MODULE 4

OpenStack Storage

Module 5 Agenda

- Introduction
  - OpenStack Storage
  - Storage Use cases
- OpenStack Object Storage Service Swift
  - Multi Site Swift
- OpenStack Block Storage Service Cinder
- Storage Backup Strategies (Snapshots)

OpenStack : Storage Types

- Ephemeral Storage
  - VM local storage (persistent for VM lifecycle)
- Persistent Storage
  - Block Storage – Cinder
  - Object Storage – Swift

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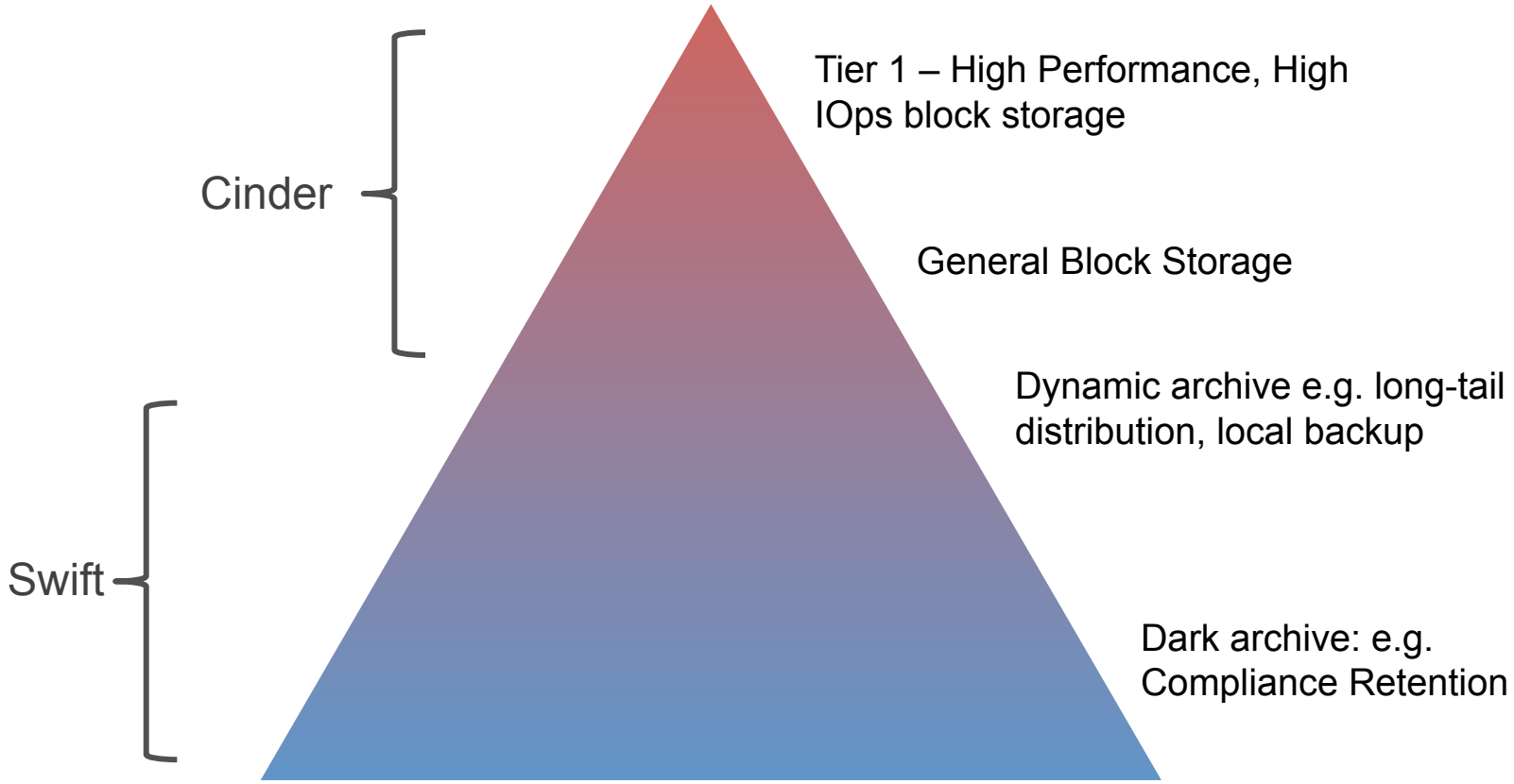
OpenStack Storage



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Review

Ephemeral Storage	Persistent Volume Storage
• Exists only for the life of an instance. • Persistent across reboots of the guest Operating System. • Will be deleted when instance is deleted.	• Volumes are persistent virtualized block. • Independent from instance. • Volume can be attached to a single instance at a time. • May be detached or reattached to a different instance while retaining all data, much like an USB drive.

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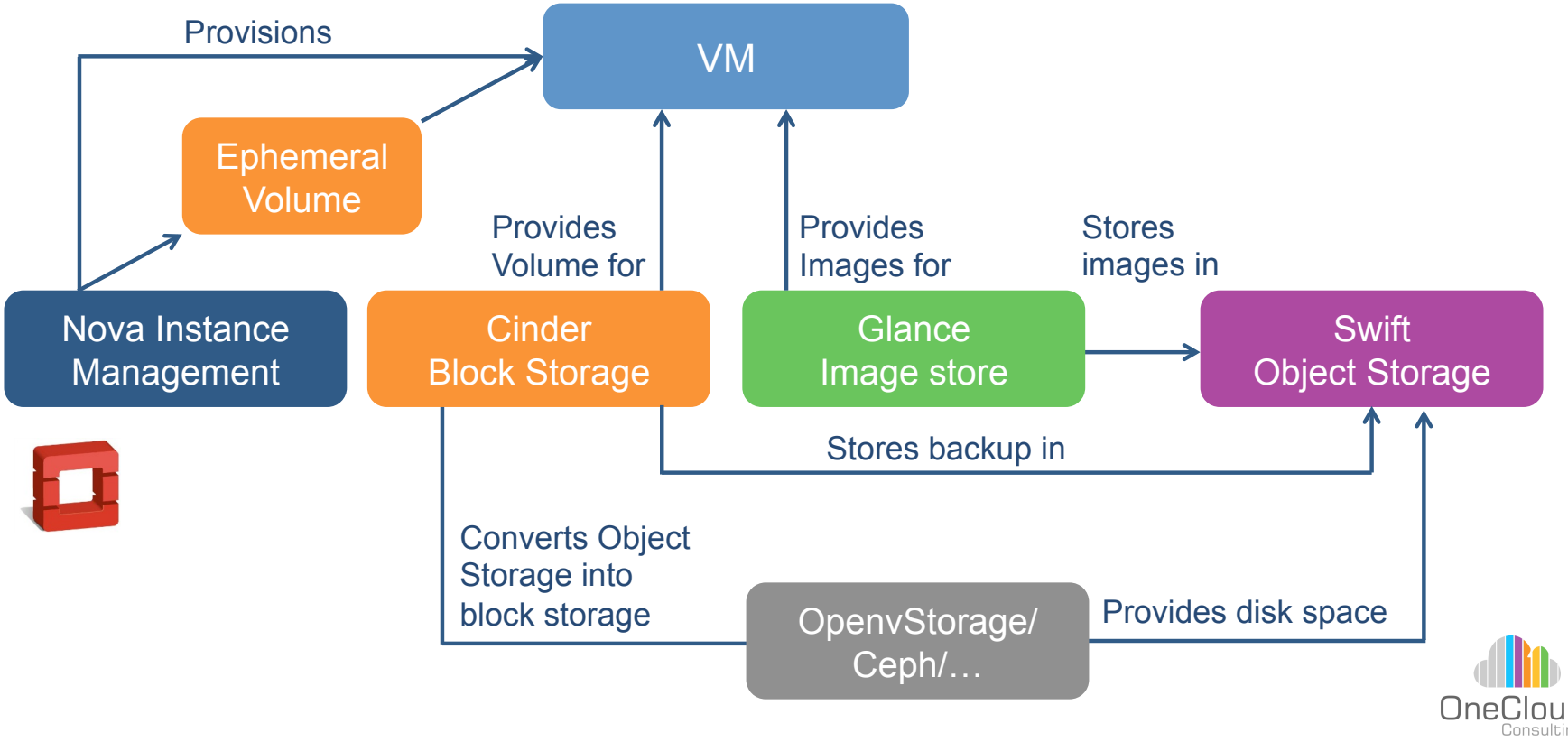
OpenStack & Storage

	Block Storage	Object Storage
Objectives	• Storage for running VM disk volumes on a host • Ideal for performance sensitive apps • Enables Amazon EBS-like service	• Ideal for cost effective, scale-out storage • Fully distributed, API-accessible • Well suited for backup, archiving, data retention
Use Cases	• Production Applications • Traditional IT Systems • Database Driven Apps • Messaging / Collaboration • Dev / Test Systems	• VM Templates • ISO Images • Disk Volume Snapshots • Backup / Archive • Image / Video Repository
Workloads	• High Change Content • Smaller, Random R/W • Higher / “Bursty” IO	• Typically More Static Content • Larger, Sequential R/W • Lower IOps

Storage Concepts

	Ephemeral Storage	Block Storage	Object Storage
Use	Run operating system and scratch space	Add persistent storage to a VM	Store data, e.g., VM images, web graphics, video files
Accessed through	A File system/Operating System	Operating System Kernel, often a file system is applied on top	REST API
Accessible from	Within a VM	Within a VM	Anywhere via HTTP(S)
Managed by	Nova	Cinder	Swift
Persists until	VM is terminated	Deleted by user	Deleted by user
Sizing determined by	Admin configured size settings in VM flavors	Specified by user in initial request	Amount of available physical storage
Example of typical usage	10 GB first disk, 30 GB second disk	1 TB disk	10s of TBs of dataset storage

VM – Storage Interactions



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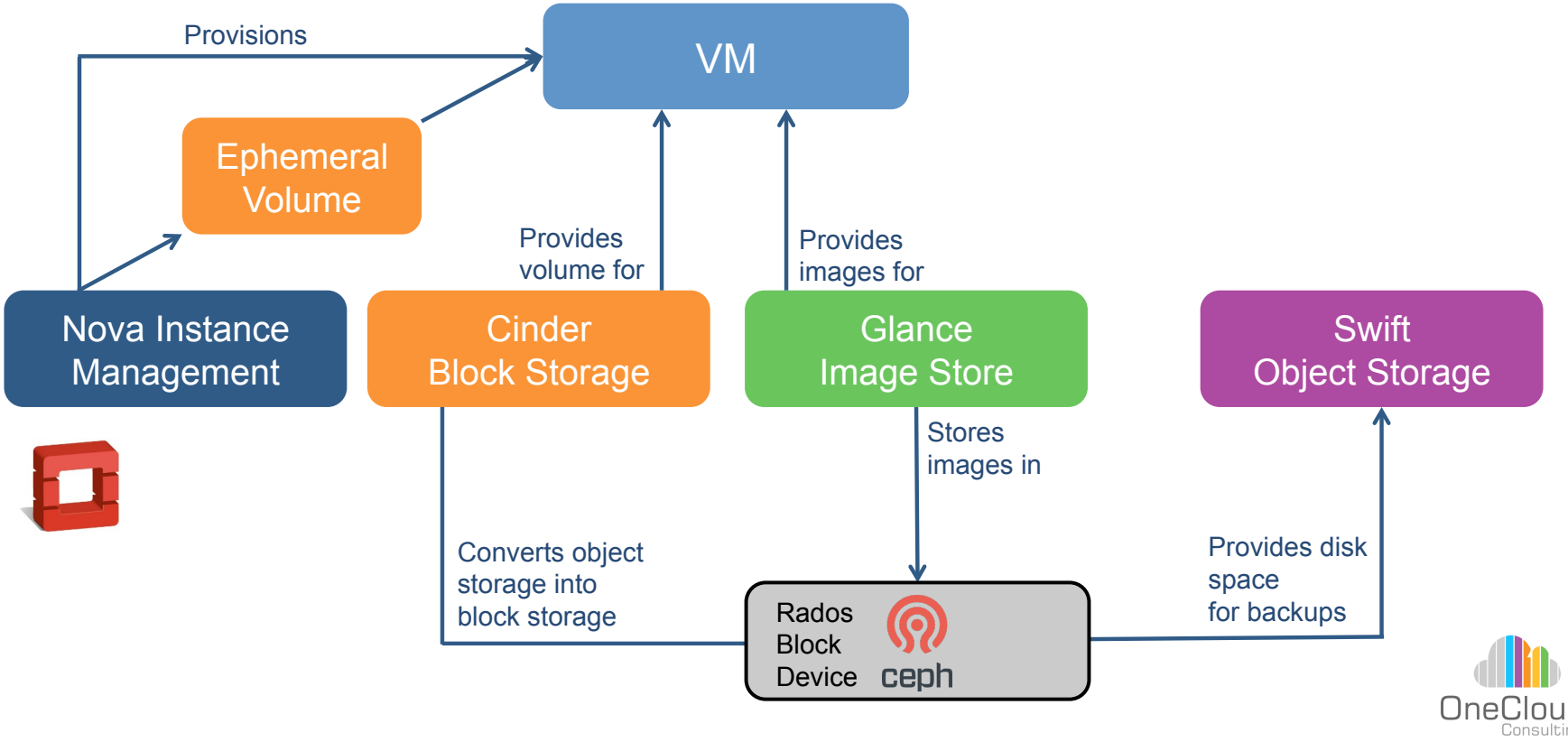
VM – Storage Interactions at TWC



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MODULE 5A

OpenStack Object Storage Service - Swift

What does Swift Do?

- Provides persistent replicated storage and retrieval of content as objects.
- Put, get, delete objects using a RESTful API (Representational State Transfer web services).
- Horizontally scalable with no single point of failure

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Object Storage Swift API Overview

With the object storage API, the user can:

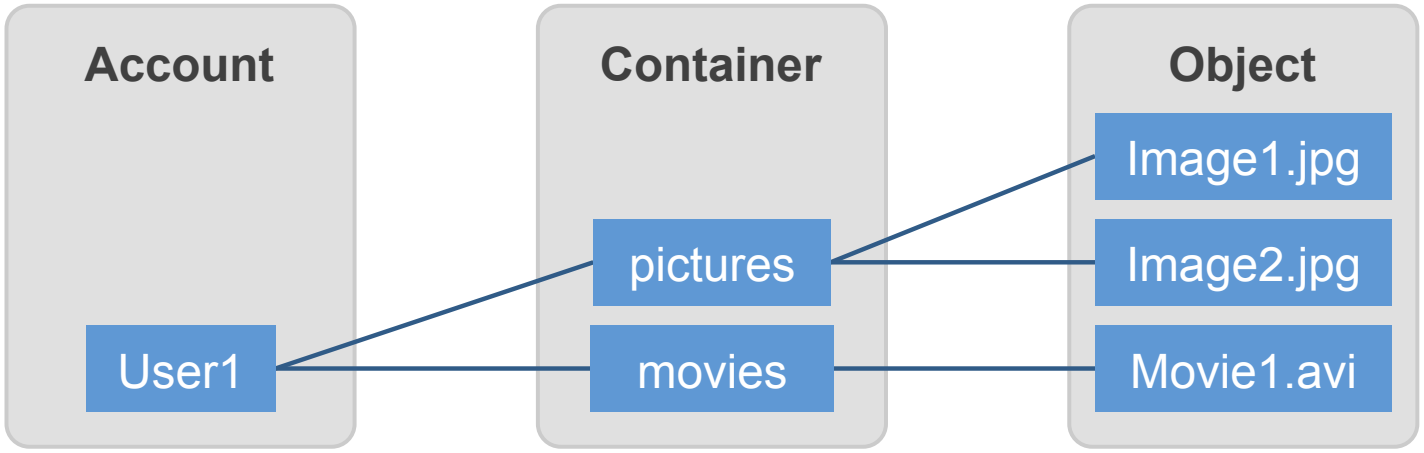
- Store an unlimited number of objects
- Use cross-origin resource sharing to manage object security
- Compress files using content-encoding metadata
- Override browser behavior for an object using content-disposition metadata
- Schedule objects for deletion
- Bulk-delete up to 10,000 objects in a single request
- Auto-extract archive files
- Generate a URL that provides time-limited GET access to an object
- Upload objects directly to the Object Storage system from a browser by using form POST middleware

Why Swift ?

Swift delivers resilient scale-out storage on commodity hardware (cost effective) being developer friendly as:

- Static content
- Expiring objects
- Time-limited urls
- Direct uploads
- Access Control List (ACL)
- Dynamic large objects
- Data is stored and served directly over HTTP
- Single multi-tenant storage system for all apps

Swift “Hierarchy”



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Swift through CLI

Typical Command usage

- To check the Swift status

  $ source keystonerc_admin

  $ swift stat

- To upload a FILE

  $ swift upload demo-container1 FILE

  ^^^ This container will be created if it's not already in existence

- To list the containers

  $ swift list

- To download the FILE

  $ swift download demo-container1 FILE

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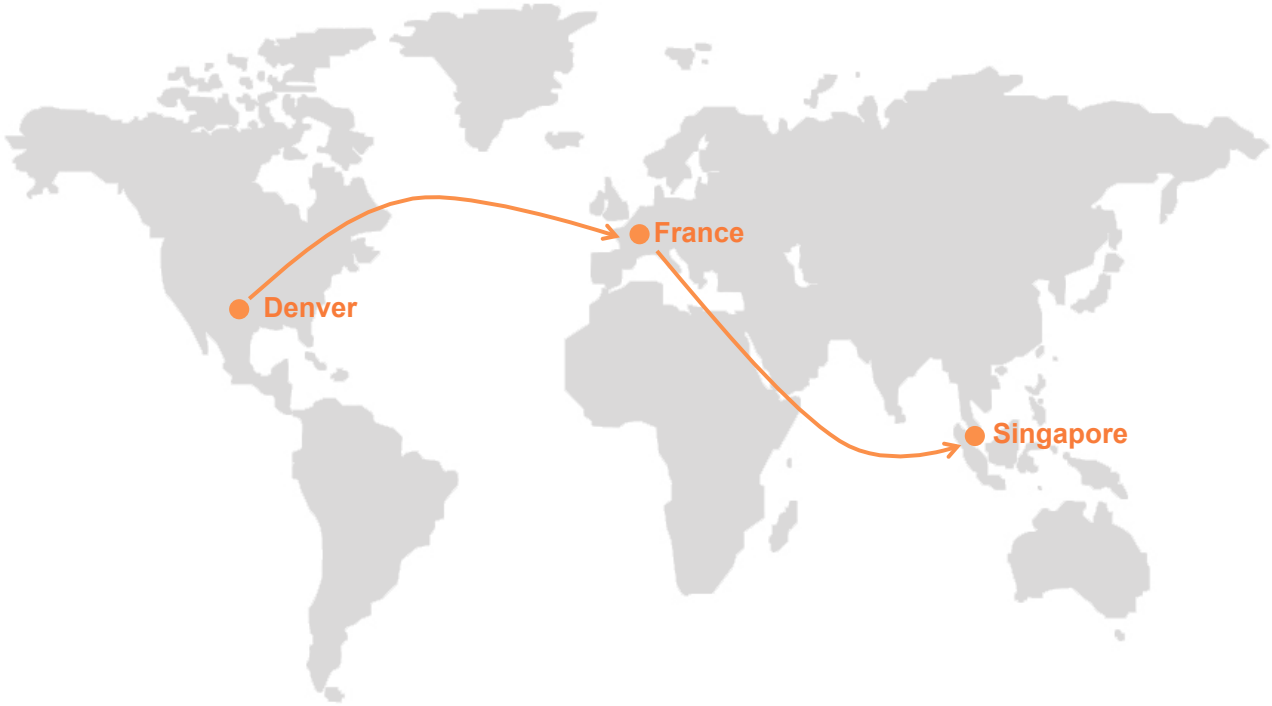
Multi Site Swift

Globally distributed cluster



Configuration options exist that make running a multi region Swift cluster possible.

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Geo-redundant SWIFT

- SWIFT stretched across sites
  - Better resiliency, even loosing an entire datacenter doesn't destroy your data
  - Lower access latency, geo-load-balancing can get you to the "nearest" site to your request
- Acts like a single swift endpoint, load data in "West", it'll be available in East (may still be replicating from West, but appears to be in East)

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Global distributed cluster/Multi Site Swift

Performance improvements:

- Optimized storage disk operations
- Memcache pool of connections (to prevent the connection count from growing without bound)
- Faster Handoff node selection (replicate handoff first)
- Cluster-wide enabled Flash apps reading content directly from a Swift cluster
- Configuration Directory (ConfD) support to better manage configurations

- Tied to a front end service (e.g. Cinder), store in ‘one’ location, automatically have access in another

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MODULE 5B

OpenStack Block Storage Service - Cinder

Cinder's Role In OpenStack

- Expandable file systems
- Integration with enterprise storage services as well as applications
- Cinder for storage of instance snapshots

Cinder Definitions

- **Volumes:** Provide persistent block storage resources that can be attached to instances as additional storage or they can be used as the root store to boot instances.
- **Snapshots:** A read-only point-in-time copy of a volume. The snapshot can be created from a volume that is currently in use.
- **Backups:** An archived copy of a volume currently archived in storage system (Swift, Ceph, S3…)

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Cinder-backup

- Manages volume backups
- Backups are full copies of cinder-created persistent volumes
- Backup volumes are independent of original volume
- Backup can be restored to original or new volume of size >= original
- Volume backups can be created, restored, deleted and listed

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User Operations

- Create/Delete Volume
- Migrate “ownership” of a volume (to another project)
- Write an image (from Glance) to a Volume & Boot from Volume
- Attach/detach a volume to a VM (via Nova)

- Create a backup/Restore a backup
- Create a snapshot/restore a snapshot

- Tags/Hints (not available at TWC)

Cinder Use Case 1

- **Nova Create Bootable Volume**

- **Step 1**: Setup

Download from:

$ wget http://download.cirros-cloud.net/0.3.3/cirros-0.3.3-x86_64-disk.img

- **Step 2** : Upload the image to glance:

$ glance add --name=cirros-boot --is-public=true --disk-format=qcow2 --container-format=bare < ./cirros-0.3.0-x86_64-disk.img

$ IMAGE_ID=$(glance image-list | awk '/ cirros-boot / {print $2}')

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Use Case 1

- **Step 3:** Create a 1Gb volume, which we will make bootable:

```
$ cinder create --image-id $IMAGE_ID --display-name=bootable-cirros 1

$ VOLUME_ID=$(cinder list | awk '/ bootable-cirros / {print $2}')
```

- **Step 4:** wait for the volume to become available:

```
$ watch "cinder show bootable-cirros | grep status"
```

- **Step 5:** Now snapshot the bootable volume we just created:

```
$ cinder snapshot-create --display-name bootable-snapshot $VOLUME_ID
```

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Use Case 1

- **Step 6:** wait for the snapshot to become available:

$ watch "cinder snapshot-show bootable_snapshot"

$ SNAPSHOT_ID=$(cinder snapshot-list | awk '/bootable-snapshot/ {print $2}')

Step 7: Boot from the bootable volume:

$ nova boot --flavor 1 --block-device source=snapshot,id=$
{SNAPSHOT_ID},dest=volume,size=2,bootindex=0 --key_name nova_key
volume_backed

Step 8: Expected Results

$ cinder list

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Backing up storage

Considerations

- Scale of storage
- Scale of VMs (root and data disks)

- Change the model?

- Store your data in a resilient fashion (SWIFT/Ceph backed block)
- Don’t store machine images (beyond golden master images)
- Install applications from source/packages
- Duplicate/copy data to a working set

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Snapshots – Ephemeral Disk

- Ephemeral Snapshots:
  - If you boot via an ephemeral disk, your snapshot is stored in Glance as an image snapshot.
  - Note that good practice is to 'sync' disks if possible (perhaps this is less of an issue with ext4, xfs, ntfs, etc.)
  - System may pause while snapshot is read

```
$ nova image-create test_host
```

  - Only root ephemeral volume is captured in the image.
  - If you have a flavor with an extra ephemeral volume, this data will not be backed up

- Ephemeral "Images":
  - One an image has been captured, it will be stored in Glance as a "snapshot"
  - Still useable as an imaging for booting additional servers (create specialized golden image)

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Snapshots - Volumes

- Volume snapshots:
  - Supports both root volumes and additional attached volumes
  - Per-disk snapshot
  - Have to apply “--force True” if volume is attached
  - Same potential issue with “sync” at the disk level for active snapshots, depending on state of writes to disk.

```
$ cinder create-snapshot --force True --display-name test-volume-sn-16022015 test-volume
```

- Volume to Glance
  - Images stored in Glance can be written to disk to allow for boot from volume
    - Can be done via CLI (Cinder, Nova) or Horizon (Volume or Instance tabs)
  - Volume snapshots can be re-uploaded to Glance as new images

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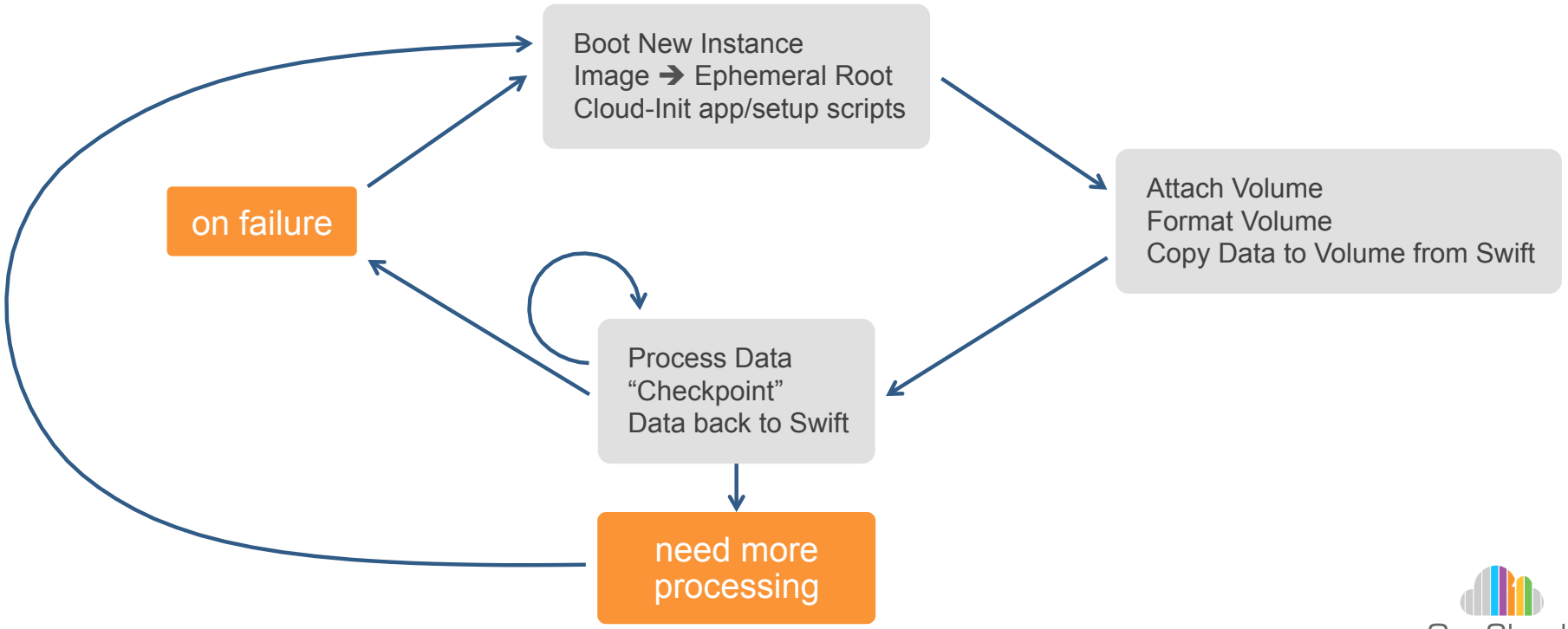
Non-Snapshot Workflow



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http://goo.gl/wY012T