Overview of Storage and Data Management Industry Trends in Long Term Information Retention and Preservation

Raymond A. Clarke
Sr. Enterprise Storage Solutions Specialist
SNIA Data Management Forum, Board of Directors
Sun Microsystems - Archive & Backup Solutions
What We'll Cover

What's Changed in 3 Years?
  Archive Requirements – How have they changed?
  Some Truths About Tape in Archive Environments
What is Sun Doing to Bring Innovation to Archive?
What's SNIA's Doing To Help?
Why is Archive So Important?

... because The History of Data Growth is Exponential!

24 Words - Pythagorean Theorem
67 Words - Archimedes Principal
179 Words - 10 Commandments
286 Words - Lincoln's Gettysburg Address
1300 Words - US Declaration of independence
26911 Words .......... EU REGULATION ON THE SALE OF CABBAGES
Challenge: Manage Data for 75++ Years

HW typically only backward compatible N-1
Yearly capacity increases
Every 2-5 years HW becomes obsolete:
Need to migrate current data to newer HW components
Replace compute parcels
Replace FC Parcel for performance and capacity
Replace tape drives and media to current technology
Replace SATA parcels for capacity / footprint
Minimize vulnerability
HW migration is inevitable; PLAN for it
Demands of a New Archive Reality

Is the ratio for archiving solutions changing?

10 / 90

versus

2 / 18 / 80

(aka Tier 1, Tier 2 Tier 3)

Next Generation Archives need to address a new dimension of the massive resting data – How do you search Petabytes of data from the edge?

The new ratio has evolved into a Write / Read / Search relationship (2 / 18 / 80)

Business semantics and data classification need to drive data management not systematic schemas

Storage abstraction and Search become critical to the presentation of the data, something new is needed...

Compute, Store and Network resources need to be integrated, yet be independently extensible.
Power Consumption is a Big Problem in Storage

Storage is a significant part of data center energy usage, and at 20% CAGR, it is the fastest growing segment. (2)

Some data centers are being told that they can have no more power!

Additional Advantages of Tape

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>2007</th>
<th>2009</th>
<th>2011</th>
<th>2017</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form Factor</td>
<td>Inches</td>
<td>5.25 FH</td>
<td>5.25 FH</td>
<td>5.25 FH</td>
<td>5.25 HH</td>
<td>5.25 HH</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>5.25 HH</td>
<td>5.25 HH</td>
<td>5.25 HH</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Volumetric Density</td>
<td>GB/in³</td>
<td>100</td>
<td>200</td>
<td>400</td>
<td>2000</td>
<td>10000</td>
</tr>
<tr>
<td>Cartridge Capacity(Native)</td>
<td>GB/TB</td>
<td>800 GB</td>
<td>1.2-1.6 TB</td>
<td>3.0-4.0 TB</td>
<td>12-16 TB</td>
<td>48-64 TB</td>
</tr>
<tr>
<td>Arial Density</td>
<td>GB/in²</td>
<td>1.2</td>
<td>2.0</td>
<td>3.0-3.5</td>
<td>10-14</td>
<td>20-40</td>
</tr>
<tr>
<td>Data Rate</td>
<td>MB/sec/Drive</td>
<td>120</td>
<td>160-180</td>
<td>200-280</td>
<td>400-800</td>
<td>800-1600</td>
</tr>
<tr>
<td>Tape Speed for Data</td>
<td>Meters/sec.</td>
<td>6-8</td>
<td>8-10</td>
<td>10-12</td>
<td>12-15</td>
<td>12-15</td>
</tr>
</tbody>
</table>

Source: Bi-annual iNEMI Mass Storage Report for 2008

The Cost Ratio for a Terabyte Stored Long-Term on SATA Disk versus LTO-4 Tape is about 23:1
For energy cost, it is about 290:1

Clipper Notes-October, 2008
How do you build an Archive, sensitive to Access and Presentation, when any asset can be requested at any time?

<table>
<thead>
<tr>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary storage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Enterprise class disk
- High-performance applications
- Mission-critical/OLTP and database
- Mirroring and replication
- Synchronous and asynchronous (remote)
- CDP |
| Secondary storage |
- SATA disk and virtual tape
- Fixed content, backup/recovery, reference data
- Point-in-time, snapshot |
| Long-term retention |
- Fixed content
- Audio, video, medical, government regulations
- Tape libraries, deep archive
- Offsite |

**Average days since creation**
0 days → 30+ days → 90+ days → 1+ years → forever

**Recovery Time Objective (RTO)**
milliseconds → seconds → minutes → hours → days

**Key components**
- Policy engine
- Data mover (remastering)
- Tiered storage hierarchy

*Source: Horizon Information Strategies*
Open Storage/Open Archive Anatomy

**Open Storage Appliances**
- Sun Storage 7110
- Sun Storage 7210
- Sun Storage 7310
- Sun Storage 7410

**Storage Servers**
- SunFire X4240
- SunFire X4250
- SunFire X4540
- CMT Servers

**Open Storage Arrays**
- Storage J4200
- Storage J4400
- Storage J4500

**SAS HBA’s**

**Open Storage Flash**
- SSD

**File-Systems**
- ZFS, Lustre, SAM/QFS, pNFS

**OpenSolaris**

**OpenStorage**

**Software**
- NFS
- CIFS
- FCP
- SAS
- iSCSI
- IB
- VTL
- OSD
- CAS
- XAM
- Web DAV

**Features**
- Replication
- Security
- Mirror/Snap
- Search
- Encryption
- De-duplication
- Migration
- Backup
- Compliance
Sun Storage 7000 Unified Storage Systems
Converges Compute, Storage and the Network

Open Architecture
Open data formats, Open protocols
OpenSolaris and Appliance Kit platforms and communities
Integrated products, reusable components
Technical Innovation
ZFS and Flash “Hybrid Storage Pool”
DTrace Analytics

Game Changing Economics
ZFS+Flash+SATA yields best $/G, $/IOP, $/MB/s, W/IOP, W/MB/s

Industry-standard architecture that leads volume price/performance
No appliance software fees and license keys
Enterprise Archive Alternatives

Structured Data
- SAP
- Oracle

Primary Database

Structured Data
- Database Backup
- Data Deduplication
- Encryption

Capacity Disk
Unified Storage or JBOD

Remote Disk, Tape Libraries and Virtual Tape
- VTL
- Local Tape

Green Archive
- Primary Access/Ingest
- Replication
- NFS

Database Archive

Unstructured Data
- Email
- Video
- Images

Open Storage/Open Archive
- Sparc or Sun Fire SSD-Based Servers

7000 Unified Storage/HSP

Email Archiver

Long-term Preservation & Retention
- Archive
- SAM-FS (IAS)

Capacity Disk
Unified Storage or JBOD

Encryption
Assured Delete

Tiered Storage Management
Industry Challenge

Reduce the complexity of managing heterogeneous data and storage environment.

Store, Protect, Secure, Access, Archive, Comply and Shred

Cost – Complexity – Risk
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This presentation is a project of the SNIA Data Management Forum.
About SNIA and the DMF

About the Storage Networking Industry Association (SNIA)
SNIA’s primary goal is to ensure that storage networks become complete and trusted solutions across the IT community. For additional information about SNIA see www.snia.org

About the SNIA Data Management Forum (DMF) - www.snia-dmf.org
DMF is a sub-group of SNIA acting as the worldwide authority on Data Management, Data Protection and Information Lifecycle Management (ILM) initiatives.
DMF is a collaborative storage industry resource available to anyone responsible for the accessibility and integrity of their organization’s information.

<table>
<thead>
<tr>
<th>DMF</th>
<th>Data Protection Initiative (DPI)</th>
<th>Information Lifecycle Management Initiative (ILMI)</th>
<th>Archive and Compliance Storage Initiative (LTACSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing standards</td>
<td>Addressing ILM challenges, simplifying and benefits</td>
<td>Developing, securing, and retaining long-term data</td>
<td></td>
</tr>
</tbody>
</table>
What's SNIA Doing About Industry Challenges?

Educates, Defines and Taking Action to Address Industry Challenges

New DMF Developed or Managed Activities

The Self-Contained Information Retention Format (SIRF)*

- Rationale & Objectives
- Requirements & Use Cases

Bridging Terminology *

Green Storage Initiative

XAM – eXtensible Access Method
What is the Self-Contained Information Retention Format (SIRF)?

A logical container format for the storage subsystem appropriate for the long-term storage of digital information
A logical data format of a mountable unit e.g. a filesystem, a block device, a stream device, an object store, a tape, etc.
Includes a cluster of “interpretable” preservation objects that can be understood in the future
Self-describing – can be interpreted by different systems
Self-contained – all data needed for the preservation objects interpretation is contained within the preservation objects cluster
If a mountable unit is damaged or lost, the effect is contained – the information in the other mountable units is still valid!
Need to define how and when external references are supported
A work effort by SNIA’s Long Term Retention Technical Work Group
Problem SIRF is Addressing

*Without SIRF*

- Cannot move cluster of preservation objects between systems by itself
- Only the original application who wrote the preservation objects can read and interpret them
- Utilize export and import processes
- Preservation Objects cannot be sustained over the long-term

*With SIRF*

- Can move cluster of preservation objects between systems by itself
- Any SIRF compliant application can read and interpret the preservation objects
- No need for export and import processes
- Preservation Objects can survive longer
SIRF Objectives

Facilitate transparent logical and physical migration and movement in order to support long term preservation. Media, subsystem or bitstream movement – remove the mountable unit from system A and put it at system B. Transparent – system A is not involved. All the information needed for system B to understand the mountable unit is self-described and self-contained within the mountable unit. Long term – 15 years and above (according to 100 years archive requirements survey). Preservation – sustain the understandability and usability of the data and not just the bits.

Considering multiple implementations of SIRF to utilize: the Open Archival Information System (OAIS) ISO standard SNIA’s eXtensible Access Method (XAM)
SIRF Initial Requirements – Format

Self-describing
The amount of required information is small and can be acquired in stages
Interpretable by both humans and machines
Ability to do offline inspection
Support self-contained data
Include means to represent internal links and cross references
Support methodology for verification of completeness and correction
Interoperability
Ability to migrate data between different systems without loss of information – data should be interpretable after migrations and interpretable in the future
## OAIS AIP Logical Structure

<table>
<thead>
<tr>
<th>Content Information</th>
<th>Preservation Descriptive Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Data Object</td>
<td>Representation Information</td>
</tr>
<tr>
<td></td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>Provenance</td>
</tr>
<tr>
<td></td>
<td>Context</td>
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<tr>
<td></td>
<td>Fixity</td>
</tr>
<tr>
<td></td>
<td>Representation Information</td>
</tr>
</tbody>
</table>

- **Content Data Object**: the raw data that is the focus of the preservation.
- **Representation Information**: the information required to interpret the raw data to its designated community.
- **Reference**: globally unique and persistent identifiers for the content information.
- **Provenance**: the history and the origin of the content information and any changes that may have taken place since it was originated, and who has had custody of it since it was originated.
- **Context**: documents reason for creation of the content information and relationship to its environment.
- **Fixity**: a demonstration that the particular content information has not been altered in an undocumented manner.

(ISO 14721:2002)
SIRF Initial Requirements – Preservation Object Data Model

Support different data models for preservation objects
Support different object data models at one time
Support complex data structures like collections of objects
Support migrating objects from one data model to an alternative data model
Can handle any proper data format for the raw data
No restrictions on file formats
Enable retention of multiple versions of the original preservation object with their relations
References from new to existing preservation objects of the same version series
There must be a persistent identifier for each preservation object
Include additional external identifiers
Building a Terminology Bridge

What is it?

A framework designed to enhance better communication among IT professionals, records administrators, security, legal, librarians, archivists, data curators and compliance officers, along with the business groups,

What specific problem does it address?

Terminology used in the data center can be very confusing. all have their own vernacular and they all hold a portion of the responsibility for maintaining corporate information assets

Objectives of the Terminology Bridge

Stimulate the ILM discussion and it's adoption

Improve communication

*Explain/define terminology and practices*
Building a Terminology Bridge

**Archive**: the report advocates that IT practices adopt a more consistent usage of the term ‘archive’ with other departments within the organization. To the archival, preservation, and records management communities, an “archive” is a specialized repository with preservation services and attributes.

**Preservation**: managing information in today’s datacenter with requirements to safeguard information assets for eDiscovery, litigation evidence, security, and regulatory compliance requires that many classes of information be preserved from time of creation. Preservation is a set of services that protect, provide availability, integrity and authenticity controls, include security and confidentiality safeguards, and include an audit log, control of metadata, and other practices for each preservation object. The old IT practice of placing information into an archive when it becomes inactive or expired no longer works for compliance or litigation support, and only adds cost.

**Authenticity**: is defined in a digital retention and preservation context as a practice of verifying a digital object has not changed. Authenticity attempts to identify that an object is currently the same genuine object that it was “originally” and verify that it has not changed over time unless that change is known and authorized. Authenticity verification requires the use of metadata. The critical change for IT practices is that metadata is now very important and must be safeguarded with the same priorities the data is. IT practices
Building a Terminology Bridge

You can obtain a copy of Building a Terminology Bridge from the DMF’s website at

http://www.snia.org/forums/dmf/knowledge/term_bridge/

and you can participate in active discussion about it and other Data Management topics at the DMF Community site,

Sun’s Infinite Archive System Approach
Incorporates Backup, Archive and Physical/Logical Information Migration

Tier 1 Disk Options
- 2500 series SAS
- F5100 Solid State Disk
- Sun Storage 7410
- ST6000 FC Disk

Tier 2 Disk Options
- SunFire X4540 Storage Server
- Sun Storage 7000
- Storage J4200
- Storage J4400

Scalable, Eco-Efficient Tape Tier Options
- Libraries
- Virtual Tape
- Encryption
- Access & Capacity Drives

Any Communications Protocol

Infinite Archive System Manager (IAS)

SAM-QFS
Thank You for Your Time and Attention

Raymond.Clarke@Sun.com
(212) 558-9321