OpenStack Cloud Storage

January 14, 2015

Today's Presenters

SNIA™
Cloud Storage Initiative

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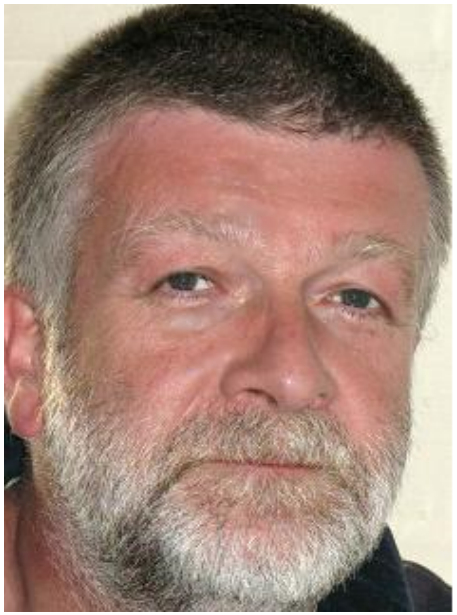

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Agenda

SNIA™ Cloud Storage Initiative

- Quick OpenStack overview
- Cloud Storage
- OpenStack and…
  - Cinder
  - Swift
  - Manila
- Summary, Q&A

What is OpenStack®

Free open source (Apache license) software governed by a non-profit foundation (corporation) with a mission **to produce the ubiquitous Open Source Cloud Computing platform that will meet the needs of public and private clouds regardless of size, by being simple to implement and massively scalable.**

- **Massively scalable** cloud operating system that controls large pools of **compute, storage**, and **networking** resources
- **Community open source** with contributions from **1000+ developers** and **180+** participating **organizations**
- **Open** web-based API ***Programmatic*** **Infrastructure** as a Service
- **Plug-in architecture**; allows different hypervisors, block storage systems, network implementations, hardware agnostic, etc.

What is OpenStack®

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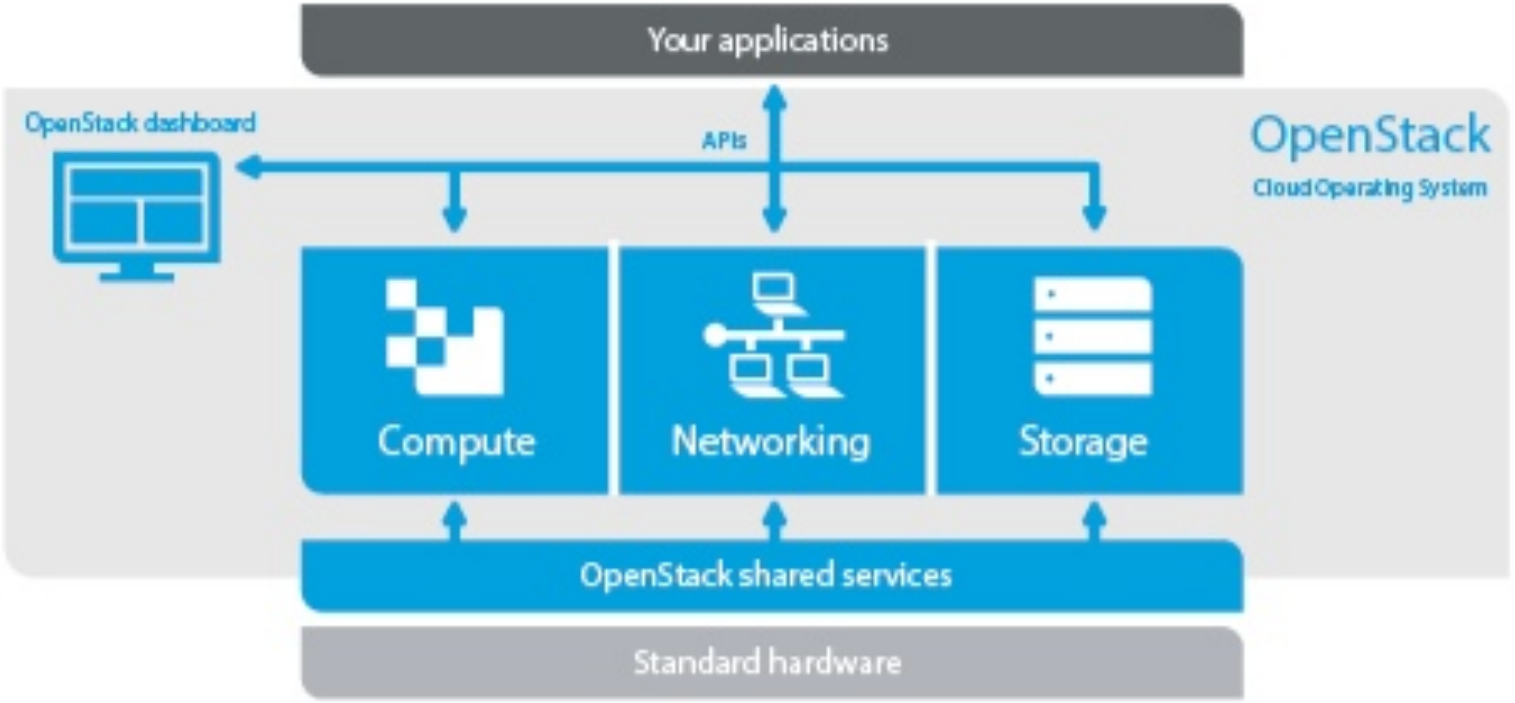
A series of interrelated projects that control pools of compute, storage, and networking infrastructure exposed as a consistent and open layer (API) for a heterogeneous Infrastructure as a Service (IaaS) environment.



OpenStack® programs (13 Integrated; 2 supporting)

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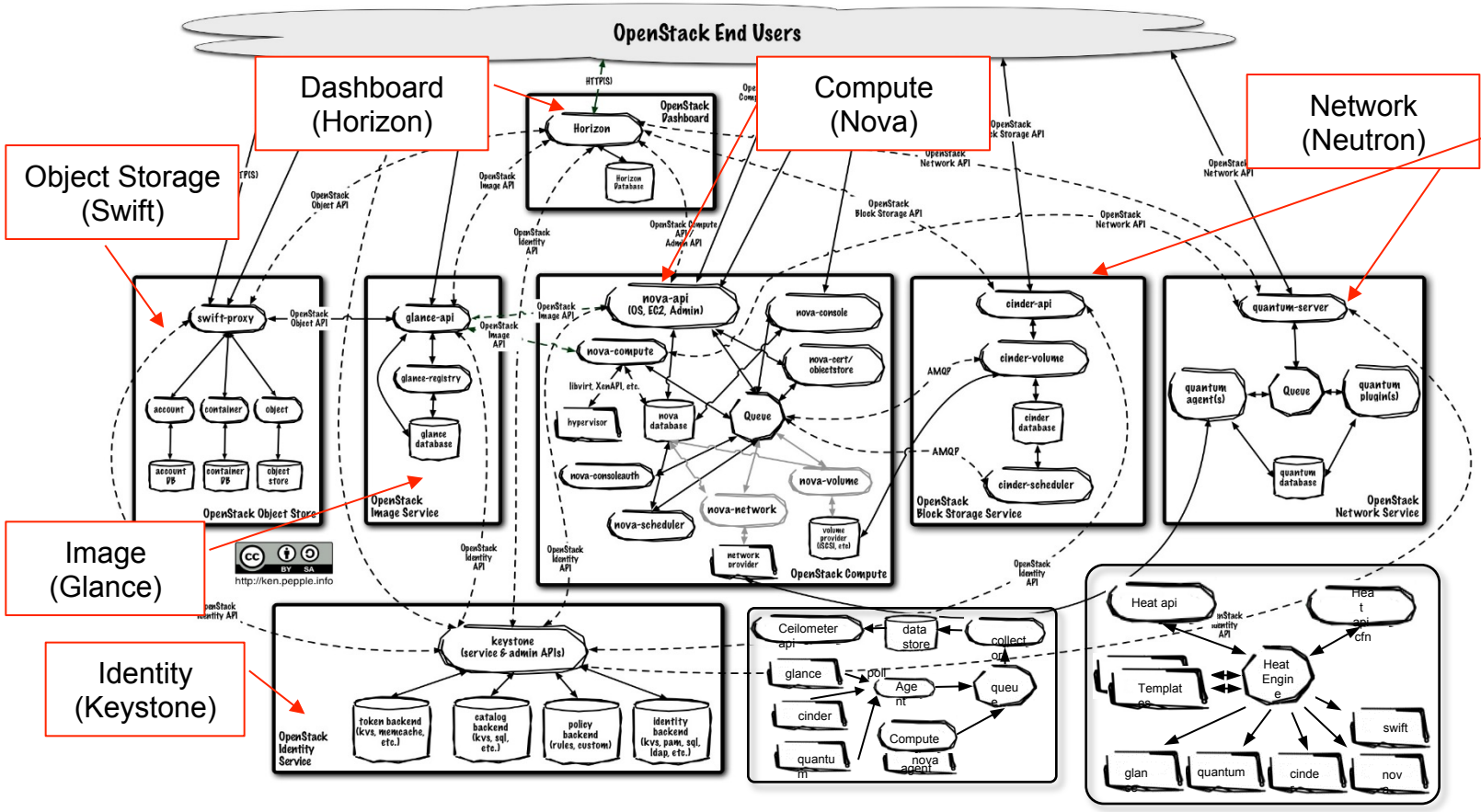
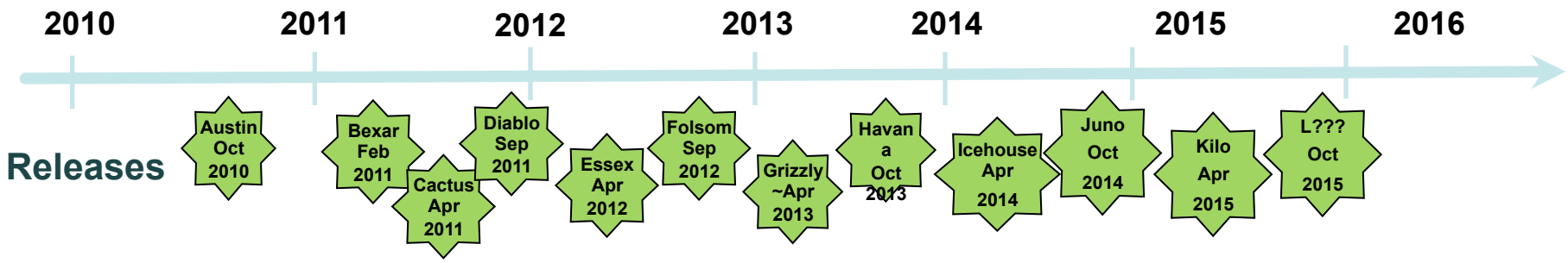


Image source: http://docs.openstack.org

OpenStack® releases



6-Month Release Cycles

- Spring and fall releases for predictable availability
- Release names use alphabetic naming

Planning

- Developers plan the next release at the Design Summit
- Sessions are selected by projects leads and are generally driven by blueprint topics
- Project Technical Leads (PTLs) accept a number of blueprints into the release plan

Development &Testing

- Milestone iterations (commonly 5 weeks) are defined and followed
- Development/documentation occurs per the blueprints and plan
- End of cycle testing with a defined Release Criteria process

Release

- Release Candidate is made available
- Next release is open for development
- After hardening, release occurs

Cloud Storage 101

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Block Storage

- Generally SCSI protocol based, organized by volumes
- Boot volumes for VMs
- Ephemeral vs. Persistent
- Not directly consumed by applications, usually used to hold a filesystem
- Low level storage abstraction upon which file and object storage is built

File Storage

- Files organized in directory hierarchy and accessed by pathname
- File-based NAS protocols like NFS and CIFS
- Rich and complex application support: random access, multiple readers, in-place file updates, locking, etc.

Object Storage

- Efficient flat namespace: objects organized by accounts, containers, object keys, and metadata
- HTTP / REST / URL based – easily scriptable, many language choices
- Relatively simple interface compared to file storage
- Scalable to very high object counts
- More easily scaled across multiple geographies
- Ideal for relatively static data

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Manila

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Swift

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OpenStack Block Storage - Cinder

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- Nova Volume
  - Originally OpenStack Compute (Nova) included support for ephemeral volumes
    - Used for boot/runtime storage of VMs
    - Volumes were typically backed by VM server files
  - Nova Volume had limited support persistent volumes on iSCSI
- Beginning with the Folsom release, a separate persistent block storage service, Cinder, was created
  - Cinder is a core part OpenStack project
  - Consists of a plug-in interface for supporting various block storage devices

Cinder Core Functionality

- Volumes
  - Create, Show, Update, Extend, Delete Volume
  - List Volume Summaries/Details
- Snapshots
  - Create, Show, Update, Delete Snapshot
  - List Snapshot Summaries/Details
- Volume types
  - List/Show volume types
  - Volume types defined in cinder.conf file, “extra specs” for advanced features
- Other features
  - Backup to swift
  - Volume migration
  - QoS – extended specs

Cinder Supported Devices

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- Available drivers include
  - Ceph RADOS Block Device
  - Coraid AoE driver configuration
  - Dell EqualLogic volume driver
  - EMC SMI-S iSCSI driver
  - GlusterFS driver
  - HDS iSCSI volume driver
  - HP 3Par StoreServ Fibre Channel and iSCSI drivers
  - HP StoreVirtual (LeftHand)
  - Huawei storage driver
  - IBM XIV/DS8K volume driver
  - IBM GPFS volume driver
  - IBM Storwize family and SVC volume driver
  - NetApp unified driver
  - Nexenta drivers
  - NFS driver
  - SolidFire
  - VMware VMDK driver
  - Windows
  - XenAPINFS
  - XenAPI Storage Manager volume driver
  - Zadara

Cinder volume attachment

- NFS/shared file system
  - Volume file created on file share, attached through libvirt or other VM specific mechanism
  - All VM hosts must already be attached to file share
- iSCSI
  - Attach to iSCSI volume over TCP/IP network
  - Cinder provisions volumes on target, coordinates initiator and target connection
- FC
  - Pre-zoned/flat – Grizzly-Havana
  - Zoning – Icehouse-Juno
- Other options
  - Ceph RBD, ATAoE, …

Key new Cinder features - Juno

- Key new Cinder Features
  - Volume Replication
  - Consistency Groups and Snapshots of Consistency Groups
  - Support for Volume pools
  - Completion of i18n-enablement
  - Honor Glance protected properties in Image Upload
  - Enable ability to restrict bandwidth usage on volume-copy operations
  - Add Volume Num Weigher Scheduling
- Horizon (UI) improvements for Cinder
  - Enabling resetting the state of a snapshot/volume
  - Supporting upload-to-image
  - Volume retype
  - QoS (quality of service) support

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Cinder Futures

- Automated discovery
- Asynchronous error reporting
- State machine
  - better error recovery
  - Less locks
- Over subscription ratios
  - for thin provisioning, dedupuplication, compression
- Horizon (UI) improvements

OpenStack Object Storage - Swift

- Swift was one of the original components of OpenStack
  - Originally developed by RackSpace
  - Distributed scale-out shared-nothing object storage
- Web APIs for data access
  - HTTP Put, Get, Post, Delete, …
- Swift is open source code, not an API standard
  - There is no compatibility suite and the API is subject to change
  - Enhanced direct implementations
    - SwiftStack, HP (StoreAll), etc.
  - Some vendors implement Swift compatible APIs
    - Ceph, Cleversafe, etc.
  - Some vendors have swift plugins – diskfile layer
    - Gluster, Seagate Kinetic, etc.

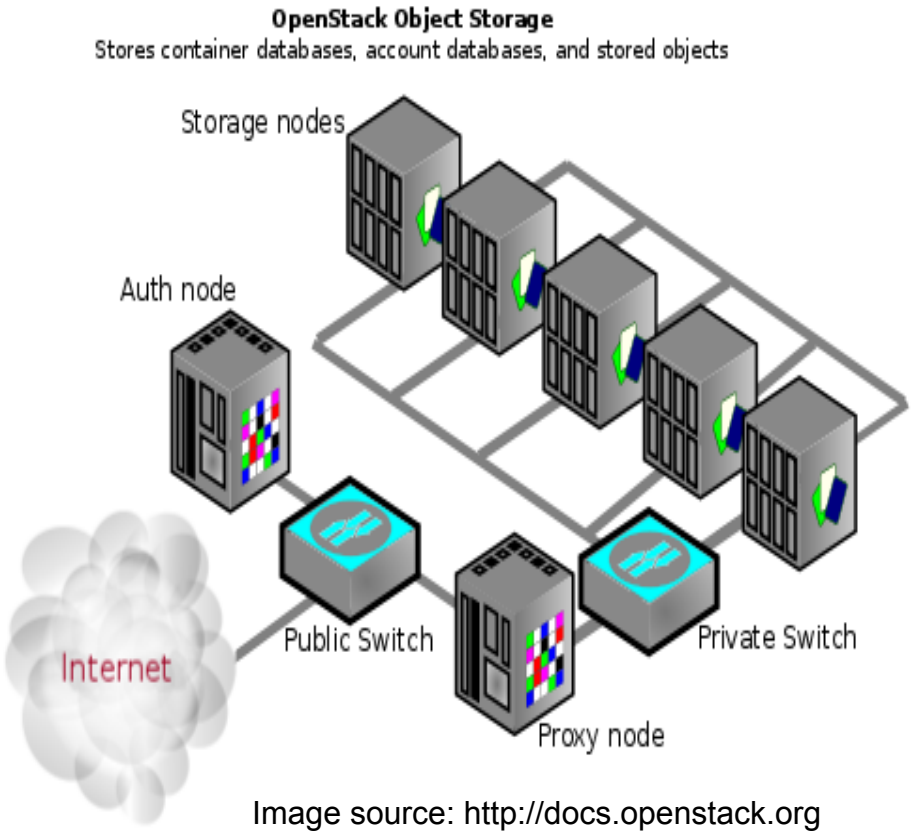

Image source: http://docs.openstack.org

Swift Storage Model

- Users authenticate with Keystone
- Each account owns a set of containers
- Containers hold a set of objects
  - Containers have metadata
  - Access permissions at container
- Objects contain data
  - Size is limited, composite objects supported for larger objects
  - Objects also have metadata
  - User specifies object name
  - Name can contain pseudo-paths

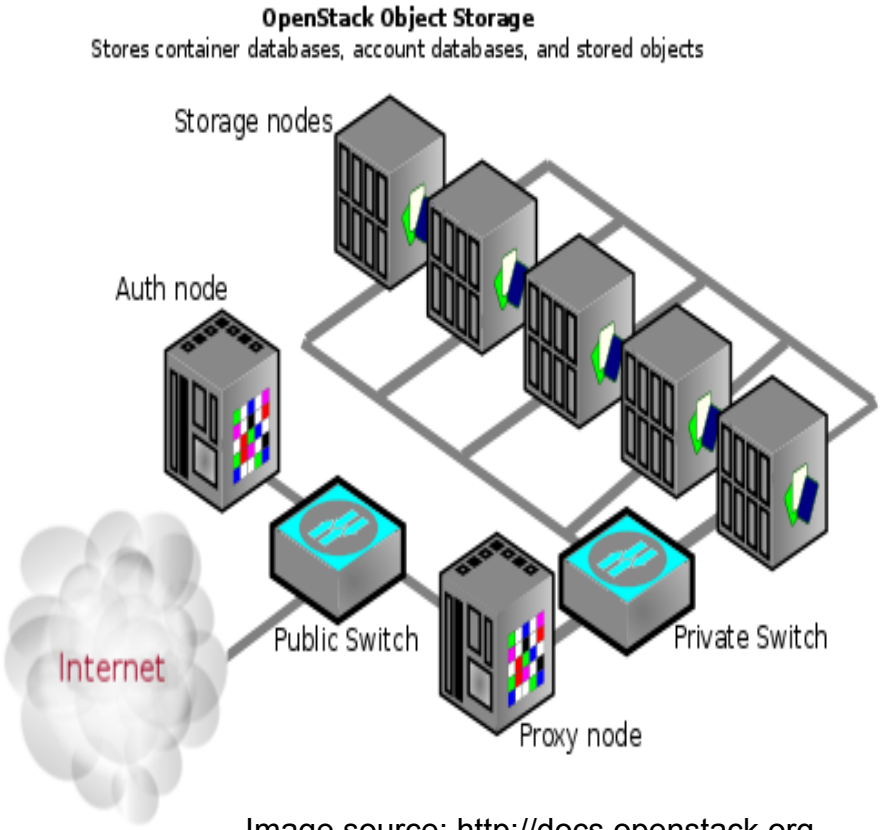

Image source: http://docs.openstack.org

Swift Operation

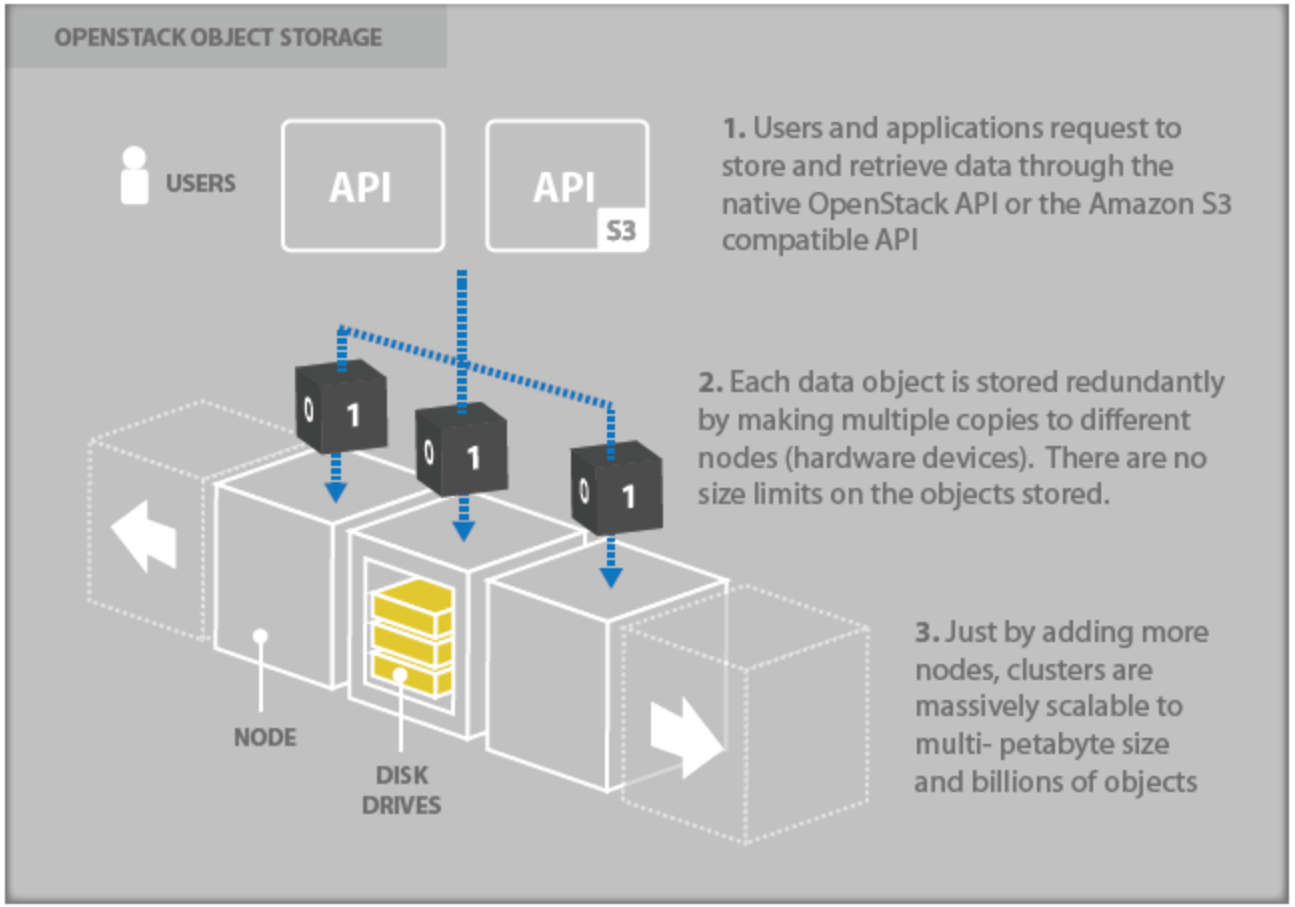

Image source: http://rogerluethy.wordpress.com

Swift Details

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- The Ring
  - hash map between names and physical location
  - rings for accounts, containers, and objects, “partitions” are replicated by default 3 times
- Proxy Server
  - responsible for tying together the Object Storage architecture.
  - exposes public developer API, extensible using “middleware”
- Container Server
  - primary job is to handle listings of objects, stored as SQLite files
- Account Server
  - similar to the Container Server, responsible for list of containers
- Object Server
  - stores, retrieves and deletes objects
  - objects are stored as files, extensible using diskFile API

Swift Details (cont.)

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- Replication
  - keeps the system in a consistent state through temporary errors
  - compares local data with remote copies to maintain the latest version.
  - replication updates are push based, updating is rsync or ssync
  - pushes records over HTTP or rsync/ssync database files.
- Updaters
  - sometimes container or account can not be immediately updated.
  - if an update fails, it is queued locally, the updater will process it
  - eventual consistency
- Auditors
  - Auditors crawl the local server checking integrity
  - If corruption found, file is quarantined, replication will replace
  - other errors are logged

New/future Swift Features

- Key new features in Juno
  - Storage policies
  - Keystone v3 support
  - Server-side account-to-account copy
  - Better partition placement when adding a new server, zone, or region.
  - Zero-copy GET responses using splice()
  - Parallel object auditor
- Future areas
  - Service tokens
    - Better security, for services like Glance
  - Single service node – PACOS servers
  - At rest encryption
  - Improvements to swiftclient and python SDK
  - **Erasure coding**

Swift Futures – Erasure Codes

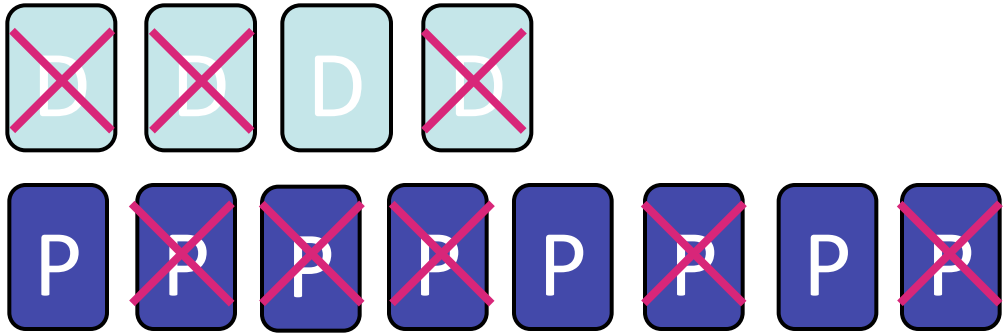
- Erasure coding has been used widely in RAID for years
  - Can yield improved storage efficiency and/or reliability
  - Objects broken into data and parity "shards" by proxy servers,
  - Shards stored like objects, reconstruction at proxy when retrieved

Put: 

Data: 

Parity: 

Fragments, schematically:



Swift Futures – Erasure Codes

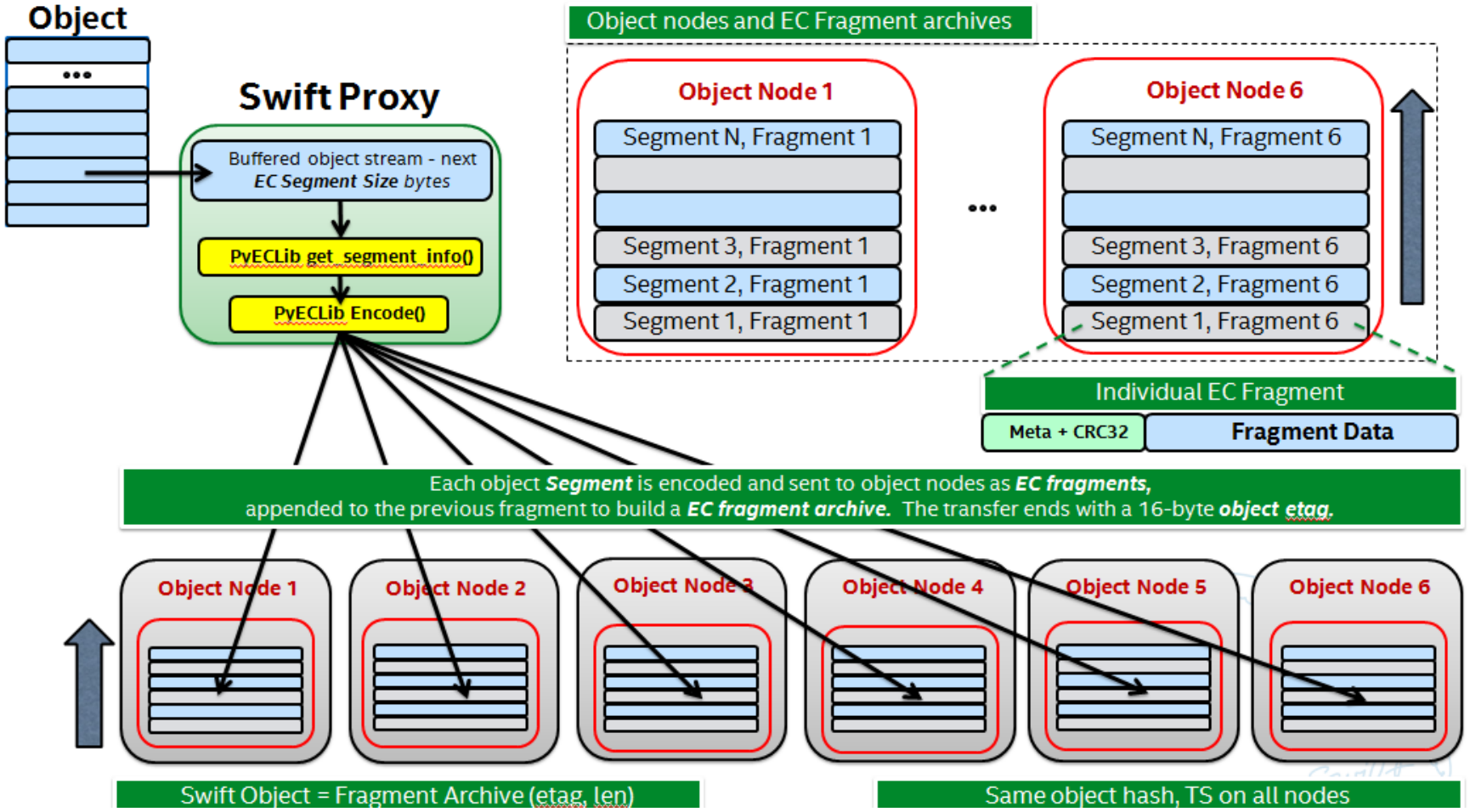


Image source: http://specs.openstack.org/openstack/swift-specs/specs/swift/erasure_coding.html

OpenStack Shared File Storage

- Not originally planned for OpenStack,
  - Clouds like AWS don't have shared file storage
  - Security and networking issues are difficult
- Demand has continued for this type of a service
  - For legacy applications that are not object storage enabled
  - Other options like running NFS on a VM or Gluster across nodes are complex to get right
- Originally proposed as an extension to Cinder
  - Implemented in Grizzly Cinder
  - Split into a new project "Manila" in Havana

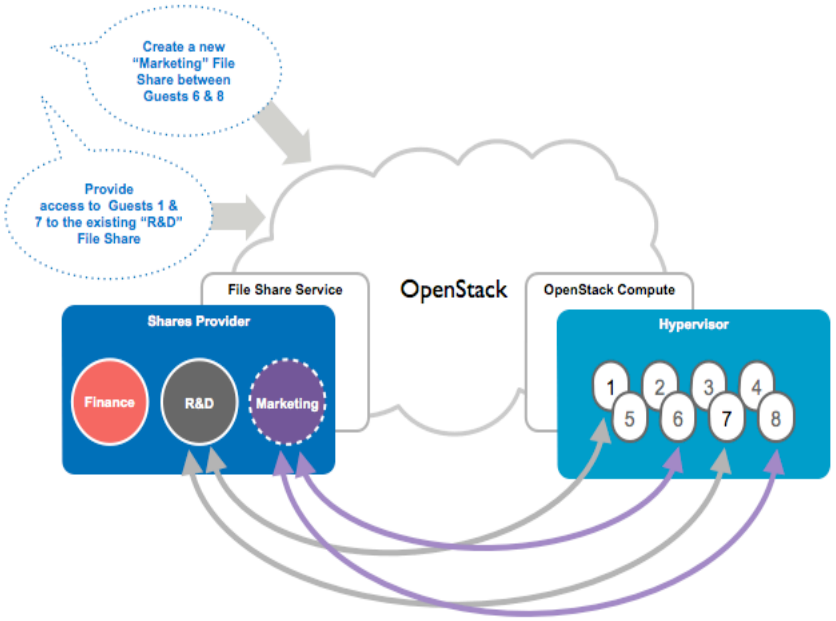


Image source: http://wiki.openstack.org/wiki/Manila

Manila vs. Cinder

- Shared Filesystems
  - Instances are able to communicate directly with the storage backend over the network
  - Uses NFS or CIFS to talk to shares, multiple readers/writers are expected
  - Storage backend is able to serve multiple tenants while maintaining secure separation between them
  - Uses the tenant (neutron) network
- Block storage
  - Usually iSCSI or FC, like a disk
  - Exposed through the hypervisor, actual “mount” is to VM host
  - Typically single attach (or if multiple attach coordination is required to corruption)
  - Utilizes a private storage or admin network

Manila core functionality

- Back-ends
  - Generic – creates a VM running SMB or NFS
  - Vendor drivers
    - For NFS or CIFS filer appliance
    - NetApp, EMC, HP, others
- Functions
  - Create or delete a share
  - Show or list shares
  - Allow/deny access to a share
  - Create/delete share snapshots, list snapshots

Manila Project Status

- Manila emerged as a separate project over Summer 2013
  - Recently promoted to "Incubator" project for Juno
  - Goal is to it part of the Kilo (or later) "integrated release"
  - Development is increasing since the Kilo summit
- Future development areas
  - Multitenancy
    - Compatibility with Neutron
    - Helper VMs
    - Server VMs vs. physical servers
  - Progress towards inclusion in "integrated release"
    - Incubator status is going away
  - Mount Automation
  - Access groups
  - Hardening, broader driver support

Summary

SNIA™ Cloud Storage Initiative

- OpenStack is free open source software for implementing public and private clouds
  - Many companies and individuals are involved in development
  - Products and services based on OpenStack exist today, and more are appearing as it matures
- OpenStack has support for block, object, and file storage
  - Both open source and commercial storage products supported
  - These provide basic and advanced functionality
  - More features, drivers, implementations are in the works
- OpenStack is maturing quickly
  - Give it a try – multiple free and commercial source distributions
  - There is plenty more work to do
  - The development process is open to anyone who wants to help

Questions?

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- More Information
  - http://openstack.org
  - http://docs.openstack.org
  - https://launchpad.net/cinder
  - https://launchpad.net/swift
  - https://launchpad.net/manila
- Contact me:
  - fineberg@hp.com

After This Webcast

SNIA Cloud Storage Initiative

- This webcast and a copy of the slides will be posted to the SNIA Cloud Storage Initiative (CSI) website and available on-demand
  - http://www.snia.org/forum/csi/knowledge/webcasts
- A full Q&A from this webcast, including answers to questions we couldn't get to today, will be posted to the SNIA-CSI blog
  - http://www.sniacloud.com/
- Next Webcast: OpenStack Manila – January 29, 2015. Register now at: http://bit.ly/1wPkbOU
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Questions?

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