reading M8 cartridges.
  - M8 media supports existing LTO format features including data compression, encryption, and partitioning, enabling IBM Linear Tape File System (Spectrum Archive EE v1.2.5 or greater)
  - M8 media will not be supported on WORM cartridges.
  - [https://www.lto.org/technology/typem/](https://www.lto.org/technology/typem/)
IBM M8 Tape Media Options

M8 media can be ordered in two ways: labeled and un-initialized, or labeled and pre-initialized

- **M8 media labeled and un-initialized**
  - Available through IBM Media- MTM 3589-452
  - Requires minimum library firmware levels
    - TS4500: Minimum LTO8 drive firmware level of HB82 and a minimum library firmware level 1.4.1.2.
    - TS4300: Minimum LTO8 drive firmware level of HB82 and a minimum library firmware level of 1.1.1.1-B00
    - TS3310: Minimum LTO8 drive firmware level of HB82 and a minimum library firmware level of 710G.GS007
    - TS3100/TS3200: Minimum LTO8 drive firmware level of HB82 and a minimum library firmware level of IBM_3573_R_F_00_3_20e
    - TS2900: Minimum LTO8 drive firmware level of HB83 and a minimum library firmware level of 0080

- **M8 media labeled and pre-initialized**
  - Only available through Media After Market (current vendors listed below)
    - Accutech Data Supplies
      - Phone: 800-759-3001
      - Website: www.accutechdata.com
    - Dexxxon Digital Storage
      - Phone: 740-548-7179
      - Website: www.digitalstorage.com
IBM M8 media supported Tape Libraries

M8 media **labeled and un-initialized support:**
- IBM TS2900 Tape Autoloader Model S8H
- IBM TS3100/TS3200 Tape Library with Ultrium 8 tape drives
- IBM TS3310 Tape Library with Ultrium 8 tape drives
- IBM TS4300 Tape Library with Ultrium 8 tape drives
- IBM TS4500 Tape Library with Ultrium 8 HD tape drives
- IBM TS1080 Tape Drive Model F8C

M8 media **labeled and pre-initialized support:**
- IBM TS2280 Tape Drive Model H8S
- IBM TS2900 Tape Autoloader Model S8H
- IBM TS3100/TS3200 Tape Library with Ultrium 8 tape drives
- IBM TS3310 Tape Library with Ultrium 8 tape drives
- IBM TS4300 Tape Library with Ultrium 8 tape drives
- IBM TS3500 Tape Library with Ultrium 8 tape drives
- IBM TS4500 Tape Library with Ultrium 8 HD tape drives
- IBM TS1080 Tape Drive Model F8A and F8C
Why IBM Media?

- **Best Warranty** – IBM’s limited lifetime warranty covers manufacturing and material defects for the life of the cartridge.
- **Quick Resolution** – IBM supplies drive, automation, media & software solutions which offers a single source and faster resolution of problems.
- **Not all Media is Created Equal** –
  - IBM media is built to rigorous IBM specifications and is tested in all IBM tape libraries.
  - IBM media is used as the Master Standard Reference Tape (MSRT) for the latest LTO generations*.
  - The MSRT is the tape media that all other vendors are compared against at the Measurement Assurance Corporation, the third party that performs compliance testing for the LTO Consortium.
- **Confidence with IBM’s Experience and Roadmaps** –
  - IBM’s tape history spans 65 years.
  - IBM has continued roadmaps for both IBM 3592 and IBM LTO tape for generations to come, and IBM continues to invest in tape research and development.
- **Delivers Data Integrity through Stringent Quality Control** –
  - IBM’s continuous extensive testing of media increases the reliability and durability of IBM tape products.
  - Only IBM tape media is tested on all IBM drive and library configurations.
- **Optimized to Tape Solutions** – IBM media and IBM drives are designed and developed together which means lower risk of data loss/errors, higher reliability, stability and prolonged media life and optimal performance.

*IBM LTO6 BaFe formula and IBM LTO7
Availability of IBM LTO8 media

• Sony Corporation has been the sole vendor to supply IBM with LTO8 media to supply to IBM customers.
• FUJIFILM Corporation filed a case against Sony Corporation with the United States International Trade Commission (ITC) alleging patent infringement related to certain magnetic data storage cartridge products shipped by Sony Corporation.
  • ITC found that Sony infringed one or more claims of Fujifilm's U.S. patent in violation of Section 337 of the Tariff Act of 1930.
• This ruling impacted LTO8 media.
• As of April 30th, 2018, Sony stopped importing its LTO8 media to the United States.
• The only country that is impacted by the ITC ruling is the United States of America.
• The ITC ruling does not impact United States Federal Government entities (State and Local Government entities excluded).
  • Available via iRPQ
• No other LTO generations effected.
• LTO7 Type M (aka M8) media still available.
Migration Strategy to LTO8 Drives

• All IBM libraries have the ability to have multiple versions of LTO drives in the library. (Except TS2900 which can only have 1 LTO drive and TS3100 with a full height LTO drive)

• For backward compatibility to LTO-6 media, some LTO6 or LTO7 drives will have to be left in the library.

• For new LTO8 installs, use LTO 7 M8 media (until LTO8 media becomes available)
# IBM LTO Tape Portfolio

<table>
<thead>
<tr>
<th></th>
<th>TS2280</th>
<th>TS2900</th>
<th>TS4300</th>
<th>TS4500</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Max capacity</strong></td>
<td>12 TB</td>
<td>108 TB</td>
<td>3.2 PB</td>
<td>278 PB</td>
</tr>
<tr>
<td><strong>Max # drives</strong></td>
<td>1</td>
<td>1</td>
<td>21</td>
<td>128</td>
</tr>
<tr>
<td><strong>Max # cartridges</strong></td>
<td>1</td>
<td>9</td>
<td>272</td>
<td>23,170</td>
</tr>
</tbody>
</table>

*All capacities are based on LTO 8 native format*
IBM TS2280 Tape Drive

• Support for LTO Ultrium 8 half-high tape drives
  - Native data transfer of up to 300 MBps and up to 750 MBps with 2.5:1 compression
• LTO generation 8 media specification tape cartridge compressed capacity of up to **30 TB** (up to **12 TB native**)
• 6 Gbps SAS attachment support
• 1 GB internal buffer
• Application-managed encryption support for half-high LTO 8 SAS tape drive
• 16 KB cartridge memory with Ultrium 8 media
• Half-high drive form factor
• Two SAS ports per drive for improved availability and attachability
• IBM Spectrum Archive™ support
  - Incorporates Linear Tape File System™ format
IBM TS2900 Tape Autoloader

What’s new?

• Support for LTO Ultrium 8 half-high tape drives
  - Native data transfer of up to 300 MBps

• LTO generation 8 media specification tape cartridge compressed capacity of up to 30 TB* (up to 12 TB native)

• Increased capacity
  - LTO 8: up to 9 cartridges = up to 270 TB* per library (108 TB native)

• 6 Gbps SAS attachment support

• Support for encryption

• IBM Spectrum Archive™ support
  - Incorporates Linear Tape File System™ format

* With 2.5:1 compression
IBM TS4300 Tape Library

What’s new?

• Support for LTO 8 tape drives
  - New IBM LTO Ultrium 8 half-high 6 Gb SAS and 8 Gb FC, and full-high 8 Gb FC drives
• LTO generation 8 media specification tape cartridge compressed capacity of up to 30 TB (up to 12 TB native)
• Increased capacity
  - LTO 8: up to 272 cartridges* = Up to 3.2 PB per library (8 PB with 2.5:1 compression)
• IBM Spectrum Archive™ support
  - Incorporates Linear Tape File System™ format
• Data security and regulatory compliance through support for Library Managed Encryption (LME) and WORM media on LTO Ultrium 8, 7, and 6 tape drives
• Improved business continuity with automatic control-path and data-path failover to provide automatic control in the event of a loss of a host adapter or control path drive

* 40 slots per module (20 per magazine) includes 5 optional I/O. 8 lowest slots of module 1 (lowest module) not accessible
IBM TS4500 Tape Library

What’s new?

• Support for LTO 8 tape drives
  - Native data transfer of up to 360 MBps

• LTO generation 8 media specification tape cartridge
  compressed capacity of up to 30 TB (up to 12 TB native)

• Increased capacity
  - LTO Ultrium 8: up to 278 PB per library (up to 695 PB with 2.5 to 1 compression)

• IBM Spectrum Archive™ support
  - Incorporates Linear Tape File System™ format

• Data security and regulatory compliance through support for
  Encryption and WORM media on LTO Ultrium 8, 7, and 6 tape drives

Increase capacity by storing up to 278 PB of uncompressed data per library with the new Linear Tape-Open (LTO) Ultrium 8 drives or up to 263.25 PB per library using 3592 cartridges.
TS3100 / TS3200 / TS3310 / TS3500 LTO8 support

• **TS3100/TS3200**
  - LTO Gen 8 HH FC and HH SAS support (no FH)
  - LTO Gen 8 Only as MES

• **TS3310**
  - LTO Gen 8 FH FC
  - LTO Gen 8 Only as MES

• **TS3500**
  - Support for **field merge only** for TS1080 (3588 F8A) drives into 3584 models L53/D53 and L52/D52

• **Performance**
  - Same library performance as present models
  - Provides LTO customers with an increase in performance and capacity
## Comparison of Spectrum Archive Products

<table>
<thead>
<tr>
<th>Name</th>
<th>License required</th>
<th>Market</th>
<th>Tape Drive Support for LTO5, LTO6, LTO7, LTO8, TS1140, TS1150 and TS1155</th>
<th>Tape Library support</th>
<th>Internal database</th>
<th>Integrates with IBM Spectrum Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM Spectrum Archive Single Drive Edition (SDE)</td>
<td>No</td>
<td>Entry - Midrange</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>IBM Spectrum Archive Library Edition (LE)</td>
<td>No</td>
<td>Midrange - Enterprise</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>IBM Spectrum Archive Enterprise Edition (EE)</td>
<td>Yes</td>
<td>Enterprise</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Spectrum Archive Single Drive Edition

- One LTFS file system per tape
- Free download available for
  - Linux RHEL 7.2, 7.3, 7.4,
  - Mac OS X 10.11, 10.12, 10.13
  - Windows 8.1, 10, 2012 R2, 2016
- Open source software (not Windows)
Spectrum Archive Library Edition (LE)

- Connect any IBM library to the Host
  - File System on tape is cached for search and access optimization
- Tape Media moves and Access operations are managed by Library Edition
  - Entire library is seen as a single drive letter or mount point
  - The number of drives in the library is transparent to the user
  - Each tape media is a directory under the drive letter
- LE does not have job Queue management.
  - File access must be managed at the user/application level to avoid conflicts
Spectrum Archive EE Functional overview

- Users and Applications
- User data
- Global name space
- GPFS Node 1
  - User file system
  - LTFS EE
  - LTFS Metadata
- GPFS Node 2
  - User file system
  - LTFS EE
- Migration (or Pre-Migration) with optional copy to other tape
- Recall with option for bulk recall
- Rebuild file system
- Export with option to keep stub in GPFS
- Import (only creates stubs in GPFS)
- Tape management: reclamation (free space) and reconciliation (synchronize)
**Spectrum Scale Information Lifecycle Management**

- **IBM Spectrum Scale** enables compute clusters, global storage cloud and big data analytics
  - **Low-latency and high-performance** using parallel data access that excels on massive data sets
  - **Global shared file system** on scalable, distributed storage infrastructure to multi-PB scale
  - **Supports mixed workloads**, i.e. any combination of traditional workloads like DB, email, and SAP as well as new generation workloads like cloud apps, Hadoop and Spark
  - **Any combination of storage devices** - Flash, Disk or Tape as well as 3rd party cloud storage pools to create tiering
  - **Automatic movement of data** based on policy to optimize for performance or cost (Cognitive ILM)
  - **Unified storage support** including, file, object, HDFS and OpenStack

- **IBM Spectrum Archive** enables automated data management to Tape
  - Seamlessly incorporates tape storage under the single namespace
    - **Keep data in active archive** at much lower costs
    - **Policy-based data placement**
    - **Persistent view** of the data - data still listed in directories
  - Tape is defined as an external pool of Spectrum Scale
    - Exporting tapes to other site and accessible with other LTFS software
    - Supports Enterprise Tape and LTO Tape
  - CLI, REST API, Grafana-based dashboard screen
Performance and storage capacity can be increased independently

- Add **Spectrum Archive node as Tape Gateway Appliance** for existing or new Spectrum Scale Cluster
  - Direct connection to Spectrum Scale cluster
- Add nodes and tape drives for **I/O bandwidth**
- Add tapes for **capacity scale-out**
  - Offline tapes for more than slots of tape library
  - Software license per node, not by capacity
- Group tapes as tape pool for **Data Collocation**
  - Pool by project, by department, by fiscal year, ...
August 2017, Fourth Edition Version 1.2.4 Enhancements

- Added support for a RESTful API
- Added high availability features:
  - Control node failover
  - Monitoring daemon
  - New start/stop
- Added a GUI dashboard for data monitoring
- Added low pool threshold attribute for pools
- Added support for 15 TB tape support with TS1155 tape drive
- Added new ltfsee node show command
- Added new ltfsee failover command
- Added new IBM Spectrum Archive EE database backup
• Provides new tape media support for LTO 8 tape drives with LTO 8 Type M cartridge (M8). The LTO program introduced a new capability with LTO 8 tape drives: the ability to write 9 TB (native) on a brand new LTO Ultrium 7 cartridge instead of 6 TB (native) as specified by the LTO 7 format.

• Added support for Red Hat Enterprise Linux Server 7.4.

• Provides support for the new 12 TB LTO 8 tape drive and TS1155 FC tape drive in the TS3500 tape library

• A library replacement procedure has been provided to allow the replacing of an old tape library (for example, TS3500 tape library) with a new tape library (for example, TS4500 tape library)

• TS4300 tape library support

• Upgraded the HSM component to version 8.1.2, allow use of AFM in Independent Writer mode.
March 2018 Spectrum Archive V1.2.6 & V1.2.6.3 enhancements

IBM Spectrum Archive Enterprise Edition V1.2.6 is designed to enhance the ability to migrate to newer libraries, tape drives and media.

- Procedure to add or replace a library into a cluster (phase 2)
- Move pools from one library to another
- Intermix of tapes in a pool to facilitate migration to new media type
- Media restriction to allow write to new media type for media migration
- ltfsee datamigrate – to move data from an older tape type to a new tape type

- Spectrum Scale 5.0 support
- Little Endian Power Server support (ppc64le)
New Monitoring Daemon (MD) triggers the Control Node failover

- MD runs on all of Spectrum Archive EE nodes, and monitors Spectrum Archive processes as well as the status of Spectrum Scale and network interface, such as RPC.
- The user can designate two a redundant Control Node for each tape library, and it will be automatically activated at the failover of Multi-tape Management Module (MMM) process.
  - `lfssee_config -m ADD_CTRL_NODE`
  - `lfssee_config -m SET_CTRL_NODE`
- In the single-node environment, MD will attempt to recover MMM failure by restarting it on the same node.

<Example of 3 node configuration>
Control Node Failover and Node Management Enhancements

Single command controls the entire sequence of start-up process to simplify the multi-node management

“ltfsee start” does the following automatically (same for “ltfsee stop”)
1. CLI starts the first MD on active Control Node for each tape library
2. First MD starts MD on other “enabled” nodes
3. On each node, MD starts LE+ component
4. When all are up, MD will start MMM component on Control Node(s)

Other new or changed commands
- “ltfsee failover” – initiate a manual failover
- “ltfsee node up”, “ltfsee node down” – tentatively remove a node for maintenance
- “ltfsee node show” – show the configuration attributes of Spectrum Archive Enterprise Edition node
- “ltfsee status” – Enhanced to display the detailed status on failure
- “ltfsee localnode” – Obsoleted

The configuration database (under .ltfsee/config directory) will be automatically backed up when a configuration change is done by ltfsee CLI commands or by ltfsee_config script
- Stored in local directory (/var/opt/ibm/ltfsee/local/dbbackup)
Web-based dashboard for statistics monitoring

- Uses open source software for data logging and visualization (*logstash*, *elasticsearch*, *Grafana*)
- Four preconfigured dashboards are provided (storage capacity, tape activity, alerts, configuration)
  - Spectrum Scale dashboard on Grafana is also available (See Spectrum Scale Knowledge Center)
- Recommended Screen Resolution: 1920x1080 or larger
Tape Usage and Performance Monitoring

REST API v1
- The list of resources and its configuration can be obtained using RESTful programming interface.
- Allows to develop a custom monitoring software or feed the information to existing software
- API v1 supports GET operation of following 6 physical and logical resources
  - Pool, Tape, Tape Drive, Tape Libraries, Node, Node Group

Example: Query the member tapes of particular pool and display their barcode ID and used capacity
## REST API

<table>
<thead>
<tr>
<th>Information</th>
<th>HTTP URL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nodes</strong></td>
<td><a href="http://192.168.45.18:7100/ibmsa/v1/nodes?pretty=true">http://192.168.45.18:7100/ibmsa/v1/nodes?pretty=true</a></td>
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<tr>
<td><strong>Nodegroups</strong></td>
<td><a href="http://192.168.45.18:7100/ibmsa/v1/nodegroups?pretty=true">http://192.168.45.18:7100/ibmsa/v1/nodegroups?pretty=true</a></td>
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<tr>
<td><strong>Drives</strong></td>
<td><a href="http://192.168.45.18:7100/ibmsa/v1/drives?pretty=true">http://192.168.45.18:7100/ibmsa/v1/drives?pretty=true</a></td>
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<tr>
<td><strong>Tapes</strong></td>
<td><a href="http://192.168.45.18:7100/ibmsa/v1/tapes?pretty=true">http://192.168.45.18:7100/ibmsa/v1/tapes?pretty=true</a></td>
</tr>
<tr>
<td><strong>Tape by barcode with barcode, pool_name, format, and status</strong></td>
<td><a href="http://192.168.45.18:7100/ibmsa/v1/tapes?pretty=true&amp;fields=barcode,pool_name,format_density,status&amp;sort=pool_name">http://192.168.45.18:7100/ibmsa/v1/tapes?pretty=true&amp;fields=barcode,pool_name,format_density,status&amp;sort=pool_name</a></td>
</tr>
</tbody>
</table>
Tape Usage and Performance Monitoring

SNMP Trap Enhancements

- Pool capacity alert
  - Low Space Warning – Alert will be generated when the remaining space is less than threshold value (in TiB)
  - No Space Warning – Alert will be generated when a file migration was failed because remaining space is less than file size
  - Remaining capacity will be checked at every 30 minutes and alert will be suppressed for next 24 hours, by default
  - The thresholds can be set/viewed per pool with “ltfsee pool set” and “ltfsee pool show” commands.

[root@metis0 src]# ltfsee pool show -p pool1
Attribute                Value
poolname                  pool1
poolid                    b34bd86c-0df2-4c03-b864-c96c9ee6491
devtype                   LTO
format                    DEFAULT (0xFFFFFFFF)
worm                      no (0)
nodgroup                  G0
fillpolicy                Default
owner                     System
mountlimit                0
lowspacewarningenable     true
lowspacewarningthreshold  0
noospacewarningenable     true

- SNMP traps for failover and recovery actions
  - defines 36 traps. (See New MIB file (IBMSA-MIB.txt) in the /opt/ibm/ltfsee/share/ directory)
Dashboard: Activity View (Performance Counter and Drive Configuration)

- Aggregated I/O Throughput
- I/O Rate per Tape Drive
- Drive Configuration
Dashboard: Screen Layout

Quick Filter ( Templating )

Shortcut buttons to other dashboard

Help ( Expanded )

Contents

Help ( Folded )

Contents
Dashboard: Storage View (Storage Usage and Pool Configuration)

- **Total of Pool Capacity**
- **Usage per Pool**
- **Consumption Trend**
- **Pool and Tape Configuration**
Dashboard: System Health View (System Alerts)

- Alert Counter
- Histogram
- Alert List
Dashboard: Configuration View (Physical/Logical Elements and Association)

<table>
<thead>
<tr>
<th>Library ID</th>
<th>Library Model</th>
<th>Library Name 1</th>
<th>Library Name 2</th>
<th># of Libraries</th>
<th># of Nodes</th>
<th># of Tape Drives</th>
<th># of Tapes</th>
<th># of Node Groups</th>
<th># of Pools</th>
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<td>000007BFA2740413</td>
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<td>TS3500_LB2</td>
<td>TS3500_LB1</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>9</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

- **Configuration Summary**
- **Library, Node Group, and Node configuration**
- **Other 3 configurations are in Storage and Activity Views**
Object Storage Interface

- Tape Integration with Object Storage via SwiftHLM middleware
  - Addressing the challenges with SWIFT “timeout”
  - In-band control of data location via API (example)
    POST http://<host>:<port>/hlm/v1/MIGRATE/<account>/<cont>
    GET http://<host>:<port>/hlm/v1/STATUS/<account>/<cont>
  - Entire container or individual objects can be migrated to tape

- Supports different storage backend through Connector
  - Spectrum Archive bundles its SwiftHLM Connector
  - Requires SwiftHLM 0.2.1 from https://github.com/ibm-research/swifthlm

*Demo program, not a part of SwiftHLM nor Spectrum Archive*
Support for Spectrum Scale Active File Management (AFM) files, for Independent Writer Mode (IW) only

**AFM**
- Active File Management (AFM) is a scalable, high-performance file-system caching layer that is integrated with the IBM Spectrum Scale cluster file system.
- AFM is based on a home-cache model.
- A single home provides the primary file storage that is exported.
- One or more caches provide a view into the exported home file system without storing the file data locally.
- Upon file access in the cache, the data is fetched from home and stored in cache.
- Another way to get files transferred from home to cache is through prefetching.

**Independent-writer**
- AFM’s independent-writer (IW) cache mode makes home the AFM target for one or more caches.
- All changes in the caches are replicated to home asynchronously.
- Changes to the same data will be applied in the home fileset so that the changes are replicated from the caches.
AFM IW Centralized Archive Repository
AFM IW Asynchronous Archive Replication
Library Replacement

The procedure for replacing an existing tape library with a new tape library was updated, making the procedure shorter and simpler.

The following new options were added to the `ltfsee_config` command in support of the library replacement procedure:

- `REPLACE_LIBRARY`
- `LIST_LIBRARIES`

The `ltfsee library show` command was added to show the attributes of a library, including the library's name, ID, serial number, and control node.
Procedure to move tape pools from one library to another

New secondary tape library is added to an existing system that already has replica pools. The following new options were added to the ltfsee_config command in support of the procedure:

- PREPARE_MOVE_POOL
- ACTIVATE_MOVE_POOL
- CANCEL_MOVE_POOL
- LIST_MOVE_POOLS

A new mode attribute was added to the tape pool attributes. It indicates whether the tape relocation operation is in progress, or completed.

A pool location mapping table tracks the current location of tapes, directing recall operations to the appropriate library and pool.
Migrate tape pools to newer tape technology

1. Function was added to allow the intermix of different tape types within a single pool.
   - A *media_restriction* attribute was added to tape pools directs writes to new media.
   - This function also allows users to move existing data, to new generation tapes, by using the *ltfsee reclaim* command.
   - The Ltfsee pool set command added the *media restriction* attribute, and there were changes to the *format* attribute functions. The Ltfsee pool add and Ltfsee pool show commands also had updates.

2. Function was added to allow all data in a tape pool to be rewritten to a different tape pool within the same node group.
   - By using the *ltfsee datamigrate* command, users can move data on older technology tapes to newer technology tapes.
   - Rewriting data to a new pool allows for the more rapid migration of data to a newer tape type.
**Spectrum Archive EE Resources**


Why IBM Tape

IBM continues to make investments on Tape, with a strong roadmap ahead

Full line of tape solutions with advanced features

Industry leader in tape and data protection technologies and solutions

IBM is #1 Branded Tape in the market

Under embargo until announcement 10/10
Resources

- IBM TS4500 Knowledge Center:

- IBM TS4300 Knowledge Center:

- IBM TS4500 R4 Tape Library Guide

- IBM Tape Library Slot and Capacity Calculator
  https://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS5322

- IBM Fix Central
  http://www-933.ibm.com/support/fixcentral/

- Tape TCO calculator
  https://www-03.ibm.com/systems/storage/tape/tco-calculator/
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March 15 - IBM FlashSystem A9000/R and SVC Configuration Best Practices
March 27 - IBM FlashSystem A9000/R Technical Update
April 12 - Introducing Spectrum NAS - The Newest Member in the Spectrum Storage Family
April 26 - TS7700 Grid Configuration Changes -- Joins, Merges and Removals
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June 28 - Open System Tape, What's New

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- IBM FlashSystem A9000R
- IBM FlashSystem V9000
- IBM FlashSystem 900
- IBM DS888F/DS8886F/DS8884F
- IBM Storwize V7000F/V5030F
- IBM All-Flash Elastic Storage Server
- IBM All-Flash SAN Volume Controller

IBM Converged Infrastructure

VersaStack
- IBM FlashSystem V9000
- IBM FlashSystem A9000
- IBM FlashSystem 900
- IBM Storwize V7000/V7000F
- IBM Storwize V5030F/V5030/V5020/V5010
- IBM SAN Volume Controller

IBM PurePower
- IBM Storwize V7000

IBM Software Defined Computing

- IBM Spectrum Symphony
- IBM Spectrum LSF
- IBM Spectrum Conductor with Spark
- IBM Spectrum Conductor for Containers

IBM Software Defined Storage

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- IBM Spectrum Control / Storage Insights
- IBM Spectrum Protect
- IBM Spectrum Accelerate
- IBM Spectrum Archive
- IBM Spectrum Scale
- IBM Spectrum Virtualize
- IBM Spectrum Copy Data Management

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Defining a new generation of software-defined computing infrastructure

Software-defined storage to speed innovation and hybrid cloud

Tape Storage for data protection and long term retention. Storage networking for increased performance, security and flexibility

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Back up
IBM 7226 Multimedia Enclosure

What’s new?

• Support for LTO Ultrium 8 half-high tape drives
  - Ultrium 8 half-high 6 Gb SAS and 8 Gb FC
  - Native data transfer of up to 300 MBps

• LTO generation 8 media specification tape cartridge compressed capacity of up to **30 TB** (up to **12 TB native**)

• Read/write compatibility of the half-high LTO Ultrium 8 drive with LTO Ultrium 8 and 7 media

*Deploy a low-profile design configuration with up to four storage devices in a 1U space in a 19-inch rack*
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