Storage Management for the Cloud

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Agenda

- Cloud computing overview
  - Cloud Motivation
  - Cloud Computing overview
  - Consolidation and Cloud computing

- Technology solutions
  - The management challenge
  - Data management
  - Storage management

- Summary
Cloud computing overview

- Business model
  - Deliver Resources – computing, data etc.
  - Delivery on demand
  - Elasticity
  - Pay as you go
  - Infrastructure as a Service (IaaS)

- Technology drivers
  - Storage virtualization
  - Server virtualization
  - Ubiquitous Networking
  - Resource consolidation and sharing
The IDC View

- Storage grows from 9% of the total Cloud Services spend to 14% by 2013.
- Storage is projected to grow from $1.6 billion to $6.2 billion.
- Storage has highest growth in share.

Worldwide IT Cloud Services Revenue* by Product/Service Type

- 2009: $17.4 billion
- 2013: $44.2 billion


Source: IDC, September 2009
What is Cloud Storage?

- The use of the term *cloud* in describing these new models arose from architecture drawings that typically used a cloud as the dominant networking icon.

- The cloud conceptually represented any to any connectivity in a network, but also an abstraction of concerns such as the actual connectivity and the services running in the network that accomplish that connectivity with little manual intervention.
Usage of Cloud Storage today

- Elastic demand for web based media (video, eBooks, audio)
- Backup to the cloud
- Internet “Drive” secondary storage
- Sync of files to the cloud and multiple devices
- Archive to the cloud
  - Including Compliance, Retention and eDiscovery
- Storage for Cloud Computing
- Cloud Application storage
Cloud Data Storage Model

/provider

Storage Management

Access Methods

CONSUMER

Cloud Data Storage

Data Management
SNIA CDMI

💧 Cloud Data Management Initiative
💧 Launched at Fall SNW 2009
  ♦ Press release listing charter members
  ♦ Cloud Pavilion on show floor
💧 Supporting the development and adoption of CDMI, Cloud Storage
💧 Marketing, Outreach, Education on Cloud Storage
💧 Requirements gathering
💧 Premier Organization promoting Cloud Storage and associated Standards
A look at some existing Cloud APIs

What are some of the offerings and their Data Storage Interfaces?

* CRUD – create, retrieve, update, delete
All of these interfaces support some or all of this model. The key to retaining the simplicity of the cloud, however, is in the use of metadata to drive the underlying services so that users need not manage the services themselves.
Cloud Storage Container

- Cloud Storage may be used similar to a volume/filesystem
- DSI Protocols include: WebDAV, NFS, CIFS, iSCSI, OSD, others
- Existing Management interfaces: SMI-S, Proprietary, Web UI
- Billing based on allocated space, Data Requirement (DR) parameters
- Resource guarantee (desired and required), consumption
- Configuration of DR is an object oriented hierarchy from containers on down to individual data elements
Clients can be in the cloud or enterprise and provide additional services (computing, data, etc.)

Clients acting in the role of using a Data Storage Interface

Block Storage Client
Exports to Cloud Computing
iSCSI, FC, FCoE LUNs, Targets
POSIX (NFS, CIFS, WebDAV)

SNIA Cloud Data Management Interface (CDMI)

Data Storage Cloud

Container

Object Storage Client

XAM Client
XAM VIM for CDMI

Database/Table Client

Multiple, Proprietary Interfaces

Management of the Cloud Storage can be standalone or part of the overall management of your cloud computing

Data/Storage Management Client

SNIA Cloud Data Management Interface (CDMI)

Cloud Data Management

Data Services

Storage Services

Clients acting in the role of Managing Data/Storage

Draws Resources on Demand

Information Services (future)
Applicable to three types of Cloud Storage:

- **Cloud Storage for Cloud Computing**
  - Whitepaper at snia.org/cloud – the management interface for the lifecycle of storage in a compute cloud

- **Public Storage Cloud**
  - Whitepaper at snia.org/cloud – both a Data Path for the Cloud and a Management Path for the Cloud Data

- **Private Cloud Storage**
  - As well as hybrid clouds
  - An API for Storage Vendors selling into Cloud based solutions

**Semantics**

- Simple Containers and Data Objects with tagged Metadata
- Data System Metadata expresses the data requirements

**Protocol**

- RESTful *) HTTP as “core” interface style
- JSON (JavaScript Object Notation) – format of the representations are extensible

*) Representational State Transfer, Roy Fielding 2000
REST

- **Representation State Transfer**
  - Started with [Dissertation by Roy Fielding](#) outlining the principles

- **Addressability**
  - Every object (resource) is addressable through a unique identifier

- **Uniform, Constrained Interface**
  - Use only HTTP verbs and model other semantics in the data model
    - Allows for Familiarity (low learning curve), Interoperability and Scalability

- **Representation Oriented**
  - Complexity is in the representations

- **Communicate Statelessly**
  - No persistent client-server connections
Why a RESTful approach for a Cloud Storage Standard

 grado

Simplicity Rules!
Common Infrastructures in many Languages on many Platforms
Low learning curve leads to developer adoption
Developer adoption creates eco-system around API
Eco-system eases adoption by vendors and customers
Models for Cloud Ecology

Cloud Federation

Computing Cloud

Distribution Cloud

Multiple Distribution Points

Cloud Peering

Data Usage

Object Storage Cloud

Object Storage Cloud

Cloud Peering

Cloud Peering
Work beyond SNIA

- **Standardizing Cloud computing interfaces**
  - SNIA : CDMI
  - OCCI: Open Grid Forum (OGF)
    - Open Cloud computing interface working group

- **Open standard APIs for cloud computing**
  - Vendor neutral
  - Non-Proprietary

- **OCCI Reference**
  - Resource oriented Architecture (ROA)
  - Resources identified by URI *)
  - HTML and other representations
    - Atom/Pub (Atom Publishing Protocol), JSON, Plain Text

*) URI Universal Resource Identifier
Resource Management

OCCI URI – IaaS Resource alignment

GET http://abc.com/compute/uid123foobar/

Operations on resources (start, stop, delete, update)
**OCCI API**

**OCCI API Implementation**
- CRUD – create, retrieve, update and delete
- Mapped to http post, get, put, delete
- Metadata
  - Exposed via HTTP headers
  - Associations between resources covered
  - Native expression in ATOM
  - OCCI working group coordination with IETF
- OCCI capabilities
  - Definition, creation, deplyoment, operation and retirement of services
  - Infrastructure lifecycle management
THE PROVIDER’S VIEW

of Storage Management

SNIA
The Provider’s view

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 IT Operations

 - Service Levels (SLA)
 - Equipment / Software cost
   - Acquisition
   - License
 - Operational cost
   - Administration, Power/cool, Building, Maintenance
 - Deployment and Implementation

 ERM (Enterprise Resource Management)

 - Operational stability
 - Optimisation of Administration
 - Vendor Independence
 - Usage assessment and trend/prediction
  - Act instead of re-act
ERM attributes

- Analyse
  - Quantify and Qualify
- Report
  - Extract and predict, Visualise
- Monitor
  - Threshold and Alert
  - End-to-End
- Migrate
  - Availability Management, Capacity Management
- Costing and Charging
  - Finance Management
- Performance
SMI-S Use

Enterprise Management Frameworks  Storage Management Applications

SMI-S Instrumentation

CIM/WBEM
(XML over HTTP)

Array Provider
Switch Provider
SNIA-SMI Provider
SNIA HBA API Provider

Disk Arrays  FC Switches  FC HBAs
The Storage – ERM Interface

- SMI-S
  - Systems Management Interface for Storage
  - WBEM based
  - XML-CIM cimXML

- SMI-S is an Interface Specification
  - Implemented as provider
  - Client applications connect to the providers
  - Several higher level clients/servers
    - Python PyCIM, PyWBEM
    - Pegasus, YAWN
Current version is 1.5

- Draft of 1.6 standard is publicly available
  - http://www.snia.org/publicreview/

Standard is published as nine books:
- Overview
- Part 1 – Common Architecture
- Part 2 – Common Profiles
- Part 3 – Block Devices
- Part 4 – File Systems
- Part 5 – Fabric
- Part 6 – Host Elements
- Part 7 – Information Lifecycle
- Part 8 – Media Libraries

SMI-S – CIM Management frameworks are commercially available today
What do I need to know?

Storage Deployment Best Practice

SNIA
Know all the requirements beforehand –

- Details of all disk spaces needed
- Hardware details of all storage, SAN and host resources available
- GROWTH in databases for next 1 to 2 yrs
- List of all applications, filesystems, databases, corresponding hosts
- Availability requirements, SLAs, DR (replication, clustering)
- Performance requirements for each fs, DB, and application etc.
- Processes needing storage team involvement such as application upgrades, refreshes, patching, etc needing snapshots, or backup/restores
- Don’t forget impact of Disk/Tape backup, de-duplication
- Tiered storage, SSD, Virtualization at Host and Storage level, Caching, Compression – usage of these technologies and their expected benefits/impacts should be well understood
Block Storage Deployment Planning

List of Apps, Type of Apps

Disk Space Needs Today + Next 1-2 yrs + The Surprise Factor!

Space Reserve for App/DB Processes (Upgrades, DB Refresh cycles, etc)

Vendor Disk Layout Recommendations

Space Reserve or Loss for Snapshots, Short-stroking, Max Disk Utilization Limit

Internal or Vendor IOPs Needs

Array (HSP), Disk (format), File system, RAID Overheads
Block Storage Deployment Planning

- Existing Cold Space
- Replication/Mirroring
- New Storage

- Net Cold Space to Purchase

- Internal and Vendor Performance
- Best Practices (Stripe size, cache, etc)

- Vendor Recommendations
- Specific to Storage Array

- Configure Storage Array(s)

**Note**
Virtualization, SSDs, Automated Tiered Storage can change the above process
Inside the Array…

- Segregate like-minded applications on separate disk arrays/pools
- Set array and LUN level cache settings. Check with Vendor first
- Review array maintenance related background activities settings
- RAID Level
  - Review DB, Storage vendor best practices, and consult your DBAs
  - General Rule of Thumb - Choose RAID-10 over RAID-5 for write-heavy usage
  - Consider usage of RAID-5 Vs RAID-10 for table spaces, transaction logs, archive logs, Indexes, Temp space, Sort space, etc
  - For # of spindles, understand the IOPs requirements for reads/writes as well as the size of the IO
- Keep in mind the IOPs needs for backups + transactions
- Pick a suitable segment size based on each app/DB needs
- Can you stripe on top of a group of LUNs?
Insider the Array…

- Standardize on 2 or 3 sizes of LUNs
  - Smaller LUNs for binaries, OS, Swap, etc
  - Larger LUNs for Database files
- Maintain a balance of ownership of LUNs among the controllers
- Allocate LUNs from different RAID-sets (i.e., spread the IO)
- If you’re not short-stroking, then keep utilization below 80%
- For Redirect-on-write operation, make SURE the disks you allocate for the deltas are configured same as the original LUNs
- For Copy-on-write operation, make sure the disks used for Deltas are separate spindles, and not shared with original disks
- Standardize on Host/Host Group naming style (match it with zones)

Check out SNIA Tutorial: Storage Performance 101
At the Host level…

› Set the optimum HBA driver settings
  – SAN Topology
  – Queue Depth
  – FiberChannel Speed

› Test path failover – break the path in every possible combination
  – Controller failure, just pull it out!
  – Manual LUN failover to alternate controller
  – Block port on the switch/director
  – Unplug fiber cable

› Know if LUN names are visible by the OS, it helps

› Make sure LUNs are ingested correctly – i.e., a LOG lun is not configured as a database lun

› Know the limits – Max # of luns, paths, LUN Zero requirement
If Storage Virtualization is involved…

- Understand the new storage terminology against existing
  - LUN/Volume/Slice/Partition/Stripe/Pool/Reserved_pool/disk_group, etc, etc…
- Compatibility check will be more complex, but do it
- For new install, pick one OS platform and test all features/functions
- Test how you’ll virtualize existing data/storage
- Test volume expansion/shrinking
- Document physical to logical (NPIV) mappings of the WWNs – do this end-to-end
- Test path failover – break the path in every possible combination
- Design several storage ‘pools’ with different characteristics
  - RAID-5, RAID-10, etc
  - Based on number of underlying disks
  - Based on disk type/capacity
  - Based on disk groups having hot spares
  - Based on array specs/type

Check out SNIA Tutorial: Five Best Practices In Virtualization
Planning for SSDs

If you plan to have SSDs in the environment

- Make sure (evaluate) that the specs meet your workload/workflow
  - Refer to the SNIA SSS Performance Test Suite Specification
- Know the costs for YOUR platform of choice, compared to disks
  - Refer to the SNIA Enterprise TCO Calculator
- Know your data! What to place on the SSDs
- What policies, processes and tools will you employ to –
  - Put data on SSDs (active and/or performance-critical)
  - Move data out of SSDs (to Tier1 or SATA)
  - What suits you? Move data at LUN level, file level or block level?
- Size the controller/CPU for # of SSD and Disk drives in the array
- Make sure you factor in the “write amplification” in your tests
- Know the “Erase Block Size” and align the partitions accordingly
- Make sure you can measure/quantify the expected performance gains
References

❖ CDMI
  ❖ http://snia.org/cloud
  ❖ http://www.snia.org/tech_activities/standards/curr_standards/cdmi/

❖ SMI-S
  ❖ Conformance Testing Program http://www.snia.org/ctp/
  ❖ SMI-S Developers Group http://groups.google.com/group/smi-s-developers-group
  ❖ SMI-Lab Program http://www.snia.org/forums/smi/tech_programs/lab_program/
  ❖ SMI-S Central http://www.snia.org/members/smis/

❖ OCCI
  ❖ http://occi-wg.org/
Summary

- Cloud Storage is available today
- Standards are in place for future-proof implementation
- SNIA is contributing to the standardisation
- Future enhancements are charted

Please visit the SNIA Europe website for more information:
  - www.snia-europe.org