

LTFS and CDMI - Tape for the Cloud

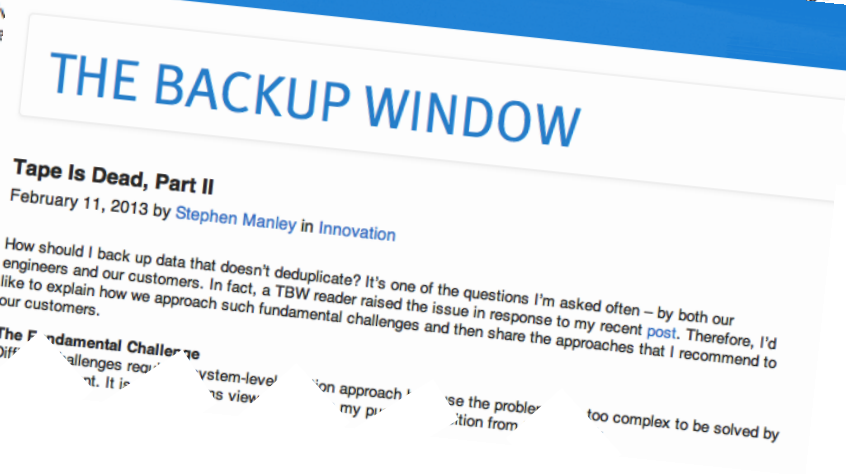
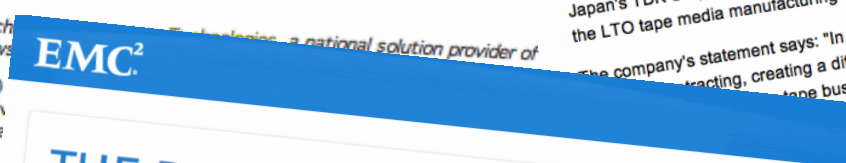
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Session Agenda

- Why Tape?
- Tape as a Cloud Protection Backing Store
- Tape as a Cloud Cold Storage Tier
- Tape for Bulk Transport
- Object Storage for LTFS
- Demo

Why Tape?

□ Isn't Tape Dead?



Why Tape?

- Isn't Tape Dead?
 - **Not where it costs less than the alternatives!**

- For **PB Scale Archives**, tape has significant economic savings compared to disk:
 - Lower capital cost (\$/GB),
 - Lower power & cooling costs, and a
 - Longer amortization period

Why Tape?

- In 2013, 2 PB crossover: Disk CapEx > Tape

Cost Analysis	Disk	Tape
Equipment Cost	\$198,000 (1)	\$123,200 (2)
Media Cost	\$0	\$73,300 (3)
Replacement Costs per year	\$66,000 (4)	\$19,650 (5)
Power and Cooling per year	\$7,154 (6)	\$1,208 (7)
Floor Space Cost per year	\$13,650 (8)	\$3,900 (9)
Maintenance Costs per year	\$39,600 (10)	\$24,640 (10)
Total Capital Costs	\$198,000 =	\$196,500
Per year Costs	\$126,404 >	\$49,398

http://snia.org/sites/default/files/CloudTapeUseCases_v1.0.pdf

- Tape OpEx is almost 1/3 that of Disk

Why Tape?

- Tape has flourished in several vertical market niches:
 - Oil and Gas: Tape is environmentally robust and easy to safely transport in harsh environments
 - Media & Entertainment: Tape simplifies workflows and data exchange
 - Archiving & Preservation: Tape provides low bit error rates and long shelf life for large scale archives

Why Tape?

- ❑ So, to summarize:
 - ❑ If you have many PB's of archival data, tape makes sense
 - ❑ If you need to physically move data around, tape makes sense
 - ❑ If you need a long shelf life, tape makes sense

Tape and cloud

- If you are a cloud provider, you have several challenges:
 1. How do you protect against data loss?
 2. How do you provide lower cost offerings?
 3. How do you bulk transfer data between/into/out of the cloud?

Tape can help!

Cloud Protection Tier

- ❑ Scenario 1 – Reducing cost for data protection

- ❑ Assume you are a cloud provider and you want to reduce the probability of customer data loss.
 - ❑ Your options are:
 1. Deploy more disks and mirror
 2. Deploy tape and archive

- ❑ Google chose #2, and it saved more than money

For more details, search for: "gmail outage 2011 tape"

Cloud Protection Tier

- ❑ As tape has higher latency, a cloud provider must still have disk storage
- ❑ To handle common failures and maintenance activities, at least two disk locations are required
- ❑ However, two disk locations are insufficient to provide sufficient survivability and fault isolation
 - ❑ Tape reduces the cost of additional copies
 - ❑ Tape reduces the probability of cascading failures that corrupt/destroy all copies

Cloud Archival SLO

- ❑ Scenario 2 – Reduced Cost Storage
- ❑ If data is stored directly to tape (or through a small staging area), savings can be passed on to the customer
- ❑ This allows a cloud service provider to offer a lower-cost differentiated service, similar to what Amazon has done with their Glacier offering

Cloud Protection Tier

- ❑ A couple of important restrictions:
 - ❑ This only works for infrequently accessed data. If data is randomly access at a frequent enough rate, tape wear will increase costs due to media replacement rates
 - ❑ This only works for data where high latencies can be tolerated by the customer
 - ❑ This requires different software interfaces in older to handle the higher latency, typically involving notifications of data availability

Cloud Protection Tier

- LTFS standardization reduces complexity, simplifies development, and enables new service offerings:
 - For example, if customer data is stored on standard tapes, in a standard format, that opens the option for a customer to request that the tapes (or copies of the tapes) be sent to them

Which leads us into our third and final scenario...

Bulk Cloud Transfer

- ❑ Scenario 3 – Bulk Cloud transfer

- ❑ Q. How do you get large amounts of data in and out of the cloud?
- ❑ A. Slowly and expensively!

- ❑ This is a significant problem for organizations that generate more data than they have bandwidth to send, and when they need to retrieve large amounts of data quickly.

Bulk Cloud Transfer

□ Transferring 2 PB over an OC-12 Link

Cost Analysis	Network	Tape
Provisioning Cost	\$0	\$0
Provisioning Time	0 Days	0 Days
On-Site Data Preparation Cost	\$0	\$73,300 for tape cartridges (1)
On-Site Data Preparation Time	0 Days	10.3 Days (2)
Transfer Cost	\$61,700 (3)	\$6,000 (4)
Transfer Time	370 Days	2 Days
Cloud Storage Cost	\$0	\$9,900 (5)
Cloud Storage Time	0 Days	10.3 Days (2)
Total Cost	\$61,700	\$89,200
Total Time	370 Days	23 Days

http://snia.org/sites/default/files/CloudTapeUseCases_v1.0.pdf

□ Save time!

Bulk Cloud Transfer

□ Transferring 10 TB over an 10 Mbit/sec Link

Cost Analysis	Network	Tape
Provisioning Cost	\$0	\$0
Provisioning Time	0 Days	0 Days
On-Site Data Preparation Cost	\$0	\$366 for tape cartridges (1)
On-Site Data Preparation Time	0 Days	1 Day (2)
Transfer Cost	\$1,852 (3)	\$52 (4)
Transfer Time	92.6 Days	2 Days
Cloud Storage Cost	\$0	\$50 (5)
Cloud Storage Time	0 Days	1 Day (2)
Total Cost	\$1,852	\$468
Total Time	92.6 Days	4 Days

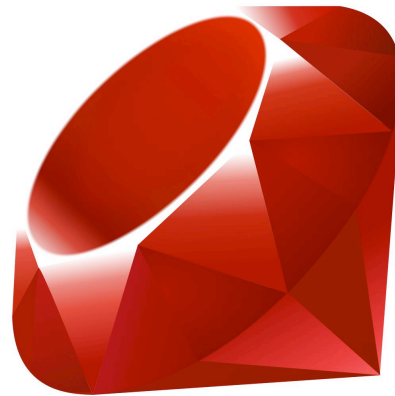
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□ Save time AND money!

Bulk Cloud Transfer

- ❑ The LTFS TWG is working on a standard way to transfer collections of data:
 - ❑ An XML manifest that describes:
 - ❑ Which tapes are used to store the data
 - ❑ Which files, directories and objects are being transferred
 - ❑ Fixity and integrity verification information
 - ❑ Instructions on how to merge data into an existing namespace
 - ❑ A standard workflow for bulk data transfer

Demonstration



Ruby Cloud -> LTFS Transfer Demonstration

Object Storage for LTFS

- ❑ LTFS provides:
 - ❑ Standardized POSIX-style directory and files
 - ❑ Standard file metadata and ACL storage
 - ❑ Standard tape spanning for large files

- ❑ This reduces the complexity of using tape as a backing store, and simplifies development

- ❑ The LTFS TWG has begun an effort to standardize how objects are stored on tape

Object Storage for LTFS

- ❑ Storing objects on LTFS adds:
 - ❑ Support for rich metadata
 - ❑ ID-based namespaces for object access
 - ❑ Support for composite objects (Queues, etc)
 - ❑ Support for object versioning

- ❑ This allows objects from object storage systems using Azure, CDMI, S3, and Swift to be stored on LTFS and accessed in a standard way

Object Storage for LTFS

- CDMI <-> LTFS Mapping Examples:
 - CDMI Named Data Object “LTFS.pdf”
 - CDMI Unnamed Data Object “00007ED90...”
 - CDMI Container “SDC 2013”
 - CDMI Queue “Messages”

- S3 & Swift mappings in the works
 - Standard Header Metadata mapping

Object Storage for LTFS

- CDMI Named Data Object “LTFS.pdf”
 - Metadata “Author” : “LTFS TWG”
- LTFS Layout:

/	LTFS Root
/LTFS.pdf	LTFS file with object name as file name
lufs.vendor.cdmobjectid	“00007ED90010F0E4FA063BCEB659D6ED”
lufs.vendor.cdmimimetype	“application/pdf”
lufs.vendor.cdmmetadata	{“Author” : “LTFS TWG”}
lufs.vendor.cdmvaluetransferencoding	“Base64”
/cdmi_objectid/	Object ID Container
/cdmi_objectid/00007ED90010F0E4FA0...	Symlink to /LTFS.pdf

Object Storage for LTFS

- ❑ CDMI Unnamed Data Object “00007ED90...”
 - ❑ Metadata “Conference” : “SDC”
- ❑ LTFS Layout:

/	LTFS Root
/cdmi_objectid/	Object ID Container
/cdmi_objectid/00007ED90010A49F2A0...	LTFS file with object ID as file name
ltfs.vendor.cdmi.objectid	“00007ED90010F0E4FA063BCEB659D6ED”
ltfs.vendor.cdmi.mimetype	“application/pdf”
ltfs.vendor.cdmi.metadata	{“Conference” : “SDC”}
ltfs.vendor.cdmi.valuetransferencoding	“Base64”

Object Storage for LTFS

- CDMI Container “SDC2013”
 - Metadata “cdmi_latency” : “1000000”
- LTFS Layout:

/	LTFS Root
/SDC2013/	LTFS directory
lfs.vendor.cdmi.objectid	“00007ED900105E38846F7EAA6C061CA7”
lfs.vendor.cdmi.metadata	{“cdmi_latency” : “1000000”}
/cdmi_objectid/	Object ID Container
/cdmi_objectid/00007ED900105E38846F...	Symlink to /SDC2013/

Object Storage for LTFS

- ❑ CDMI Queue “Messages”
- ❑ LTFS Layout:

/	LTFS Root
/Messages	LTFS file with queue name as file name
ltfs.vendor.cdmobjectid	“00007ED90010A49F2A0F1F996095A626”
/Messages.cdmqueue/	LTFS directory for queue values
/Messages.cdmqueue/0	LTFS file corresponding to first queue value
ltfs.vendor.cdmimimetype	“text/plain”
ltfs.vendor.cdmvaluetransferencoding	“UTF8”
/Messages.cdmqueue/1	LTFS file corresponding to next queue value
ltfs.vendor.cdmimimetype	“text/plain”
ltfs.vendor.cdmvaluetransferencoding	“UTF8”
/cdmobjectid/	Object ID Container
/cdmobjectid/00007ED90010A49F2A0...	Symlink to /Messages

Next Steps

- ❑ Read the SNIA Cloud Tape Use Cases document:
 - ❑ http://snia.org/sites/default/files/CloudTapeUseCases_v1.0.pdf

- ❑ Join the SNIA Joint Cloud/LTFS Technical Working Group

- ❑ Active projects include:
 - ❑ Cloud Data Transfer Workflow & XML
 - ❑ Object storage for LTFS Tape

Thank You!

Questions and Answers

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