The Role of Tape in the Cloud

Chris Marsh
Spectra Logic

Agenda

- Meeting Cloud Objectives Through Tape
- Technical Advantages of Tape
- Addressing Misperceptions of Tape
- Infrastructure Concepts: approaches to multiple storage mediums
- Summary: Why Tape in Cloud Infrastructures
- Questions

Meeting Cloud Objectives With Tape

Tape's role In:

- Seeding & Exit
- Multi-tenancy
- Non-repudiation
- Availability
- Interoperability
- Cost Efficiency
- Security
- Data Integrity

Seeding & Exit Strategy

- Sending large amounts of data across a WAN can be both costly and time consuming. Tape can be used to transfer data between sites.
  - LTFS and TAR are suited data ingestion
  - Tape is designed to be portable
  - 350 LTO-5 tapes can hold over 1PB of data
    - 1PB using tape: 9.5 days plus overnight shipping, through tape-based retrieval speeds of up to 1.24GB/s or 4.35TB/hr
    - 1 PB using replication over a WAN with GigE: 104 days

Multi-tenancy

- All environments can provide logical partitions to separate data.
- Logical partitioning using tape libraries
  - provide dedicated resources to customers without risk of intermixing data.
  - provide multi-tenancy through proper encryption key management.
- Physical partitioning using tape cartridges: provides multi-tenancy through true physical barriers.

Non-repudiation

- Ultimately more of a function of the data management application not the media.
- Media must be able to fully destroy/erase user data
  - Tape: Degausser, Destroyed Encryption Key, Physical Destruction.
  - Tape Media is much less expensive to replace than a disk drive if data needs to be verifiably destroyed.

Availability

- Advances in data management applications allows near-line access to tape
  - Retrieval speeds average 30-90 seconds for a file/Object from any tape in library.
  - Retrieval speeds can achieve up to 4.35TB/h
    - If a tape is already mounted in the drive, retrieval speeds can hit 3 seconds.

Cost Effectiveness

- Tape is less expensive than disk
- Cost is not a technical issue but important to consider
  - Cloud is a business model

Heterogeneous Interoperability

Look for Open Systems and Open Format Compliance

- Non-proprietary formatting mitigates data risk concerns around viability of cloud businesses.
- LTFS & TAR allow data migration between heterogeneous environments for files or objects.
  - TAR is a bit stream format for writing a chunk of data on tape storage not confined to archive
- Hardware WAN protocols: CDMI (SNIA, CSI)

Technical Advantages of Tape

- Energy Efficiency
- Portability
- Security
- Reliability
- Speed when streaming

Energy Efficiency of Tape

- "disk consumes 238 times as much energy as tape under assumptions that lean towards favoring disk." – Clipper Group 2010
  - The offline nature of tape storage within a library will maintain this advantage. Consistent with studies from 2007, and previous studies.
  - Tape storage only requires power and cooling while during read/writes or integrity verification.
- Two Key Implications:
  - Year over year cost – Clouds must assess implication to bottom line impacts
  - Power availability – Cloud Infrastructures are designed to be large scaled datacenters, power availability can become an issue anywhere.

Portable and Secure Media

Tape is intended to be moved, shipped, stored.

- The MAM chip, or RFID chip can store metadata that identifies the tape if the label is compromised.
- AES 256 prevents unauthorized access
  - An encrypted tape without the key is "legally" destroyed for compliance purposes.
- Some manufacturers can prevent any direct physical contact with any single tape.

Data Security in an Online World

- Tape can be taken offline without compromising its integrity.
  - Isolates data from self propagating errors, malicious attack, disgruntled employee actions, etc.
  - Offsite and offline is the only truly "safe" data.
- Any media that is connected to a system on a network is conceivably vulnerable
  - tape and disk

Reliability

- Bit Error Rates for Data Transfers on Tape and Disk:
  - SATA HDD: 10^{-15}
  - FC and SAS HDD: 10^{-16}
  - LTO-5 Tape: 10^{-17}
  - T10KC (Oracle) Enterprise Tape: 10^{-19}
  - TS1140 (IBM) Enterprise Tape: 10^{-20}
- Tape has an order 2-5 magnitude better BER than disk. That's 100X to 100,000X reliability over disk.

Speed When Streaming

- A LTO-5 Tape drive can steam at 280MB/s
  - With tape, performance and capacity are independent.
- A Enterprise Hard Disk can have a sustained speed of about 125MB/s.
  - Aggregation of disk drives can exceed tape
  - With disk, performance and capacity are tied together.

Addressing Misperceptions of Tape

- Retrieval Speeds
- Complexity
- Sequential Write Pattern
- Near-random Access through Metadata
- Reliability

Tape Retrieval Speeds

- Derived from the serial nature of tape
- Accessing many small files can be slow from tape
  - Tape is not inherently slow but better suited for large files.
- Software that treats disk like tape is slow, likewise software that is designed specifically around disk systems is often slow with tape.
- Tape is faster than disk in retrieving large quantity of data from tape.

Sequential Write Pattern

- Yes, data must be accessed sequentially, and the tape spun.
  - A benefit of this is that you don't get fragmentation.
  - Files and objects aren't virtually broken across multiple physical storage devices unless.
    - Exception: RAIT or dedupe to tape.

Complexity: Except what if?

- What if a tape could present itself as a virtual storage volume or file system?
- What if data could be migrated independent of software for copies or media migration?
- What if tape could be simplified so a tape drive could be connected to a workstation and appear just like a flash drive or external hard drive?
- What if you had to migrate once every 9 years instead of of 3?

Near Random Access

- Advances in Metadata have dramatically improved the ability restore granular aspects off of tape.
  - A full backup is designed for full restores
  - Archive and active tape usage models do not approach tape this way.
- The Media and Entertainment approach:
  - Optimize tape efficiency
  - The idea of asset management

Perception of Tape Reliability

Perception: Tape is not reliable

- Reality: Would you compare a 2011 computer to a 386PC? Or MS Dos to Windows 7?
- Reality: Do any of your disk drives boot up after 10 years?
- Reality: Human error is the primary cause of tape failures: Inappropriate storage conditions, non-management of data.
- Reality: Tape is 100-100,000x more reliable than disk

Infrastructure Concepts

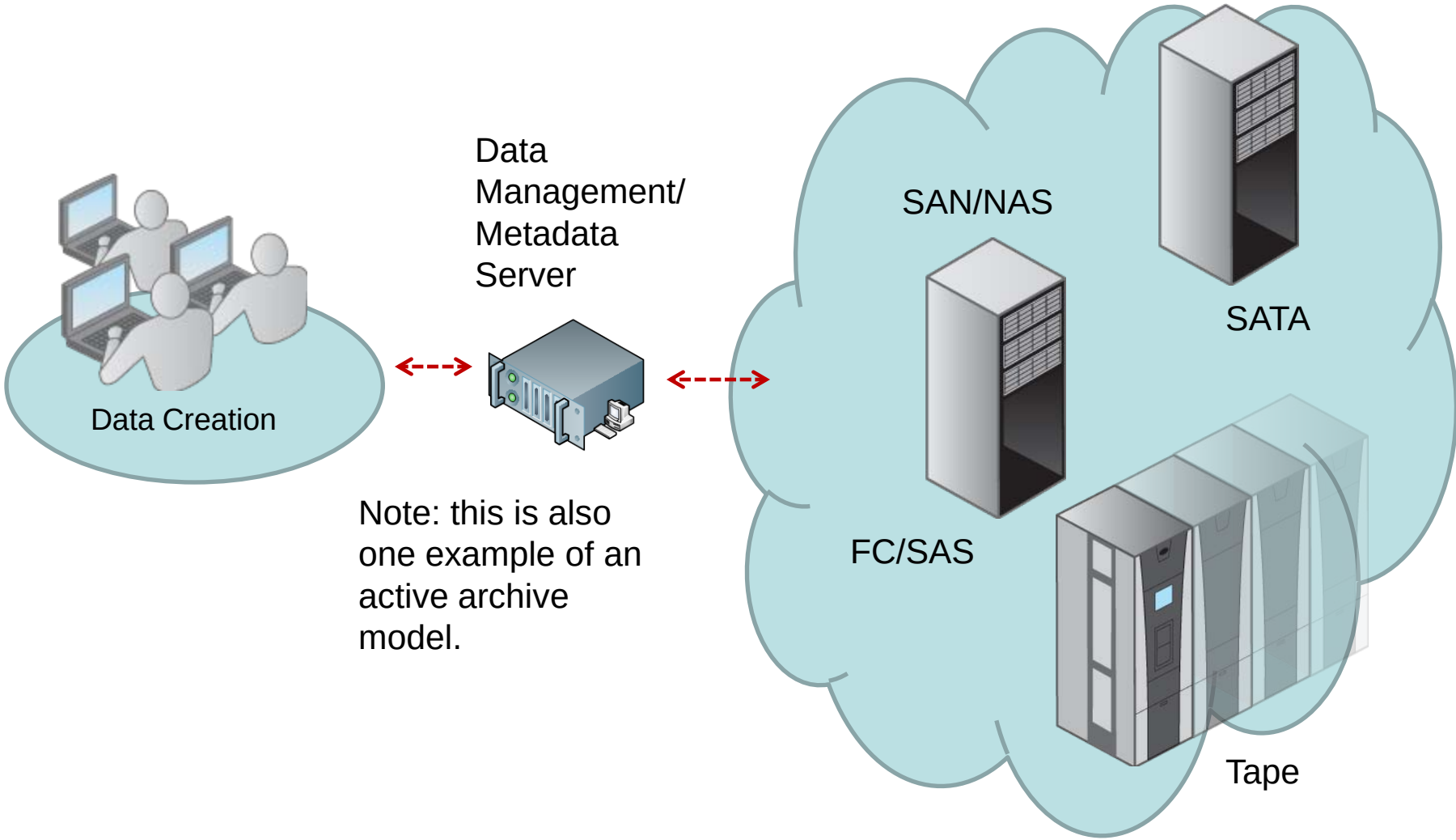
Data center architecture must capitalize on the system features and functionality

- Tiering, Virtualization, Object Oriented Management
- Interoperability between heterogeneous environments
  - Heterogeneous environments are not bad!

The Deception of Tiering

- Concept of Tiering is no longer compulsory, but ingrained in our mind based on perceived infrastructures.
- Data management, indexing, writing and retrieval can be done to any system within a virtualized environment without a hierarchical data path.
- Data Tiering simply refers to moving the data between platforms, however, should not be viewed as rigid Information Flow Paths.

Non-Tiered Storage Virtualization



Note: this is also one example of an active archive model.

Why Storage Platforms Aren't Tiers

- Tiered near-line architecture:
  - Definition: "A layer or ranking or classification-group in any real or imagined hierarchy"
  - Assertion: Storage Tiers are not tied to hardware, they are tied to the storage object.
    - Concept of hardware/platform tiering originated from traditional HSM infrastructures and backup methods.
    - Expanded Storage Models (cloud) redefine tiering. (See previous slide)

Set Theory Revisted

- Let Tier = {I, M} Where Tier is the hierarchical ranking in a data storage information flow.
  - Let I = is an positive Integer that represents Iteration of the copy of Data.
  - Let M = the Media or Storage Platform where M = {Tape, FC/SAS HDD, SATA HDD, Cloud}
  - If x € Tier, x = {1,FC HDD} and y € Tier, y = {1, SATA HDD} and x ≠ y. Then M is not a subset of I.
  - If a€ Tier, a = {1, SATA HDD} and b € Tier, b = {2, SATA HDD} and a≠b. Then I is not a subset of M.

Tiering and Object Management

- If a, b and c are Objects and a = (1,Tape) and b = (2, Tape) and c = (3, Tape)
  - Tape is therefore housing Primary, Secondary, and Tertiary Data.
  - Performance is determined by the type of data and the storage system. Therefore insufficient data exists to determine the performance of a(1,Tape) and y(1,SATA) in a given system.
  - Therefore performance doesn't determine Tier.

Tiering in the cloud

- If Performance doesn't determine tiers, tiers exist, and any M, Platform is a direct storage target (i.e. active archive), then either:
  - A)Tiers are arbitrary (imaginary)
  - B) Tiers are not determined by M or Storage Platform.
  - Therefore if tiers are not arbitrary or imaginary then Tiers are determined by the object iteration, I.

Summary

- Tape technology addresses many needs inherent to cloud storage
- Tape has unique advantages over other media times,
- No media is perfect, but perception isn't either
- Infrastructure determines effectiveness: don't limit yourself old methods
- Tape is a reliable, cost-effective media that should be included in any cloud infrastructure.

Thank You

Questions?