IBM Tivoli Storage Manager

Protecting OpenStack with Tivoli Storage Manager for Virtual Environments

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REVISION HISTORY

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About this document

The rapid adoption of OpenStack by both public cloud vendors and private cloud IT providers has created a demand for enterprise-class data protection for cloud computing. This paper examines the features in IBM Tivoli Storage Manager that ensure data protection in these new cloud computing environments.

Tivoli Storage Manager provides data protection, archive, and disaster recovery solutions for dedicated client/server applications that are based on shared hosts or “bare-metal” environments. Tivoli Storage Manager for Virtual Environments provides agentless data protection of virtual machine guests (or instances). In addition, open source code contributions by IBM to the OpenStack Foundation allow back up and restore operations of block storage volumes directly to Tivoli Storage Manager.

This paper shares our experience with our own in-house OpenStack cloud configured with a VMware compute node. The paper examines the configuration requirements and notes any limitations and workarounds necessary to ensure protection of OpenStack.

The objectives of this paper are:

- Establish a reference environment for OpenStack and Tivoli Storage Manager testing. We also note specific configuration choices of OpenStack, VMware, and Tivoli Storage Manager necessary to ensure successful data protection.
- Document the different data protection approaches for OpenStack administrators and tenants:
    - Document the procedure for backups and restore operations of OpenStack instances running on VMware compute nodes.
    - Document the procedure for back up and restore of OpenStack block storage volumes.
- Document the procedure for back up and restore of OpenStack servers.

Statement of support

IBM Tivoli Storage Manager provides protection for disk volumes, hosts, and instances for bare-metal and in-guest virtualized environments. IBM Tivoli Storage Manager for Virtual Environments-Data Protection for VMware is designed to provide protection for VMware vSphere hypervisor-based instances. Although Tivoli Storage Manager and Tivoli Storage Manager for Virtual Environments do not support OpenStack at this time, these products can be used to back up and restore instances and volumes that are controlled by OpenStack to the extent described in this paper. IBM supports the back up and recovery of instances and volumes as explicitly described in this document.

Tivoli Storage Manager does not offer any additional protection for OpenStack deployments beyond what is described in this document.

Specifically, in the context of the OpenStack, the following caveats are discussed:

- Understanding how instances created by OpenStack using the VMware vSphere driver map to the underlying vSphere infrastructure and how they are named in the context of OpenStack and Tivoli Storage Manager
- Understanding how to recover an instance in the OpenStack infrastructure by restoring the instance with Tivoli Storage Manager for Virtual Environments and then restarting the instance or importing a boot image into OpenStack and creating a new instance.
- Understanding how to handle consistency of the instances or volumes after recovery, if necessary

The information that is gathered in this paper was verified based on the version of the following software. Because these products are continually being enhanced, the documented procedures and results might vary or might not apply for versions before and after these releases.

- Tivoli Storage Manager for Virtual Environments version 7.1.0
- OpenStack Havana and Icehouse releases
- VMware vCenter Server Appliance version 5.1 and 5.5
- VMware ESXi version 5.1 and 5.5
- RedHat Enterprise Linux (RHEL) Server version 6.4 and 6.5, and Ubuntu 12.04 (LTS) for OpenStack controllers and compute nodes.

1 OpenStack overview

OpenStack is a quickly maturing open source alternative to proprietary cloud computing solutions. At its core, OpenStack provides an elastic and scalable cloud computing control layer over existing software-defined computing, storage, and network technologies.

The movement toward open source cloud computing is motivated by following factors:

- Public cloud solutions like AWS, Rackspace, and Softlayer, are pressuring traditional single-purposed, in-house enterprise solutions toward lower cost and faster speed of deployment.
- Unification of the user interface and control APIs provide the freedom to choose the virtualization technologies that are best suited for the target applications.
- OpenStack enables transition from proprietary solutions to heterogeneous, multi-vendor solutions within a single cloud. Cloud architects have the flexibility to choose the software and hardware solutions that are best suited for the applications to be supported, freeing them from the limitations of single-vendor solutions. In addition, the virtualization technologies that are used by OpenStack can convert underutilized, single-purpose hardware, to multitenant resources.
- OpenStack's self-service, multitenant interfaces enable users to provision the required computing infrastructure (IaaS) with minimal delays and with the flexibility to expand or contract resources on demand.
- The trend toward continuous integration (CI) and continuous deployment (CD) requires the provisioning of short-lived infrastructures for DevOps app development teams.
- Interoperability between public and private clouds makes OpenStack ideally suited for hybrid cloud solutions.

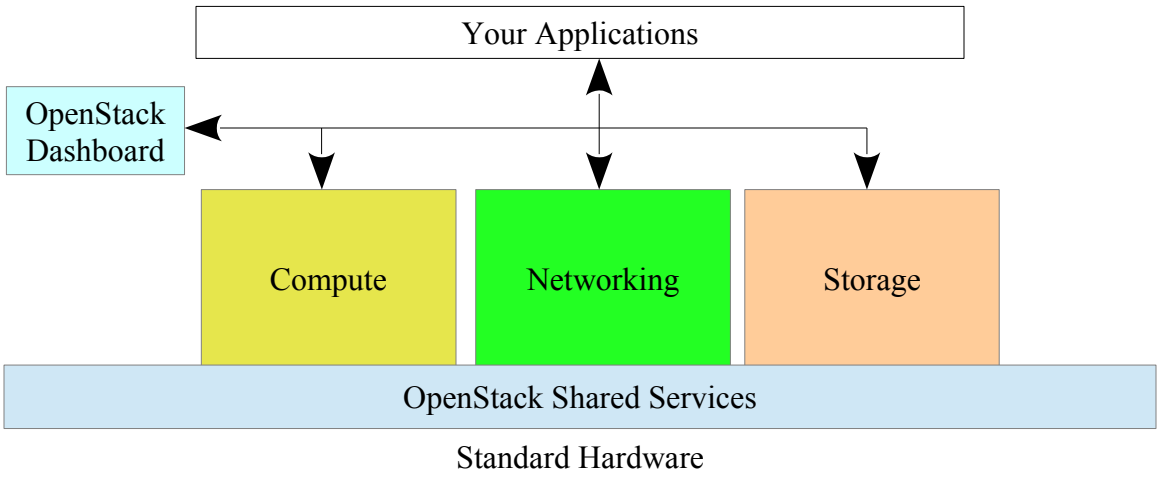

Figure 1: OpenStack Architecture Overview

OpenStack is organized into independent services, each assigned a project code name. These services function independently, using their own databases and messaging queues (share nothing) so that users can selectively use the services as needed. OpenStack defines the core services that are required in a minimal OpenStack deployment: Nova (Compute), Cinder (Storage), Neutron (Network), and Horizon (Dashboard). Other shared services include Keystone (Identity), and Glance (Image), Ceilometer (Telemetry), Heat (Orchestration), Trove (Database), and Swift (Object Storage). New services and functions within existing services are typically added or replaced with each release. You can learn more about the architecture of OpenStack at http://www.openstack.org/software/.

OpenStack interfaces to underlying hypervisors and hardware solutions by using plug-in adapters called drivers. OpenStack deployments require the configuration of these drivers to use both open source and proprietary solutions. For example, hypervisor interfaces for KVM/QEMU, VMware vCenter, Xen, Hyper-V, LXC, and bare-metal, are all provided as drivers by the Nova (Compute) service.

OpenStack packages can be downloaded for use in public or private clouds, or for proof-of-concept exploration. Usage is governed by the Apache 2.0 license agreement terms and conditions at http://www.apache.org/licenses/LICENSE-2.0.

OpenStack is also use by several public cloud vendors that include IBM Softlayer, HP Helion, Rackspace, and DreamHost.

1.1 OpenStack terminology

OpenStack uses terminology that might differ from other virtualization and cloud-based solutions. For this document the following terminology is used:

ephemeral drive

One or more virtual disk drives, including the system boot drive, which are defined to an instance. Ephemeral drives are terminated when the instance is terminated. The OpenStack VMware driver in the Icehouse release does not support ephemeral drives, except for the instance boot drive.

flavor

In OpenStack, the virtualize hardware characteristics and ephemeral drives that are associated with an instance are bound at boot time. This allows images to be free of runtime dependencies and enables computing, storage, and network resources to be dynamically changed. For practical purposes, a running instance is the combination of an image and a flavor. These resources include the number of cores (VCPUs), virtual storage (RAM), size of boot disk, size of ephemeral disk, and size of the swap disk. Flavors are predefined by OpenStack administrators and can be restricted to specific tenants and limited to resources by security and quota rules.

image

A predefined operating system (or container) bootstrap image, managed by OpenStack Image Services (Glance) that can be used to create instances. Unlike other virtualization technologies, OpenStack Compute Services (Nova) uses “Flavors” to assign the virtualized hardware resources. Images are free from hardware specifications, enabling better reuse of images and elastic reconfiguration as workloads grow or contract. Images can also contain preinstalled or partially installed applications. OpenStack orchestration services (Heat) can be used with images to dynamically configure applications and apply maintenance after instance are started.

instance

A virtualized operating system or application container, in running, paused, or stopped state, that is assigned to run on a compute node. Other synonyms include *guest* or *virtual machine (VM)*.

snapshot

An instantaneous back up of an instance or volume. Instance snapshots include virtual memory and register information that is needed to restore a running instance to the exact moment before the snapshot was taken. A snapshot allows an instance to be restored to a point of execution, without requiring the shutdown of the instance. Snapshots might not be application nor file system consistent, therefore additional recovery measures may be required to check application and file system consistency (for example DBMS journal-based rollforward recovery or running the `fsck` or `chkdsk` commands).

volume

A persistent virtual disk volume that is managed by OpenStack Block Storage Services (Cinder). Unlike ephemeral storage, volumes are created independently of instances, and can be attached (mounted) to instances. Volumes persist even after instances are terminated. A volume can be attached to one instance, then later detached, and attached to another instance, as allowed by security rules. Cinder provides the capability to take backups of detached (inactive) volumes. Instance snapshots can also be written to volumes, and these volumes can then be used as images to create new instances. A snapshot of an active volume can also be taken as an instantaneous copy of the block storage and can be used to create new volumes. Users must ensure the consistency of volumes that are created from snapshots, applying application recovery to ensure consistency, if necessary.

1.2 OpenStack references

For more information about OpenStack and OpenStack services, refer to the web links in the table.

Table 1 OpenStack Service project code names (Icehouse release)

Project Name	Service	Web link
Ceilometer	Telemetry	http://www.openstack.org/software/openstack-shared-services/
Cinder	Block Storage	http://www.openstack.org/software/openstack-storage/
Glance	Image	http://www.openstack.org/software/openstack-shared-services/
Heat	Orchestration	http://www.openstack.org/software/openstack-shared-services/
Horizon	Dashboard	http://www.openstack.org/software/openstack-dashboard/
Keystone	Identity	http://www.openstack.org/software/openstack-shared-services/
Neutron	Network	http://www.openstack.org/software/openstack-networking/
Nova	Compute	http://www.openstack.org/software/openstack-compute/
Swift	Object Storage	http://docs.openstack.org/icehouse/config-reference/content/ch_configuring-object-storage.html
Trove	Database	http://www.openstack.org/software/openstack-shared-services/

2 Tivoli Storage Manager overview

IBM Tivoli Storage Manager is a family of products that provide data protection, archive, and disaster recovery solutions for UNIX, Microsoft Windows, MacOS, and z/OS® environments. Tivoli Storage Manager includes a backup-archive client and a server that can protect a wide range of applications. Tivoli Storage Manager includes the following features:

- Comprehensive security and encryption
- Efficient data compression and data deduplication
- Policy-based controls for automated back up and retention
- Monitoring and reporting

Tivoli Storage Manager includes the following optional features:

- Rapid application recovery
- Granular file recovery and vendor-specific database recovery
- Hierarchical storage management (HSM)
- Network-attached storage device support
- Extended disaster recovery with off-site replication.

For more information about Tivoli Storage Manager, see:these resources

http://www.ibm.com/software/products/en/tivoli-storage-manager-family

http://www.ibm.com/software/products/en/tivostormana

http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.ve.doc/relnote_ve710.html

2.1 Tivoli Storage Manager for Virtual Environments overview

IBM Tivoli Storage Manager for Virtual Environments (referred to as Data Protection for VMware) extends the basic features of Tivoli Storage Manager to virtualized systems that are managed by VMware. The features enable proxy-based (agentless) back up and restore operations, without requiring the backup-archive client on every instance.

Tivoli Storage Manager for Virtual Environments, includes data protection capabilities for other hypervisors (for example HyperV), however, only the VMware capabilities are examined in this paper.

This paper shows how Tivoli Storage Manager for Virtual Environments can protect an OpenStack cloud when configured with a VMware compute node. You can also learn how

to use the backup-archive client capabilities to protect OpenStack servers and the Tivoli Storage Manager Cinder Backup driver built-in to the OpenStack Havana release and later.

For more information about Tivoli Storage Manager for Virtual Environments, refer to the following product link:
http://www.ibm.com/software/products/en/storage-mgr-ve

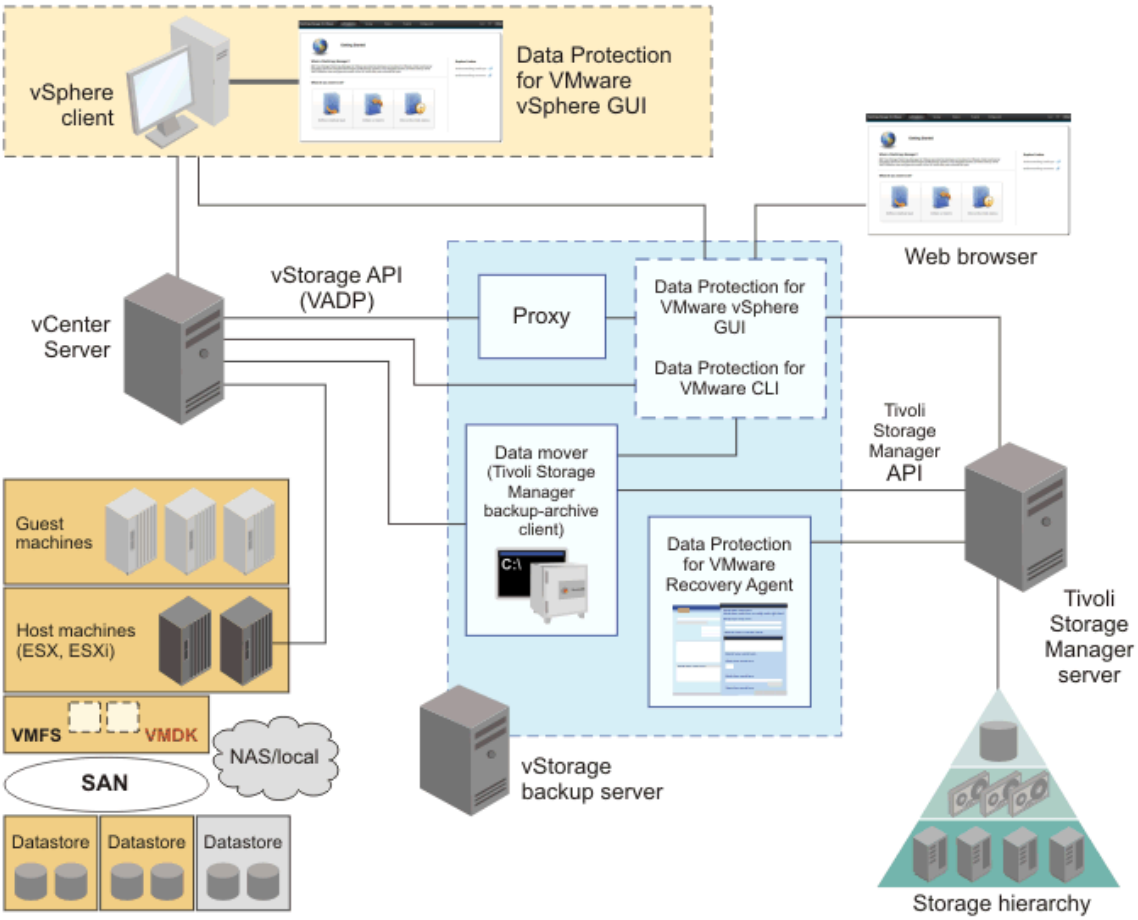

Figure 2: Tivoli Storage Manager for Virtual Environments Overview

3 Test environment

Figures 3 and 4 depicts the test environment. The yellow boxes (“@” in the upper-left corner) show a single All-in-One OpenStack controller and compute node that is running on a dedicated bare metal x86 server. We used Red Hat Enterprise Linux Server release 6.4 and RDO OpenStack Icehouse release with the Packstack utility to install and configure the OpenStack software.

The Nova Compute service was configured with the VMware vCenter driver (`compute_driver=vmwareapi.VMwareVCDriver` in `nova.conf`). In addition, the Cinder service was configured with the Logical Volume Manager (LVM) for block storage volumes.

The Nova Compute driver uses a TCP/IP connection to communicate with a vCenter server to manage the instances that are assigned to run on an ESXi server. Another instance to house the Tivoli Storage Manager for Virtual Environments vStorage Backup Server was defined in a Red Hat Enterprise Linux Server release 6.4 instance running on the ESXi server. We used a vCenter client from our workstations to observe OpenStack and Tivoli Storage Manager back up operations on the vCenter server. The vCenter server was configured to control a single cluster on the ESXi host. These are depicted in the blue boxes (“*” in the upper-left corner) in the diagram.

The Tivoli Storage Manager server was installed on a POWER5 64-bit bare-metal server running AIX 6.1, with a 7 TB disk to hold the Tivoli Storage Manager database. In addition, the Tivoli Storage Manager backup-archive client was installed on the OpenStack All-in-One server to enable Cinder volume backups and in-guest backups of the OpenStack server. These are depicted in green (“$” in the upper-left corner).

We also configured an Ubuntu 12.04 (LTS) server on an x86_64 instance that was configured with a Devstack All-in-One configuration to verify the Tivoli Storage Manager backup-archive client operation on an OpenStack controller.

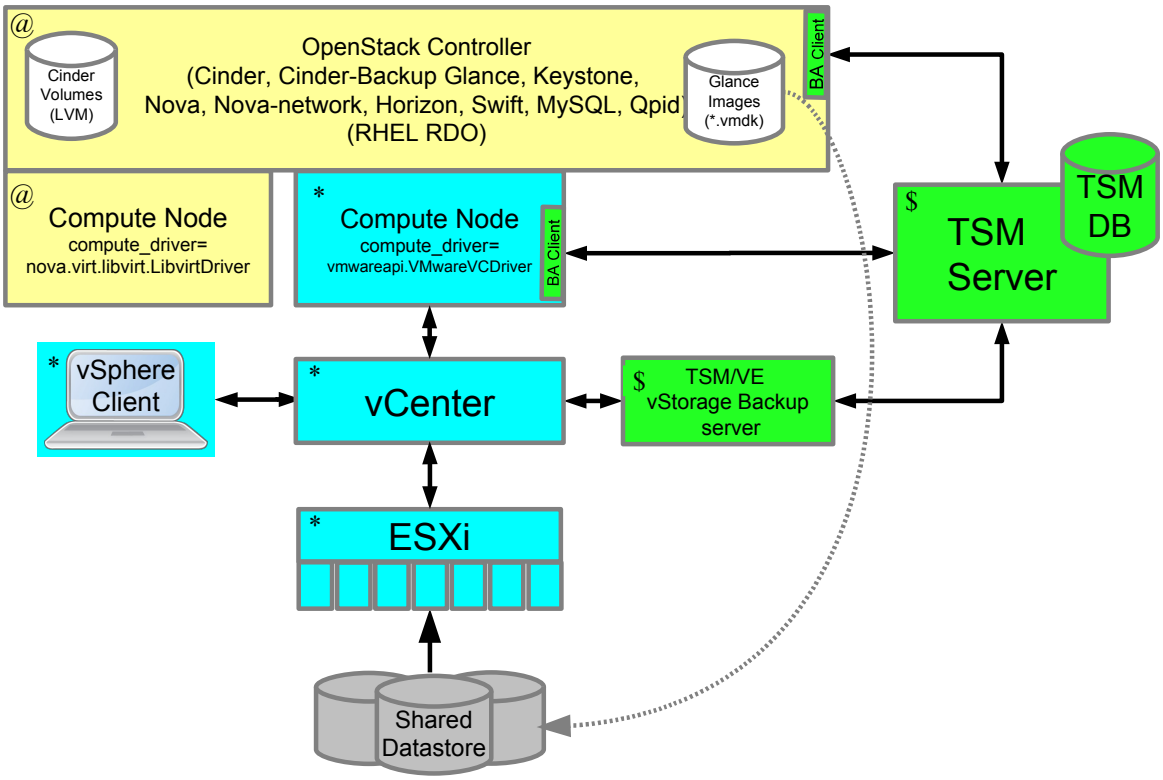

Figure 3: Our Test Environment

	ESXi Server	OpenStack All-in-One	Tivoli Storage Manager Server
CPU	12-core 2.0 GHz x86-64-bit CPU	12-core 2.0 GHz x86-64-bit CPU	4-core 1.6 GHz POWER5 64-bit CPU
Memory	96 GB	96 GB	27 GB
HDD	4 TB	4 TB	7 TB

Table 2: Test Environment Hardware

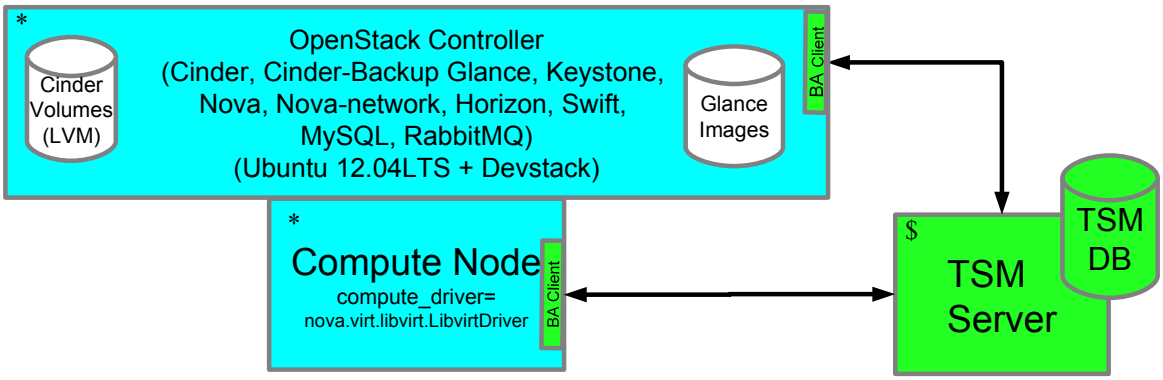

Figure 4: Ubuntu with Devstack Icehouse Test Environment

4 Protecting instances on VMware compute nodes

OpenStack provides a vCenter Nova (Compute) driver to manage instances on VMware clusters. Instances that are created by the driver can be backed up and restored by using Tivoli Storage Manager for Virtual Environments. Tivoli Storage Manager for Virtual Environments uses one or more vStorage Backup servers to coordinate the back up and restore of instances, without requiring a Tivoli Storage Manager backup-archive client to be installed on each instance.

Before you begin

To protect instances on VMware compute nodes, complete the following steps:

1. Configure the VMware Nova compute driver for the OpenStack compute node that connects the driver to a vCenter server capable of controlling the target VMware clusters. For details, see the following information:

   - http://docs.openstack.org/icehouse/config-reference/content/vmware.html
   - http://docs.openstack.org/icehouse/config-reference/content/vmware.html#VMwareVCDriver_details

2. Define and enable a vCenter server, in an instance of one of ESXi hypervisor hosts, to control the VMware clusters.

   Tip: You can use a web-browser based vSphere client to verify access and operation of the vCenter server.

3. Ensure that Tivoli Storage Manager for Virtual Environments is installed and configured. Follow the instructions in "*Installing Data Protection for VMware"* (http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.ve.inst.doc/t_ve_installing.html).

4. Configure the data mover on the vStorage Backup server. This data mover is a backup-archive client that is a proxy between the Tivoli Storage Manager server and the vCenter server. The vStorage Backup server can be either an instance or a "bare-metal" server and must have TCP/IP access to the vCenter server and the Tivoli Storage Manager server. Complete the following steps to configure the Tivoli Storage Manager for Virtual Environments data mover:

   A) Configure the vStorage Backup server using the documented process. The vStorage Backup server can be a Linux or Windows host. The Data Protection for VMware package can be installed configured using the installation wizard. http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.ve.inst.doc/c_ve_configure_start.html

      If you choose to manually configuring the vStorage Backup server, follow the Advanced configuration tasks for vSphere environments as documented at this link:

http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.ve.inst.doc/t_ve_cfggui.html

B) For vStorage Backup servers install on Linux, verify that LD_LIBRARY_PATH environment variable was assigned to the backup-archive client bin directory and exported in the /root/.bash_profile and /etc/init.d/dsmcad files. http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.ve.inst.doc/t_ve_cfg_setdmnodes.html

5. Optional: You can configure the Data Protection for VMware VMCLI, GUI, vSphere plug-in and other components, using the configuration wizard. The back up and restore commands that are documented in this paper are issued from the data mover (backup-archive client) command-line interface of the vStorage Backup server. The configuration wizard installs the Data Protection for VMware VMCLI, GUI, and vSphere plug-in, which can be used as alternatives to the data mover **`dsmc`** command. However, for simplicity, only **`dsmc`** commands are used for back up and restore operations in this paper. (http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.ve.inst.doc/c_ve_configure_start.html)

6. Optional: Configure the VMware shared-storage Cinder volume driver and VMware shared-storage Glance volume driver in the OpenStack. While these drivers are not required for instance backups, they might reduce the I/O overhead required when restoring backups to new instances. For more information, see: http://docs.openstack.org/trunk/config-reference/content/vmware-vmdk-driver.html http://docs.openstack.org/trunk/config-reference/content/vmware-glance-backend.html

4.1 Backing up and restoring OpenStack instances by using the vStorage Backup server

The following sections demonstrate instance back up and restore operations using a set of predefined instances that are provisioned on an OpenStack cloud.

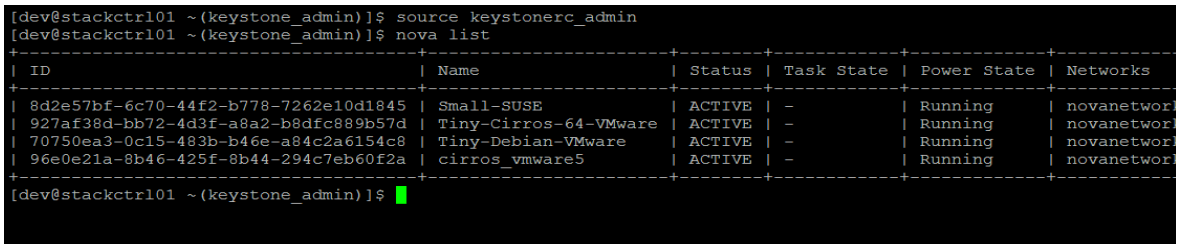

Figure 5: Four instances that were created on a VMware compute node

In the preceding figure, four instances were created on a VMware compute node. A vStorage Backup server was installed on a RedHat 6.4 Linux instance (which is not part of the cluster that is controlled by OpenStack) and configured with the Tivoli Storage Manager backup-archive client that is configured as a Tivoli Storage Manager for Virtual Environments data mover.

Examples of VMware backups of the OpenStack instances, and a selective restore of an instance are shown in the following sections.

We can take advantage of agentless backups and restore operations by issuing Tivoli Storage Manager commands directly to the vStorage Backup server. This eliminates the need to install and configure the Tivoli Storage Manager backup-archive client on each instance.

The incremental-forever mode is used in all the examples that follow. A full back up is taken only if no previous back up for an instance exists. Subsequent backups will include only the blocks that changed since the last back up of the instance.

The examples also assumed that the current user has root privileges via the **sudo** command. This ensures that all manual and scheduled backups are executed from the same ID of root.

We also use the **-asnode=OPENSTACK_DATACENTER** option in all commands to identify the back up and restore operations are executed on behalf of the datacenter node (referred to as MY_DCNODE in configuration documentation) defined during the data mover configuration on the vStorage Backup server. Replace this value with the datacenter node defined for your data mover.

4.1.1 Back up of OpenStack instances on a VMware compute node

Issue the following command to back up all OpenStack instances that are running on the VMware clusters. These clusters are managed by the vCenter server that is defined to the vStorage Backup server.

```
sudo -i dsmc backup vm "*" -vmbackuptype=fullvm -mode=ifincremental
-asnode=OPENSTACK_DATACENTER
```


You can create a back up that targets a specific instance by replacing the wildcard (**"*"**) in the preceding example with the OpenStack instance ID . You can find the ID of an instance on the OpenStack Instance Detail page in the Horizon dashboard, or by issuing a **nova list** command.

The ID can then be passed in the Tivoli Storage Manager **backup vm** command. For example:

```
sudo -i dsmc backup vm "8d2e57bf-6c70-44f2-b778-7262e10d1845"
   -vmbackuptype=fullvm -mode=ifincremental
   -asnode=OPENSTACK_DATACENTER
```

In Figure 9, only 769.74 KB were transmitted for this back up because the incremental-forever mode was specified and a full back up was previously taken.

An automated back up of all instances or a selective list of instances running on specific ESXi hosts, clusters, or virtual data centers can be enabled for regular unattended backups. In our test environment, we used the following steps to protect all instances on a VMware compute node:

1. Ensure that the following options to enable scheduled events are specified in the **dsm.sys** file in the **/opt/tivoli/tsm/client/ba/bin** directory of a vStorage Backup server on Linux or the **dsm.opt** file in the **C:\Program Files\Tivoli\TSM\baclient** directory for a vStorage Backup server on Windows.

   The following example shows the **dsm.sys** file on our test vStorage Backup server on Linux.

   ```
   SErvername server
      NODename OPENSTACK_DATACENTER_DM
      PASSWORDAccess generate
      VMCHost tsmstack04.storage.usca.ibm.com
      VMBACKUPType Fullvm
      MANAGEDServices schedule webclient
      DOMAIN.VMFULL all-vm
      TCPServeraddress orion.storage.usca.ibm.com
      TCPPort 1500
      COMMMethod tcpip
      HTTPPORT 1583
   ```

   where
   VMCHost tsmstack04.storage.usca.ibm.com specifies the vCenter server that is protected by the vStorage Backup server.
   DOMAIN.VMFULL all-vm specifies all instances on the vCenter server that is backed up by default.
   VMBACKUPType Fullvm specifies full VM backups are taken by default.
   MANAGEDServices schedule webclient specifies both scheduled services and webclient services are enabled on the vStorage Backup server.

2. Define a schedule with the Tivoli Storage Management Server to trigger instance backups on the vStorage Backup server on a regular time interval. The following the **dsmadmc** command schedules a **backup vm** command to execute at 11pm daily on the vStorage Backup server data mover node, **OPENSTACK_DATACENTER_DM**.

```
define schedule standard daily_vm action=backup subact=VM
   options='-vmbackuptype=fullvm -mode=ifincremental
   -asnode=OPENSTACK_DATACENTER' starttime=23:00
define association standard daily_vm
   OPENSTACK_DATACENTER_DM
```

3. Ensure that the client acceptor daemon, **dsmcad**, was configured and started. On Linux, the following command will return a running status if **dsmcad** was started and configured properly.

```
service dsmcad status
```

   For more information about the client acceptor daemon, refer to the following link: http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.client.doc/c_sched_autotasks.html?lang=en

4. Use the following command to verify that the back up was scheduled properly: **dsmc q schedule**

You can verify and debug automated back up operations by examining the contents of the **dsmsched.log** file in the directory where the backup-archive client was installed. This file is found in the **/opt/tivoli/tsm/client/ba/bin** directory for vStorage Backup servers that are installed on Linux.

```
[dev@tsmstack05 ~]$ sudo -i dsmc backup vm "*" -vmbackuptype=fullvm -mode=ifincremental -asnode=OPENSTACK_DATACENTER
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.1
  Client date/time: 09/18/2014 10:20:27
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All Rights Reserved.

Node Name: OPENSTACK_DATACENTER_DM
Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/18/2014 10:19:00  Last access: 09/18/2014 10:18:06

Accessing as node: OPENSTACK_DATACENTER
Full BACKUP VM of virtual machines '*'.


Backup VM command started.  Total number of virtual machines to process: 6
Accessing as node: OPENSTACK_DATACENTER
```

*Figure 6: Backing up instances using the **dsmc backup vm** command with wildcard "*" on the vStorage Backup server*

```
        mode:                'Incremental Forever - Full'
        target node name:    'OPENSTACK_DATACENTER'
        data mover node name: 'OPENSTACK_DATACENTER_DM'

Statistics for Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'.

Total number of objects inspected:            1
Total number of objects backed up:            1
Total number of objects updated:              0
Total number of objects rebound:              0
Total number of objects deleted:              0
Total number of objects expired:              0
Total number of objects failed:               0
Total number of bytes inspected:          20.00 GB
Total number of bytes transferred:        16.00 GB
Data transfer time:                      581.87 sec
Network data transfer rate:           28,832.87 KB/sec
Aggregate data transfer rate:         27,613.76 KB/sec
Objects compressed by:                        0%
Total data reduction ratio:              20.00%
Elapsed processing time:                 00:10:07
Removing snapshot for virtual machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
Deleted directory /tmp/vmware-root/4222ef1b-1822-aec9-23a4-33587e8f8a23-vm-31/san
Deleted directory /tmp/vmware-root/4222ef1b-1822-aec9-23a4-33587e8f8a23-vm-31/nbdssl

Aggregate statistics for Backup VM command.

Total number of objects inspected:            6
Total number of objects backed up:            6
Total number of objects updated:              0
Total number of objects rebound:              0
Total number of objects deleted:              0
Total number of objects expired:              0
Total number of objects failed:               0
Total number of bytes inspected:          79.00 GB
Total number of bytes transferred:        28.44 GB
Data transfer time:                    1,075.05 sec
Network data transfer rate:           27,724.88 KB/sec
Aggregate data transfer rate:         24,953.72 KB/sec
Objects compressed by:                        0%
Total data reduction ratio:              64.02%
Elapsed processing time:                 00:19:54

Backup VM command complete
Total number of virtual machines backed up successfully: 6
  virtual machine vSphere Compute Node backed up to nodename OPENSTACK_DATACENTER
  virtual machine Windows Server 2008r2U1 backed up to nodename OPENSTACK_DATACENTER
  virtual machine 70750ea3-0c15-483b-b46e-a84c2a6154c8 backed up to nodename OPENSTACK_DATACENTER
  virtual machine 927af38d-bb72-4d3f-a8a2-b8dfc889b57d backed up to nodename OPENSTACK_DATACENTER
  virtual machine 96e0e21a-8b46-425f-8b44-294c7eb60f2a backed up to nodename OPENSTACK_DATACENTER
  virtual machine 8d2e57bf-6c70-44f2-b778-7262e10d1845 backed up to nodename OPENSTACK_DATACENTER
Total number of virtual machines failed: 0
Total number of virtual machines processed: 6
```

*Figure 7: Conclusion of the **dsmc backup vm** command with wildcard "*" on the vStorage Backup server*


```
[dev@stackctrl01 ~]$ source keystonerc_admin
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+-----------------------+--------+------------+-------------+-----------------------+
| ID                                   | Name                  | Status | Task State | Power State | Networks              |
+--------------------------------------+-----------------------+--------+------------+-------------+-----------------------+
| 8d2e57bf-6c70-44f2-b778-7262e10d1845 | Small-SUSE            | ACTIVE | -          | Running     | novanetwork=192.168.32|
| 927af38d-bb72-4d3f-a8a2-b8dfc889b57d | Tiny-Cirros-64-VMware | ACTIVE | -          | Running     | novanetwork=192.168.32|
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware    | ACTIVE | -          | Running     | novanetwork=192.168.32|
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5        | ACTIVE | -          | Running     | novanetwork=192.168.32|
+--------------------------------------+-----------------------+--------+------------+-------------+-----------------------+
[dev@stackctrl01 ~(keystone_admin)]$
```

*Figure 8: Using the **nova list** command to determine the instance ID on the OpenStack controller*

```
Full BACKUP VM of virtual machines ' 8d2e57bf-6c70-44f2-b778-7262e10d1845'.


Backup VM command started.  Total number of virtual machines to process: 1
Accessing as node: OPENSTACK_DATACENTER
Starting Full VM backup of VMware Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
       mode:                    'Incremental Forever - Incremental'
       target node name:        'OPENSTACK_DATACENTER'
       data mover node name:    'OPENSTACK_DATACENTER_DM'
       application protection type: 'VMware'
       application(s) protected:    'n/a'

Creating snapshot for virtual machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
Backing up Full VM configuration information for '8d2e57bf-6c70-44f2-b778-7262e10d1845'
        15,585 VM Configuration [Sent]
Processing snapshot
       disk:         [datastore1] 8d2e57bf-6c70-44f2-b778-7262e10d1845/8d2e57bf-6c70-44f2-b778-7262e10d1845.vmdk (Hard Disk 1)
       Capacity:     21,474,836,480
       Data to Send: 393,216
       Transport:     (nbdssl)[sending]
Volume --> 21,474,836,480 [datastore1] 8d2e57bf-6c70-44f2-b778-7262e10d1845/8d2e57bf-6c70-44f2-b778-7262e10d1845.vmdk (Hard Disk 1) [Se

Successful Full VM backup of VMware Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
       mode:                'Incremental Forever - Incremental'
       target node name:    'OPENSTACK_DATACENTER'
       data mover node name: 'OPENSTACK_DATACENTER_DM'

Statistics for Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'.

Total number of objects inspected:           1
Total number of objects backed up:           1
Total number of objects updated:             0
Total number of objects rebound:             0
Total number of objects deleted:             0
Total number of objects expired:             0
Total number of objects failed:              0
Total number of bytes inspected:          20.00 GB
Total number of bytes transferred:       769.74 KB
Data transfer time:                       14.73 sec
Network data transfer rate:               27.10 KB/sec
Aggregate data transfer rate:             13.27 KB/sec
Objects compressed by:                       0%
Total data reduction ratio:              100.00%
Elapsed processing time:                00:00:30
Removing snapshot for virtual machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
Deleted directory /tmp/vmware-root/4222ef1b-1822-aec9-23a4-33587e8f8a23-vm-31/san
Deleted directory /tmp/vmware-root/4222ef1b-1822-aec9-23a4-33587e8f8a23-vm-31/nbdssl

Backup VM command complete
Total number of virtual machines backed up successfully: 1
  virtual machine 8d2e57bf-6c70-44f2-b778-7262e10d1845 backed up to nodename OPENSTACK_DATACENTER
Total number of virtual machines failed: 0
Total number of virtual machines processed: 1
```

*Figure 9: Backing up a specific instance using a **dsmc backup vm** command with incremental-forever mode on the vStorage Backup server*

```
[dev@tsmstack05 ~]$ dsmadmc
IBM Tivoli Storage Manager
Command Line Administrative Interface - Version 7, Release 1, Level 0.1
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All Rights Reserved.

Enter your user id:  admin

Enter your password:

Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/18/2014 11:02:00  Last access: 09/18/2014 11:01:15


tsm: ORION>define schedule standard daily_vm action=backup subact=VM options='-vmbackuptype=fullvm -mode=ifincremental -asnode=OPENSTACK_DATACENTER' sta
e=23:00
ANR2500I Schedule DAILY_VM defined in policy domain STANDARD.

tsm: ORION>define association standard daily_vm OPENSTACK_DATACENTER_DM
ANR2510I Node OPENSTACK_DATACENTER_DM associated with schedule DAILY_VM in policy domain STANDARD.

tsm: ORION>query schedule standard daily_vm

Domain          *     Schedule Name        Action     Start Date/Time          Duration     Period     Day
------------    -     ----------------     ------     --------------------     --------     ------     ---
STANDARD              DAILY_VM             Backup     09/18/2014 23:00:00          1 H       1 D      Any
                                            VM

tsm: ORION>query association standard daily_vm

Policy Domain Name                Schedule Name                    Associated Nodes
------------------------------    ------------------------------   ------------------------------------------------------------
STANDARD                          DAILY_VM                         OPENSTACK_DATACENTER_DM

tsm: ORION>
```

*Figure 10: Setting up an automated **BACKUP VM** command to run at 23:00:00 daily on the vStorage backup server*

```
[dev@tsmstack05 ~]$ dsmc q schedule
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.1
  Client date/time: 09/18/2014 11:07:06
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All Rights Reserved.

Node Name: OPENSTACK_DATACENTER_DM
Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/18/2014 11:05:39  Last access: 09/18/2014 11:02:39

    Schedule Name: DAILY_VM
      Description:
   Schedule Style: Classic
           Action: Backup VM
          Options: -vmbackuptype=fullvm -mode=ifincremental -asnode=OPENSTACK_DATACENTER
          Objects:
         Priority: 5
   Next Execution: 11 Hours and 55 Minutes
         Duration: 1 Hour
           Period: 1 Day
      Day of Week: Any
            Month:
     Day of Month:
    Week of Month:
           Expire: Never

[dev@tsmstack05 ~]$
```

*Figure 11: Verification of scheduled daily back up with **dsmc q schedule** command on the vStorage Backup server*

```
09/18/2014 23:40:39
09/18/2014 23:40:39 Successful Full VM backup of VMware Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
       mode:                'Incremental Forever - Full'
       target node name:    'OPENSTACK_DATACENTER'
       data mover node name: 'OPENSTACK_DATACENTER_DM'
09/18/2014 23:40:39
09/18/2014 23:40:39 Statistics for Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'.
09/18/2014 23:40:39 Total number of objects inspected:           1
09/18/2014 23:40:39 Total number of objects backed up:           1
09/18/2014 23:40:39 Total number of objects updated:             0
09/18/2014 23:40:39 Total number of objects rebound:             0
09/18/2014 23:40:39 Total number of objects deleted:             0
09/18/2014 23:40:39 Total number of objects expired:             0
09/18/2014 23:40:39 Total number of objects failed:              0
09/18/2014 23:40:39 Total number of bytes inspected:         20.00 GB
09/18/2014 23:40:39 Total number of bytes transferred:       16.00 GB
09/18/2014 23:40:39 Data transfer time:                     632.02 sec
09/18/2014 23:40:39 Network data transfer rate:          26,545.34 KB/sec
09/18/2014 23:40:39 Aggregate data transfer rate:        20,740.52 KB/sec
09/18/2014 23:40:39 Objects compressed by:                       0%
09/18/2014 23:40:39 Total data reduction ratio:              20.00%
09/18/2014 23:40:39 Elapsed processing time:                00:13:28
09/18/2014 23:40:39 Removing snapshot for virtual machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
09/18/2014 23:40:40 Aggregate statistics for Backup VM command.
09/18/2014 23:40:40 Total number of objects inspected:           8
09/18/2014 23:40:40 Total number of objects backed up:           8
09/18/2014 23:40:40 Total number of objects updated:             0
09/18/2014 23:40:40 Total number of objects rebound:             0
09/18/2014 23:40:40 Total number of objects deleted:             0
09/18/2014 23:40:40 Total number of objects expired:             0
09/18/2014 23:40:40 Total number of objects failed:              0
09/18/2014 23:40:40 Total number of bytes inspected:        119.00 GB
09/18/2014 23:40:40 Total number of bytes transferred:       52.19 GB
09/18/2014 23:40:40 Data transfer time:                   1,987.83 sec
09/18/2014 23:40:40 Network data transfer rate:          27,517.40 KB/sec
09/18/2014 23:40:40 Aggregate data transfer rate:        23,410.42 KB/sec
09/18/2014 23:40:40 Objects compressed by:                       0%
09/18/2014 23:40:40 Total data reduction ratio:              56.17%
09/18/2014 23:40:40 Elapsed processing time:                00:38:56
09/18/2014 23:40:40 Backup VM command complete
09/18/2014 23:40:40 Total number of virtual machines backed up successfully: 8
09/18/2014 23:40:40   virtual machine vSphere Compute Node backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine Windows Server 2008r2U1 backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine 70750ea3-0c15-483b-b46e-a84c2a6154c8 backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine 927af38d-bb72-4d3f-a8a2-b8dfc889b57d backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine 878459dc-5084-4ceb-b1dc-5969ad72c5da backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine 96e0e21a-8b46-425f-8b44-294c7eb60f2a backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine Temp-restored backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40   virtual machine 8d2e57bf-6c70-44f2-b778-7262e10d1845 backed up to nodename OPENSTACK_DATACENTER
09/18/2014 23:40:40 Total number of virtual machines failed: 0
09/18/2014 23:40:40 Total number of virtual machines processed: 8
09/18/2014 23:40:40 Scheduled event 'DAILY_VM' completed successfully.
09/18/2014 23:40:40 Sending results for scheduled event 'DAILY_VM'.
09/18/2014 23:40:40 Accessing as node: OPENSTACK_DATACENTER_DM
09/18/2014 23:40:41 Results sent to server for scheduled event 'DAILY_VM'.
```

*Figure 12: Completion messages of unattended back up written to **dsmsched.log** on the vStorage Backup server*

4.2 Restoring an instance from a back up

The following sections present instance restore scenarios resulting in a new instance or the restoration of a failed instance from a previous back up.

4.2.1 Restoring to a new OpenStack instance

A restore of an instance from a prior back up to a new instance requires coordination with the OpenStack controller and Nova compute node. Restoring an instance directly to an ESXi hypervisor host is not sufficient because the new instance will not be registered as one controlled by OpenStack.

Restoring an instance with the coordination of the OpenStack Nova (Compute) service requires a new image to be created from the instance back up using the following procedure:

1. Determine the instance back up that you want to use. Note the instance ID. Issue the **`sudo dsmc query vm "*" -asnode=OPENSTACK_DATACENTER`** command on the Tivoli Storage Manager vStorage Backup server to match the instance ID shown in the Horizon (Dashboard) instance details display. For example, the instance with the ID of **`8d2e57bf-6c70-44f2-b778-7262e10d1845`** can be restored from a back up as shown in Figure 13.

2. Restore the boot disk VMDK file from a backed up instance into a temporary virtual machine named **`Temp-restored`**. From the Tivoli Storage Manager vStorage Backup server command-line, issue the following command:

   ```
   sudo -i dsmc restore vm "8d2e57bf-6c70-44f2-b778-
      7262e10d1845:vmdk=Hard Disk 1" -vmname="Temp-restored"
      -asnode=OPENSTACK_DATACENTER
   ```

3. The **`dsmc restore vm`** command creates a directory that is named **`Temp-restored`** on the ESXi server, which contains a **`flat.vmdk`** file containing the image of the backed up instance. Upload the **`flat.vmdk`** file from the ESXi server to the OpenStack controller where the Glance (Image) server is installed. From the OpenStack controller, issue the following command to upload the file.

   ```
   scp
      root@stackesx01.storage.usca.ibm.com:/vmfs/volumes/data
      store1/Temp-restored/Temp-restored-flat.vmdk ~/images/.
   ```

   In the preceding example, the following values were used:

   - The ESXi server name is **`stackesx01.storage.usca.ibm.com.`** The ESXi server must be enabled for SSH access.

   - The name of the VMware datastore that is used by the ESXi server is **`datastore1.`**

- The temporarily restored vmname is **Temp-restored.** You must specify this value in both the directory name and the **flat.vmdk** file.

- The home directory **~/images** on the OpenStack controller receives the **flat.vmdk** file.

- You are prompted for the password of the **root** account on the ESXi server before transfer of the **flat.vmdk** file begins.

4. Run a Keystone (Identify) shell script to set the tenant credentials before issuing the **glance image-create** command. In the following example, **keystonerc_admin** is a shell script that was generated by the Packstack installer to set environment variables with the admin tenant credentials. Issue the following Glance (Image) command to register the uploaded **flat.vmdk** file to OpenStack image service as a new bootable image:

```
source keystonerc_admin
glance image-create --name=Temp-restored --disk-format=vmdk
   --container-format bare --is-public True --property
   vmware_adaptertype="lsiLogic" --property
   vmware_disktype="preallocated" --property
   hypervisor_type="vmware" < ~/images/Temp-restored-
   flat.vmdk
```

5. Start a new OpenStack instance specifying the flavor that you want to use with the new image. Use the Horizon (Dashboard) instance display **Launch Instance** button.

   Tip: You can also issue the **nova boot --flavor m1.small --image Temp-restored --availability-zone vmware Small-SUSE-Restored** command to launch the restored image from the OpenStack Controller. Specify the flavor, availability-zone, and instance name values appropriately for the instance to be restored.

6. Verify the proper operation of the restored instance before you delete the **Temp-restored** image file and virtual machine.

7. Delete the uploaded image file if it is no longer needed. Issue the following command from the OpenStack controller:

   ```
   rm ~/images/Temp-restored-flat.vmdk
   ```

8. Use the **Delete Image** button on the Horizon (Dashboard) image display to remove the **Temp-restored** image, if it is no longer needed.

   Tip: You can also issue the **glance image-delete Temp-restored** command to delete the image from the OpenStack Controller

9. Use the vSphere web client, **Delete from Disk** action on the virtual machine that is named **Temp-restored** if it is no longer needed.

Restriction: Excessive network I/O between servers can cause delays when large **`flat.vmdk`** files are transferred between servers and when the Glance image is transferred to the ESX1 server datastore. The shared storage VMware driver for Glance images can provide some relief when restoring large instances.


```
[dev@tsmstack05 ~]$ sudo dsmc query vm "*" -asnode=OPENSTACK_DATACENTER
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.1
  Client date/time: 09/18/2014 11:16:36
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All Rights Reserved.

Node Name: OPENSTACK_DATACENTER_DM
Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/18/2014 11:15:09  Last access: 09/18/2014 11:13:33

Accessing as node: OPENSTACK_DATACENTER
Query Virtual Machine for Full VM backup

 #      Backup Date       Mgmt Class  Size         Type   A/I Virtual Machine
---  -------------------  ----------  -----------  ------ --- ---------------
  1  09/18/2014 10:20:37  STANDARD       15.62 GB  IFFULL  A  vSphere Compute Node
  2  09/18/2014 10:23:43  STANDARD       39.06 GB  IFFULL  A  Windows Server 2008r2U1
  3  09/18/2014 10:29:00  STANDARD    1,000.00 MB  IFFULL  A  70750ea3-0c15-483b-b46e-a84c2a6154c8
  4  09/18/2014 10:29:50  STANDARD    1,000.00 MB  IFFULL  A  927af38d-bb72-4d3f-a8a2-b8dfc889b57d
  5  09/18/2014 10:30:05  STANDARD    1,000.00 MB  IFFULL  A  96e0e21a-8b46-425f-8b44-294c7eb60f2a
  6  09/18/2014 10:50:34  STANDARD       19.53 GB  IFINCR  A  8d2e57bf-6c70-44f2-b778-7262e10d1845
[dev@tsmstack05 ~]$
```

*Figure 13: Using the **dsmc q vm "*"** command to determine the ID of the instance to be restored on the vStorage Backup server*

```
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.1
  Client date/time: 09/18/2014 12:14:03
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All Rights Reserved.

Node Name: OPENSTACK_DATACENTER_DM
Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/18/2014 12:12:35  Last access: 09/18/2014 12:11:45

Accessing as node: OPENSTACK_DATACENTER
Restore function invoked.



Restore VM command started.  Total number of virtual machines to process: 1


Restore of Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845' started


Starting Full VM restore of VMware Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845' target node name='OPENSTACK_DATACENTER', data mover node name='OPEN
STACK_DATACENTER_DM'

Restoring VM configuration information for '8d2e57bf-6c70-44f2-b778-7262e10d1845'
Creating snapshot for virtual machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
Deleted directory /tmp/vmware-root/4222dadc-3354-f952-4ab2-ccfe03876a33-vm-152/nbdssl
Deleted directory /tmp/vmware-root/4222dadc-3354-f952-4ab2-ccfe03876a33-vm-152/san
Restoring disk [datastore1] Temp-restored/Temp-restored.vmdk (Hard Disk 1), Capacity: 21,474,836,480   (nbdssl)[receiving]
Restoring IFINCR (09/18/2014 10:50:34) - bytes to restore: 17,179,869,184
Restoring  21,474,836,480   Hard disk 1 [Done]
Restoring  21,474,836,480   8d2e57bf-6c70-44f2-b778-7262e10d1845 [Done]
Successful Full VM restore of Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845'
Removing snapshot for virtual machine 'Temp-restored'
Deleted directory /tmp/vmware-root/4222638c-9a62-7348-606a-f624240cfe71-vm-154/san
Deleted directory /tmp/vmware-root/4222638c-9a62-7348-606a-f624240cfe71-vm-154/nbdssl
<   16.00 GB> [ - ]
Restore processing finished.

Successful Full VM restore of VMware Virtual Machine '8d2e57bf-6c70-44f2-b778-7262e10d1845' target node name='OPENSTACK_DATACENTER', data mover node name='OP
ENSTACK_DATACENTER_DM'

Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/18/2014 12:52:13  Last access: 09/18/2014 12:12:50

Accessing as node: OPENSTACK_DATACENTER

Total number of objects restored:            1
Total number of objects failed:              0
Total number of bytes transferred:       16.00 GB
Data transfer time:                   2,328.25 sec
Network data transfer rate:           7,205.92 KB/sec
Aggregate data transfer rate:         7,077.13 KB/sec
Elapsed processing time:              00:39:30
[dev@tsmstack05 ~]$
```

*Figure 14: Using the **dsmc restore vm** command to restore an instance on the vStorage Backup server*

```
[dev@stackctrl01 ~(keystone_admin)]$ scp root@stackesx01.storage.usca.ibm.com:/vmfs/volumes/datastore1/Temp-restored/Temp-restored-flat.vmdk ~/images/.
Password:
Temp-restored-flat.vmdk                                                                                    100%   20GB  41.2MB/s   08:17
[dev@stackctrl01 ~(keystone_admin)]$ source keystonerc_admin
[dev@stackctrl01 ~(keystone_admin)]$ glance image-create --name=Temp-restored --disk-format=vmdk --container-format bare --is-public True --property vmware_a
daptertype="lsiLogic" --property vmware_disktype="preallocated" --property hypervisor_type="vmware" < ~/images/Temp-restored-flat.vmdk
+------------------------------+--------------------------------------+
| Property                     | Value                                |
+------------------------------+--------------------------------------+
| Property 'hypervisor_type'   | vmware                               |
| Property 'vmware_adaptertype'| lsiLogic                             |
| Property 'vmware_disktype'   | preallocated                         |
| checksum                     | 1b29df8009c3fb3eb5501a577e712519     |
| container_format             | bare                                 |
| created_at                   | 2014-09-18T20:24:14                  |
| deleted                      | False                                |
| deleted_at                   | None                                 |
| disk_format                  | vmdk                                 |
| id                           | dc3b3b97-959a-4333-a8ac-4fac03bc3a7b |
| is_public                    | True                                 |
| min_disk                     | 0                                    |
| min_ram                      | 0                                    |
| name                         | Temp-restored                        |
| owner                        | 19401b77077f4a0ba05129ca19a338cb     |
| protected                    | False                                |
| size                         | 21474836480                          |
| status                       | active                               |
| updated_at                   | 2014-09-18T20:26:33                  |
| virtual_size                 | None                                 |
+------------------------------+--------------------------------------+
[dev@stackctrl01 ~(keystone_admin)]$
```

*Figure 15: Secure copy of a restored **flat.vdmk** and creation of a new image using the **glance image-create command** on the OpenStack controller*

```
[dev@stackctrl01 ~(keystone_admin)]$ nova boot --flavor m1.small --image Temp-restored --availability-zone vmware Small-SUSE-Restored
+--------------------------------------+--------------------------------------------------+
| Property                             | Value                                            |
+--------------------------------------+--------------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                           |
| OS-EXT-AZ:availability_zone          | nova                                             |
| OS-EXT-SRV-ATTR:host                 | -                                                |
| OS-EXT-SRV-ATTR:hypervisor_hostname  | -                                                |
| OS-EXT-SRV-ATTR:instance_name        | instance-0000002e                                |
| OS-EXT-STS:power_state               | 0                                                |
| OS-EXT-STS:task_state                | scheduling                                       |
| OS-EXT-STS:vm_state                  | building                                         |
| OS-SRV-USG:launched_at               | -                                                |
| OS-SRV-USG:terminated_at             | -                                                |
| accessIPv4                           |                                                  |
| accessIPv6                           |                                                  |
| adminPass                            | p8sLZmUFx2kK                                     |
| config_drive                         |                                                  |
| created                              | 2014-09-25T19:03:03Z                             |
| flavor                               | m1.small (2)                                     |
| hostId                               |                                                  |
| id                                   | 654a1393-1e9c-4832-b8b0-fc432becbe35             |
| image                                | Temp-restored (47caae7a-a066-4079-a552-d7bf05f095cd) |
| key_name                             | -                                                |
| metadata                             | {}                                               |
| name                                 | Small-SUSE-Restored                              |
| os-extended-volumes:volumes_attached | []                                               |
| progress                             | 0                                                |
| security_groups                      | default                                          |
| status                               | BUILD                                            |
| tenant_id                            | 19401b77077f4a0ba05129ca19a338cb                 |
| updated                              | 2014-09-25T19:03:03Z                             |
| user_id                              | 79285a9981be42e7910091b625cf83f8                 |
+--------------------------------------+--------------------------------------------------+
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+---------------------+---------+------------+-------------+---------------------------------
| ID                                   | Name                | Status  | Task State | Power State | Networks
+--------------------------------------+---------------------+---------+------------+-------------+---------------------------------
| 022350d5-5e27-4bab-9ab7-336dbb617ede | Small-SUSE          | SHUTOFF | -          | Shutdown    | novanetwork=192.168.32.4, 9.52.18
| 654a1393-1e9c-4832-b8b0-fc432becbe35 | Small-SUSE-Restored | ACTIVE  | -          | Running     | novanetwork=192.168.32.6, 9.52.18
| 5f300924-02e3-41fd-b69d-6ef63f1a756b | Tiny-Cirros-64      | ACTIVE  | -          | Running     | novanetwork=192.168.32.5, 9.52.18
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware  | ACTIVE  | -          | Running     | novanetwork=192.168.32.3, 9.52.18
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5      | ACTIVE  | -          | Running     | novanetwork=192.168.32.2, 9.52.18
+--------------------------------------+---------------------+---------+------------+-------------+---------------------------------
```

*Figure 16: Starting a restored instance using the **nova boot** command on the OpenStack controller*

4.2.2 Restoring an existing OpenStack instance

A restore operation over an existing instance is used to replace a corrupted instance from a back up that is known to contain an operational version of the instance. A restore operation requires that you shut down the target instance before you start the replacement process.

The Tivoli Storage Manager backup-archive client does not allow a complete replacement of an instance, but you can selectively restore the disk images from the back up to an existing instance. Because the OpenStack VMware driver does not support other ephemeral drives, only the main boot disk needs to be replaced to restore the instance from a back up. The hardware characteristics are specified by the flavor of the existing instance and are retained. If you need to change the flavor, use the **Resize Instance** button in the Horizon instance detail display or the **`nova resize`** command before restarting the instance.

Use the following steps to restore data to an existing instance:

1. Determine the ID of the instance to be restored from the Horizon (Dashboard) instance detail display. The following examples use the instance ID, **`e697348d-e154-42fe-9dbd-5c07e1c46c28`**.

   Tip: You can also use the **`nova list`** command to display the instance IDs.

2. Use the Horizon (Dashboard) instance display to issue a **Shut off instance** action on the instance to shut down the instance to be restored:

   Tip: You can also issue the following command to shut down the instance from the OpenStack controller: **`nova stop e697348d-e154-42fe-9dbd-5c07e1c46c28`**

3. Verify that the instance is stopped before continuing. Use the Horizon instance display.

   Tip: You can also issue the **`nova list`** command to verify that the instance has stopped.

4. Restore the VMDK file for **`Hard Disk 1`** of an existing instance from a back up, by issuing the following command to the Tivoli Storage Manager vStorage Backup server.

   ```
   sudo -i dsmc restore vm "e697348d-e154-42fe-9dbd-
      5c07e1c46c28:vmdk=Hard Disk 1:-vmdk=cnfg"
      -asnode=OPENSTACK_DATACENTER
   ```

   Only the main boot disk is restored and the instance flavor configuration remains unchanged.

5. Restart the restored instance. Use the **Start Instance** button in the Horizon (Dashboard) instance display to restart the instance,

   Tip: You can also issue the **`nova start e697348d-e154-42fe-9dbd-5c07e1c46c28`** command to restart the instance.

```
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+---------------------+--------+------------+-------------+--
| ID                                   | Name                | Status | Task State | Power State | N
+--------------------------------------+---------------------+--------+------------+-------------+--
| e697348d-e154-42fe-9dbd-5c07e1c46c28 | Small-SUSE          | ACTIVE | -          | Running     | r
| 5f300924-02e3-41fd-b69d-6ef63f1a756b | Tiny-Cirros-64      | ACTIVE | -          | Running     | r
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware  | ACTIVE | -          | Running     | r
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5      | ACTIVE | -          | Running     | r
+--------------------------------------+---------------------+--------+------------+-------------+--
[dev@stackctrl01 ~(keystone_admin)]$ nova stop e697348d-e154-42fe-9dbd-5c07e1c46c28
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+---------------------+--------+--------------+-------------+
| ID                                   | Name                | Status | Task State   | Power State |
+--------------------------------------+---------------------+--------+--------------+-------------+
| e697348d-e154-42fe-9dbd-5c07e1c46c28 | Small-SUSE          | ACTIVE | powering-off | Running     |
| 5f300924-02e3-41fd-b69d-6ef63f1a756b | Tiny-Cirros-64      | ACTIVE | -            | Running     |
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware  | ACTIVE | -            | Running     |
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5      | ACTIVE | -            | Running     |
+--------------------------------------+---------------------+--------+--------------+-------------+
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+---------------------+---------+------------+-------------+-
| ID                                   | Name                | Status  | Task State | Power State |
+--------------------------------------+---------------------+---------+------------+-------------+-
| e697348d-e154-42fe-9dbd-5c07e1c46c28 | Small-SUSE          | SHUTOFF | -          | Shutdown    |
| 5f300924-02e3-41fd-b69d-6ef63f1a756b | Tiny-Cirros-64      | ACTIVE  | -          | Running     |
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware  | ACTIVE  | -          | Running     |
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5      | ACTIVE  | -          | Running     |
+--------------------------------------+---------------------+---------+------------+-------------+-
[dev@stackctrl01 ~(keystone_admin)]$
```

*Figure 17: Shutting down an instance using **nova stop** command.on the OpenStack controller*

```
[dev@tsmstack05 ~]$ sudo -i dsmc restore vm "e697348d-e154-42fe-9dbd-5c07e1c46c28:vmdk=Hard Disk 1:-vmdk=cnfg" -asnode=OPENSTACK_DATACENTER
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.1
  Client date/time: 09/25/2014 16:40:45
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All Rights Reserved.

Node Name: OPENSTACK_DATACENTER_DM
Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/25/2014 16:39:20  Last access: 09/25/2014 16:38:51

Accessing as node: OPENSTACK_DATACENTER
Restore function invoked.



Restore VM command started.  Total number of virtual machines to process: 1


Restore of Virtual Machine 'e697348d-e154-42fe-9dbd-5c07e1c46c28' started


Starting Full VM restore of VMware Virtual Machine 'e697348d-e154-42fe-9dbd-5c07e1c46c28' target node name='OPENSTACK_DATACENTER', data move
STACK_DATACENTER_DM'

Creating snapshot for virtual machine 'e697348d-e154-42fe-9dbd-5c07e1c46c28'
Restoring VM configuration information for 'e697348d-e154-42fe-9dbd-5c07e1c46c28'
ANS2145W Warning - updating an existing virtual machine named 'e697348d-e154-42fe-9dbd-5c07e1c46c28'.  The restore operation continues.
Restoring disk [datastore1] e697348d-e154-42fe-9dbd-5c07e1c46c28/e697348d-e154-42fe-9dbd-5c07e1c46c28-000003.vmdk (Hard Disk 1), Capacity: 2
nbdssl)[receiving]
Restoring IFFULL (09/25/2014 16:01:51) - bytes to restore: 17,179,869,184
Restoring  21,474,836,480   Hard disk 1 [Done]
Restoring  21,474,836,480   e697348d-e154-42fe-9dbd-5c07e1c46c28 [Done]
Successful Full VM restore of Virtual Machine 'e697348d-e154-42fe-9dbd-5c07e1c46c28'
Removing snapshot for virtual machine 'e697348d-e154-42fe-9dbd-5c07e1c46c28'
Deleted directory /tmp/vmware-root/4222d406-7fa7-8b3b-234c-e9de7bb57a93-vm-222/san
Deleted directory /tmp/vmware-root/4222d406-7fa7-8b3b-234c-e9de7bb57a93-vm-222/nbdssl
<   16.00 GB> [ - ]
Restore processing finished.

Successful Full VM restore of VMware Virtual Machine 'e697348d-e154-42fe-9dbd-5c07e1c46c28' target node name='OPENSTACK_DATACENTER', data mov
ENSTACK_DATACENTER_DM'

Session established with server ORION: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 09/25/2014 17:07:52  Last access: 09/25/2014 16:39:25

Accessing as node: OPENSTACK_DATACENTER

Total number of objects restored:            1
Total number of objects failed:              0
Total number of bytes transferred:       16.00 GB
Data transfer time:                   1,612.58 sec
Network data transfer rate:          10,403.95 KB/sec
Aggregate data transfer rate:         9,807.60 KB/sec
```

*Figure 18: Restoring the **flat.vmdk** file for an existing instance from the vStorage Backup server*


```
[dev@stackctrl01 ~(keystone_admin)]$ nova start e697348d-e154-42fe-9dbd-5c07e1c46c28
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+--------------------+---------+-------------+-------------+--------------------------------------+
| ID                                   | Name               | Status  | Task State  | Power State | Networks                             |
+--------------------------------------+--------------------+---------+-------------+-------------+--------------------------------------+
| e697348d-e154-42fe-9dbd-5c07e1c46c28 | Small-SUSE         | SHUTOFF | powering-on | Shutdown    | novanetwork=192.168.32.4, 9.52.180.108 |
| 5f300924-02e3-41fd-b69d-6ef63f1a756b | Tiny-Cirros-64     | ACTIVE  | -           | Running     | novanetwork=192.168.32.5, 9.52.180.109 |
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware | ACTIVE  | -           | Running     | novanetwork=192.168.32.3, 9.52.180.107 |
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5     | ACTIVE  | -           | Running     | novanetwork=192.168.32.2, 9.52.180.106 |
+--------------------------------------+--------------------+---------+-------------+-------------+--------------------------------------+
[dev@stackctrl01 ~(keystone_admin)]$ nova list
+--------------------------------------+--------------------+--------+------------+-------------+--------------------------------------+
| ID                                   | Name               | Status | Task State | Power State | Networks                             |
+--------------------------------------+--------------------+--------+------------+-------------+--------------------------------------+
| e697348d-e154-42fe-9dbd-5c07e1c46c28 | Small-SUSE         | ACTIVE | -          | Running     | novanetwork=192.168.32.4, 9.52.180.108 |
| 5f300924-02e3-41fd-b69d-6ef63f1a756b | Tiny-Cirros-64     | ACTIVE | -          | Running     | novanetwork=192.168.32.5, 9.52.180.109 |
| 70750ea3-0c15-483b-b46e-a84c2a6154c8 | Tiny-Debian-VMware | ACTIVE | -          | Running     | novanetwork=192.168.32.3, 9.52.180.107 |
| 96e0e21a-8b46-425f-8b44-294c7eb60f2a | cirros_vmware5     | ACTIVE | -          | Running     | novanetwork=192.168.32.2, 9.52.180.106 |
+--------------------------------------+--------------------+--------+------------+-------------+--------------------------------------+
[dev@stackctrl01 ~(keystone_admin)]$
```

*Figure 19: Restarting the restored instance using the **nova start** command on the OpenStack controller*

5 Protecting Cinder volumes by using the Tivoli Storage Manager back up driver

OpenStack provides several drivers to back up block storage volumes. Volumes, unlike ephemeral storage, are independent of instances, persisting after instances are terminated. Volumes provide portable storage that can be attached to an instance and reattached to another, or replicated as needed.

By default, the Swift Object store is enabled for Cinder volume backups. A Tivoli Storage Manager back up driver is also available starting with the OpenStack Havana release. After you configure the back up service, you can use OpenStack commands and APIs to back up and restore volumes with Tivoli Storage Manager.

Before you begin

To protect Cinder volumes, complete the following steps:

1. Install and configure the Tivoli Storage Manager backup-archive client on the OpenStack Cinder host.
2. Update the **`cinder.conf`** file to configure the Tivoli Storage Manager back up driver.
3. Start the Cinder Backup service.

5.1 Install and configure the Tivoli Storage Manager backup-archive client

1. Install and configure the Tivoli Storage Manager backup-archive client on the Cinder controller by using the procedure for the host operating system.

   http://pic.dhe.ibm.com/infocenter/tsminfo/v7r1/topic/com.ibm.itsm.client.doc/c_inst_baunix.html

   http://pic.dhe.ibm.com/infocenter/tsminfo/v7r1/topic/com.ibm.itsm.client.doc/c_cfg.html

   Follow the instructions in Chapter 6 of "*Installing the Tivoli Storage Manager backup-archive client on Ubuntu"*, if your Cinder service is running on an Ubuntu server.

2. Ensure that the **errorLogName** parameter in the **dsm.sys** file specifies a file in a preexisting directory with the appropriate read and write privileges to allow debugging of request errors. This ensures that the Tivoli Storage Manager error log is written in the same directory, independent of the directory that is used by the Cinder root process, the user that issues the back up and restore commands, and the directory where the commands are issued.

```
SErvername  server_a
   nodename          TSMSTACK03
   PASSWORDAccess    generate
   COMMMethod        TCPip
   TCPPort           1500
   TCPServeraddress tsmserver.storage.usca.ibm.com
   errorLogName      /var/log/tsm/dsmerror.log
```

3. Verify that the Tivoli Storage Manager backup-archive client is operational and connects to the target Tivoli Storage Manager server by issuing a **dsmc q se** command:

```
dsmc q se
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.0
  Client date/time: 07/16/2014 14:46:55
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All
Rights Reserved.

Node Name: TSMSTACK03
Session established with server TSMSERVER: AIX
  Server Version 7, Release 1, Level 0.0

  Server date/time: 07/16/2014 14:34:07  Last access:
07/16/2014 12:33:34

TSM Server Connection Information

Home Server Name........: SERVER_A
Server Type.............: AIX
Archive Retain Protect..: "No"
Server Version..........: Ver. 7, Rel. 1, Lev. 0.0
Last Access Date........: 07/16/2014 12:33:34
Delete Backup Files.....: "No"
Delete Archive Files....: "Yes"
Deduplication...........: "Server Only"

Node Name...............: TSMSTACK03
User Name...............: dev

Secondary Server Information
Not configured for failover
```


5.2 Configuring and starting the Cinder Backup service

To configure and start the Tivoli Storage Manager Cinder Backup driver, follow the steps in "IBM Tivoli Storage Manager back up driver" in the OpenStack configuration documentation: http://docs.openstack.org/icehouse/config-reference/content/tsm-backup-driver.html.

The following values are specified in the **cinder.conf** file that is used in our test server:

```
#
# Options defined in cinder.backup.drivers.tsm
#

# Volume prefix for the backup id when backing up to TSM
# (string value)
backup_tsm_volume_prefix=backup

# TSM password for the running username (string value)
backup_tsm_password=openstack

# Enable or Disable compression for backups (boolean value)
backup_tsm_compression=true

#
# Options defined in cinder.backup.manager
#
# Driver to use for backups. (string value)
# Deprecated group/name - [DEFAULT]/backup_service
#backup_driver=cinder.backup.drivers.swift
backup_driver=cinder.backup.drivers.tsm
```

5.3 Start the Cinder Backup (c-bak) Service

Most OpenStack packages deliver a predefined service definition in the **/etc/init.d/openstack-cinder-backup** file. This might vary depending on the version of OpenStack installed and the Linux operating system. Use the following command to start the predefined service:

```
sudo service openstack-cinder-backup start
```

If you are using Devstack, you can start the **c-bak** service by ensuring that your **local.conf** file contains the following entry before running the **/stack.sh** shell script:

```
# Enable Cinder Backup driver
enable_service c-bak
```

If you started Devstack, you can restart it after you change the **conf** files. Run the **./unstack.sh** shell script to shut down Devstack, and then run the **./stack.sh** script to restart Devstack with the **c-bak** service.

5.4 Verifying that Cinder Backup service is running

Verify that the Cinder Backup service is operational by issuing the following commands. If no previous backups were taken and the service was configured and started, the **cinder backup-list** command displays an empty table. A blank line is returned if the back up service is not configured properly.

```
source keystonerc_admin
cinder backup-list
```

The **keystonerc_admin** shell script contains the tenant credentials that are required to issue back up and restore commands. You must set these credentials before you can issue any OpenStack commands. The file name and contents can vary for your installation. For reference, the contents of the **keystonerc_admin** file that is generated by the Packstack installer on our OpenStack controller is as follows:

```
export OS_USERNAME=admin
export OS_TENANT_NAME=admin
export OS_PASSWORD=d4bdbac0aa044e2e
export OS_AUTH_URL=http://9.52.183.132:5000/v2.0/
export PS1='[\u@\h \W(keystone_admin)]\$ '
```

5.5 Backing up a detached volume

OpenStack Cinder services allow block storage devices to be created, formatted, and mounted for access by running instances.

To back up a detached volume from the OpenStack controller, complete the following steps:

1. Issue the **cinder list** command to list all block storage volumes so that you can determine the name or the volume ID of the volume to be backed up. Ensure that the volume is not attached to an instance.

2. Back up the volume by specifying the name of the volume or the volume ID in the **cinder backup-create** command In the following example, the volume name to be backed, **Tiny-Volume**, is specified in the **cinder backup-create** command:

   ```
   cinder list
   cinder backup-create Tiny-Volume
   ```

3. Determine the disposition of the request to back up the volume by using the **cinder backup-list** command.


```
[dev@tsmstack03 ~(keystone_admin)]$ source keystonerc_admin
[dev@tsmstack03 ~(keystone_admin)]$ cinder list
+--------------------------------------+-----------+--------------------------+------+-------------+----------+-------------+
|                  ID                  |   Status  |       Display Name       | Size | Volume Type | Bootable | Attached to |
+--------------------------------------+-----------+--------------------------+------+-------------+----------+-------------+
| 36728ed8-d6b3-4ac9-9a44-820b4a097db9 | available | Tiny-Volume-from-Snapshot |  2   |     None    |  false   |             |
| dffac80d-da32-415c-a3cf-ec5868c5cc12 | available |       Tiny-Volume        |  2   |     None    |  false   |             |
+--------------------------------------+-----------+--------------------------+------+-------------+----------+-------------+
[dev@tsmstack03 ~(keystone_admin)]$ cinder backup-create Tiny-Volume
+-----------+--------------------------------------+
|  Property |                Value                 |
+-----------+--------------------------------------+
|     id    | 193264e2-3800-4fd5-a6f2-40039cba0f79 |
|    name   |                 None                 |
| volume_id | dffac80d-da32-415c-a3cf-ec5868c5cc12 |
+-----------+--------------------------------------+
[dev@tsmstack03 ~(keystone_admin)]$ cinder backup-list
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
|                  ID                  |              Volume ID               |   Status  | Name | Size | Object Count | Container |
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
| 193264e2-3800-4fd5-a6f2-40039cba0f79 | dffac80d-da32-415c-a3cf-ec5868c5cc12 |  creating | None |  2   |     None     |    None   |
| a3c390e8-e0de-428d-a83e-05a104c19dae | 36728ed8-d6b3-4ac9-9a44-820b4a097db9 | available | None |  2   |     None     |    None   |
| bb4c9755-b582-4c18-87ae-5defc36dcf6f | dffac80d-da32-415c-a3cf-ec5868c5cc12 |   error   | None |  2   |     None     |    None   |
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
[dev@tsmstack03 ~(keystone_admin)]$ cinder backup-list
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
|                  ID                  |              Volume ID               |   Status  | Name | Size | Object Count | Container |
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
| 193264e2-3800-4fd5-a6f2-40039cba0f79 | dffac80d-da32-415c-a3cf-ec5868c5cc12 | available | None |  2   |     None     |    None   |
| a3c390e8-e0de-428d-a83e-05a104c19dae | 36728ed8-d6b3-4ac9-9a44-820b4a097db9 | available | None |  2   |     None     |    None   |
| bb4c9755-b582-4c18-87ae-5defc36dcf6f | dffac80d-da32-415c-a3cf-ec5868c5cc12 |   error   | None |  2   |     None     |    None   |
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
```

*Figure 20: Backing up a detached volume using **cinder backup-create** command on the OpenStack controller*

5.6 Backing up an attached volume

You can take a snapshot of an attached but not actively used volume. You can use the snapshot to create a new volume. You can take a back up of the volume without affecting the running instance that is attached to the original volume. However, there is no guarantee of the consistency of the resulting snapshot and the consistently of the back up.

After the volume is created, you can issue the **`cinder backup-create`** command to take a back up of the volume. Issue the **`cinder backup-list`** command to verify the completion of the back up.

To back up an attached volume, complete the following steps:

1. Take a snapshot of the volume by using the Horizon (Dashboard). Use the **Create Snapshot** action from the Volume display.

   Tip: You can also use the **`cinder snapshot-create --force True Tiny-Volume`** command to take a snap of the volume. The **`–force True`** option specifies that the snapshot is to be taken even though the volume is attached to an instance.

2. Create a volume from the snapshot by using the **Create Volume** button. Establish the tenant client credentials by sourcing the **`keystonerc_admin`** shell script. Then determine the volume name and volume ID of the new volume by issuing the **`cinder list`** command.

3. **Tip:** You can also issue the command **`cinder create --snapshot-id e48abce2-f4e4-48f0-890c-cb28ba625c86 --display-name Tiny-Volume-from-Snapshot 2`** to create the volume. Specify the **`–snapshot-id`**

value shown by the **cinder snapshot-list** command for the snapshot that was taken for the original volume. In the following example, **e48abce2-f4e4-48f0-890c-cb28ba625c86** is the snapshot ID value, **Tiny-Volume-from-Snapshot** is the name of the new volume that was created from the snapshot, and "**2**" specifies that the new volume should be 2GB, the same size as the original volume.

4. Create the back up by issuing the **cinder backup-create** command. In the following example, the volume name of **Tiny-Volume-from-Snapshot** is specified. Issue the **cinder backup-list** command to determine the disposition of the back up request:

```
cinder backup-create Tiny-Volume-from-Snapshot
cinder backup-list
```

5. After the restored volume it is attached to an instance, issue a **fsck** or **chkdsk** command to verify the file consistency of the restored volume. If the volume contained a database, start a rollforward recovery process to ensure database integrity.

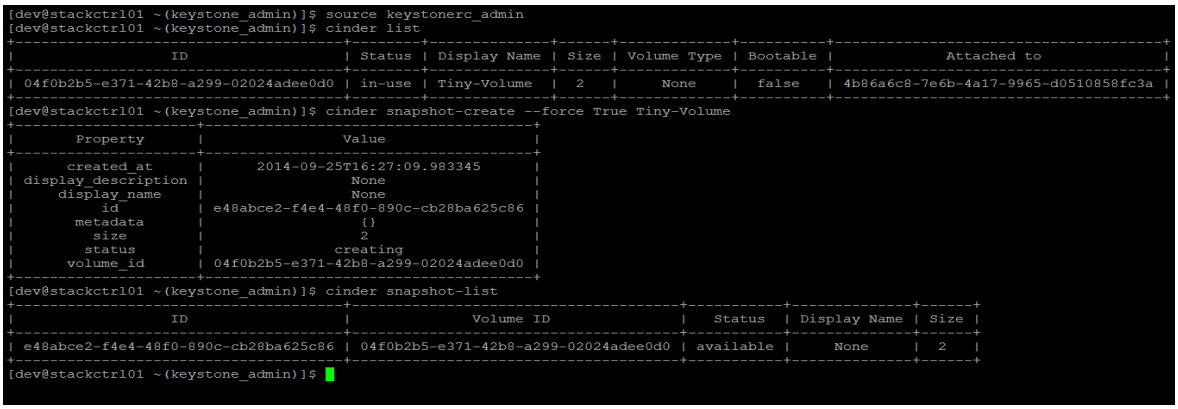

*Figure 21: Taking a volume snapshot using the **cinder snapshot-create** command on the OpenStack controller*

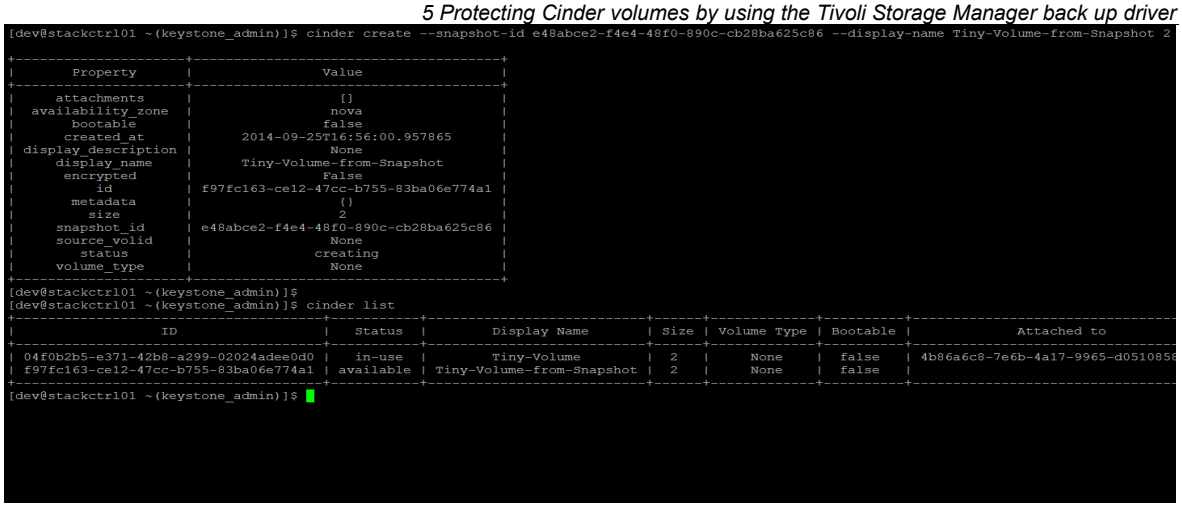

*Figure 22: Creating a volume from a snapshot using the **cinder create** command on the OpenStack controller*

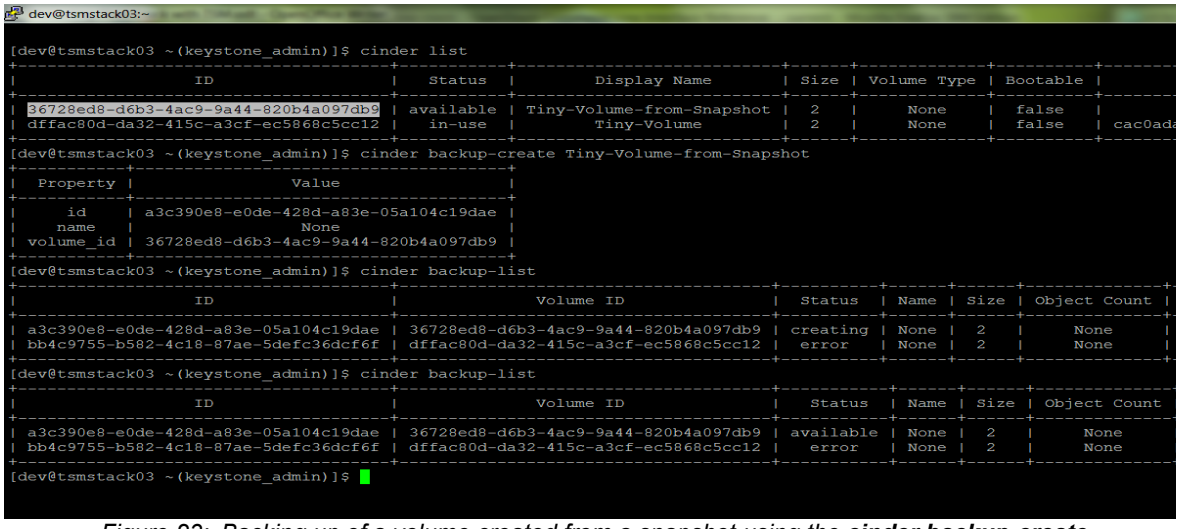

*Figure 23: Backing up of a volume created from a snapshot using the **cinder backup-create** command on the OpenStack controller*

5.7 Restoring a volume

To restore volume from a back up, issue the **`cinder backup-restore`** command. A volume is created by the restore operation that contains the contents of the original back up. You must specify the back up ID of the original volume in the command. You can find the ID by issuing the **`cinder backup-list`** command.

To restore of volume, complete the following steps:

1. Establish the tenant client credentials. This is normally accomplished by running a shell script. In example that follows, the **`keystonerc_admin`** shell script is executed to set the credentials.

2. Determine the back up ID of the volume that is to be used for the restore operation by issuing the **`cinder backup-list`** command.

3. To restore the volume, issue the **`cinder backup-restore`** command. In the following example, the backup ID of **`193264e2-3800-4fd5-a6f2-40039cba0f79`** is specified.

4. To determine the disposition of the restore request, issue the **`cinder list`** command or the Horizon (Dashboard) tenant volume.

```
[dev@tsmstack03 ~(keystone_admin)]$ source keystonerc_admin
[dev@tsmstack03 ~(keystone_admin)]$ cinder backup-list
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
|                  ID                  |              Volume ID               |   Status  | Name | Size | Object Count | Container |
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
| 193264e2-3800-4fd5-a6f2-40039cba0f79 | dffac80d-da32-415c-a3cf-ec5868c5cc12 | available | None |  2   |     None     |    None   |
| a3c390e8-e0de-428d-a83e-05a104c19dae | 36728ed8-d6b3-4ac9-9a44-820b4a097db9 | available | None |  2   |     None     |    None   |
| bb4c9755-b582-4c18-87ae-5defc36dcf6f | dffac80d-da32-415c-a3cf-ec5868c5cc12 |   error   | None |  2   |     None     |    None   |
+--------------------------------------+--------------------------------------+-----------+------+------+--------------+-----------+
[dev@tsmstack03 ~(keystone_admin)]$ cinder backup-restore 193264e2-3800-4fd5-a6f2-40039cba0f79
[dev@tsmstack03 ~(keystone_admin)]$ cinder list
+--------------------------------------+------------------+-----------------------------------------------------+------+-------------+----------+-------------
-+
|                  ID                  |      Status      |                     Display Name                    | Size | Volume Type | Bootable | Attached to
 |
+--------------------------------------+------------------+-----------------------------------------------------+------+-------------+----------+-------------
-+
| 1c6e00db-f318-417d-b972-c83e435fef0a | restoring-backup | restore_backup_193264e2-3800-4fd5-a6f2-40039cba0f79 |  2   |     None    |  false   |
 |
| 36728ed8-d6b3-4ac9-9a44-820b4a097db9 |    available     |              Tiny-Volume-from-Snapshot              |  2   |     None    |  false   |
 |
| dffac80d-da32-415c-a3cf-ec5868c5cc12 |    available     |                     Tiny-Volume                     |  2   |     None    |  false   |
 |
+--------------------------------------+------------------+-----------------------------------------------------+------+-------------+----------+-------------
-+
[dev@tsmstack03 ~(keystone_admin)]$ cinder list
+--------------------------------------+-----------+-----------------------------------------------------+------+-------------+----------+-------------+
|                  ID                  |   Status  |                     Display Name                    | Size | Volume Type | Bootable | Attached to |
+--------------------------------------+-----------+-----------------------------------------------------+------+-------------+----------+-------------+
| 1c6e00db-f318-417d-b972-c83e435fef0a | available | restore_backup_193264e2-3800-4fd5-a6f2-40039cba0f79 |  2   |     None    |  false   |             |
| 36728ed8-d6b3-4ac9-9a44-820b4a097db9 | available |              Tiny-Volume-from-Snapshot              |  2   |     None    |  false   |             |
| dffac80d-da32-415c-a3cf-ec5868c5cc12 | available |                     Tiny-Volume                     |  2   |     None    |  false   |             |
+--------------------------------------+-----------+-----------------------------------------------------+------+-------------+----------+-------------+
[dev@tsmstack03 ~(keystone_admin)]$
```

*Figure 24: Restoring a volume using the **cinder backup-restore** command on the OpenStack controller*

6 Installing the Tivoli Storage Manager backup-archive client on Ubuntu

According to recent OpenStack Summit user surveys, Ubuntu is the most popular operating system that is used in OpenStack cloud deployments. For more information, see: http://www.slideshare.net/ryan-lane/openstack-atlanta-user-survey

Tivoli Storage Manager 7.1.0 delivers **`rpm`** format packages for Linux. Debian-based distributions, like Ubuntu, cannot directly consume **`rpm`** packages, and require that the **`rpm`** files be reformatted into **`deb`** files by third-party software.

We used the following procedure to install the Tivoli Storage Manager 7.1.0 backup-archive client on an Ubuntu 12.04 (LTS) server on a x86_64 instance. Your procedure can vary depending the version of Ubuntu, the hardware used (bare-metal or instance), the existing packages that are installed, and the version of the Tivoli Storage Manager backup-archive client.

Tivoli Storage Manager provides “best-effort” support for Ubuntu and other operating systems that are listed in this link:
http://www.ibm.com/support/docview.wss?uid=swg21417165#7.1%20DISTRIBUTION%20AND%20RELEASE%20LEVE

Although the backup-archive client can be used to protect OpenStack servers, nodes, and instances on a wide variety of operating systems, only a subset of operating systems are supported for the Tivoli Storage Manager for Virtual Environments data mover and recovery agent. The following link specifies the operating systems and platforms that are supported for these Tivoli Storage Manager for Virtual Environments components:
http://www-01.ibm.com/support/docview.wss?uid=swg21652843

6.1 Installing and configuring the Tivoli Storage Manager backup-archive client

The following section describes the process that we used to install and configure the Tivoli Storage Manager 7.1.0 backup-archive client on an Ubuntu 12.04 operating system running on x86_64 hardware.

Requirements:

- The **`alien`** utility associate with the Ubuntu release must be installed with the **`apt-get`** command. The: **`apt-get`** command requires Internet access to public repositories to download other product dependencies.

- The following commands assume the user who issues the commands has root privileges through the **`sudo`** command.

The steps to install that Tivoli Storage Manager backup-archive client follows:

1. Install alien, libstdc++5 and Korn shell components:

   ```
   sudo apt-get install alien libstdc++5 ksh
   ```

2. Obtain the Tivoli Storage Manager backup-archive client tar package from the product DVD or from an IBM download site. In the example that follows the file name is **7.1.0.0-TIV-TSMBAC-Linux86.tar.**

3. Expand the **tar** file into the **rpm** files:

   ```
   tar -xvf 7.1.0.0-TIV-TSMBAC-Linux86.tar
   ```

   Tip: You can also copy the Tivoli Storage Manager backup-archive client **rpm** files from the Tivoli Storage Manager/VE CD/DVD media from the **/Linux/DataMover** subdirectory.

4. Convert the following four **rpm** files to **deb** files, replacing the version numbers in file names to those matching the **rpm** files to be retrieved in previous steps:

   ```
   sudo alien -k --scripts TIVsm-BA.x86_64.rpm
   sudo alien -k --scripts TIVsm-API64.x86_64.rpm
   sudo alien -k --scripts gskcrypt64-8.0.14.28.linux.x86_64.rpm
   sudo alien -k --scripts gskssl64-8.0.14.28.linux.x86_64.rpm
   ```

5. Create shared library directory and symbolic link:

   ```
   sudo mkdir /usr/lib64/
   sudo ln -s /usr/lib/ /usr/lib64/
   ```

6. Install the deb files that were converted by the **alien** utility in step 4:

   ```
   sudo dpkg -i ./gskcrypt*.deb
   sudo dpkg -i ./gskssl*.deb
   sudo dpkg -i ./tivsm-api64_*.deb
   sudo dpkg -i ./tivsm-ba_*.deb
   ```

7. Fix incorrect symbolic links to shared libraries replacing the version numbers in library names as necessary:

   ```
   sudo unlink /usr/lib64/libApiTSM64.so
   sudo unlink /usr/lib64/libxmlutil-7.1.0.0.so
   sudo unlink /usr/lib64/libtsmxerces-c.so.28
   sudo unlink /usr/lib64/libtsmxerces-depdom.so.28
   sudo ln -s /opt/tivoli/tsm/client/api/bin64/libApiTSM64.so
    /usr/lib64/libApiTSM64.so
   sudo ln -s /opt/tivoli/tsm/client/api/bin64/libxmlutil*.so
    /usr/lib64/
   sudo ln -s /opt/tivoli/tsm/client/api/bin64/libtsmxerces-
    c.so.28.0 /usr/lib64/
   sudo ln -s /opt/tivoli/tsm/client/api/bin64/libtsmxerces-
    c.so.28.0 /usr/lib64/libtsmxerces-c.so.28
   sudo ln -s /opt/tivoli/tsm/client/api/bin64/libtsmxerces-
    depdom.so.28.0 /usr/lib64/
   sudo ln -s /opt/tivoli/tsm/client/api/bin64/libtsmxerces-
    depdom.so.28.0 /usr/lib64/libtsmxerces-depdom.so.28
   ```


8. Issue the command **ldd /opt/tivoli/tsm/client/ba/bin/dsmc.**Verify that all shared libraries that are referenced by the **dsmc** command are resolved. If any references are unresolved, to the symbolic links defined in the **/usr/lib64/** directory, create a file that is named **/etc/ld.so.conf.d/tsm.conf** and refresh the shared library cache by issuing the following commands:

```
echo "/usr/lib64" | sudo tee /etc/ld.so.conf.d/tsm.conf
sudo ldconfig
```

9. Configure the **dsm.sys** and **dsm.opt** in **/opt/tivoli/tsm/client/ba/bin** directory. Use the sample files **dsm.sys.smp** and **dsm.opt.smp** that are provided in the directory. The following example shows the contents of the **dsm.sys** file from our test system.

```
SErvername  server_a
   COMMMethod       TCPip
   TCPPort          1500
   TCPServeraddress tsmserver.storage.usca.ibm.com
   Nodename         Ubuntu1204
   Passwordaccess   generate
```

10. Register the system as a new Tivoli Storage Manager client node and set the password by issuing the **dsmc** command. You must supply a user ID (default is the nodename that is specified in **dsm.sys**), set a password, verify the password, and provide a contact name.

```
sudo dsmc
IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.0
  Client date/time: 07/14/2014 17:55:16
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All
Rights Reserved.

Node Name: UBUNTU1204
Please enter your user id <UBUNTU1204>:
Please enter password for user id "UBUNTU1204":xxxxxxxx

Your ID (UBUNTU1204) is not currently registered with the server.

Enter the following information to set up a new ID:

Please enter a password:xxxxxxxx
Enter new password for verification:xxxxxxxx

Enter contact information: John Q. Admin

Session established with server TSMSERVER: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 07/14/2014 17:55:14  Last access: 07/14/2014
17:55:14
```

11. Reply **quit** to exit the **tsm>** prompt, remove the **dsmerror.log** file, and verify connectivity to the Tivoli Storage Manager server by issuing a **dsmc q se** command.

```
tsm> quit
sudo rm dsmerror.log
rm: remove write-protected regular file `dsmerror.log'? y
dsmc q se

IBM Tivoli Storage Manager
Command Line Backup-Archive Client Interface
  Client Version 7, Release 1, Level 0.0
  Client date/time: 07/14/2014 11:32:43
(c) Copyright by IBM Corporation and other(s) 1990, 2013. All
Rights Reserved.

Node Name: UBUNTU1204
Session established with server TSMSERVER: AIX
  Server Version 7, Release 1, Level 0.0
  Server date/time: 07/14/2014 11:32:20  Last access: 07/11/2014
14:57:25

TSM Server Connection Information

Home Server Name........: SERVER_A
Server Type.............: AIX
Archive Retain Protect..: "No"
Server Version..........: Ver. 7, Rel. 1, Lev. 0.0
Last Access Date........: 07/11/2014 14:57:25
Delete Backup Files.....: "No"
Delete Archive Files....: "Yes"
Deduplication...........: "Server Only"

Node Name...............: UBUNTU1204
User Name...............: dev

Secondary Server Information
Not configured for failover
```

6.1.1 What to do next

You can now issue **dsmc** commands on your Ubuntu server or instance for back up and restore operations. For more information about back up and restore commands see:

http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.0/com.ibm.itsm.client.doc/r_client_ref.html.

7 Protecting an OpenStack server using backup-archive client

OpenStack documents the backup and restore of controllers and nodes using these procedures: http://docs.openstack.org/openstack-ops/content/backup_and_recovery.html

The following sections augments these procedures by replacing the copy commands (**cp**) of critical directories with Tivoli Storage Manager backup-archive client back up and restore commands.

The cloud administrator must ensure that the metadata that are stored in OpenStack databases are consistent with the instances, images, volumes, and networks that are provisioned by the OpenStack drivers and provider hosts.

Tip: Recovery of OpenStack servers might require further synchronization with underlying hypervisors, storage servers/devices, and software-defined network objects that are not controlled by the OpenStack server.

Before you begin

The Tivoli Storage Manager backup-archive client must be installed and configured on your OpenStack controller or node server. The following links specify the operating systems that are currently supported by the Tivoli Storage Manager backup-archive client.
Backup-archive client: http://www.ibm.com/support/docview.wss?uid=swg21243309
Best effort: http://www.ibm.com/support/docview.wss?uid=swg21417165

7.1 Backing up an OpenStack server

The following sections provide the steps that required to backing up an OpenStack server.

7.1.1 Stop OpenStack services

1. IBM recommends stopping OpenStack services to quiesce database activities before you back up and restore data.

   Hypervisor (KVM, VMware, HyperV, Xen, and so on), identify (Keystone agents), network (OVS, Neutron agents, and so on), and block volume (LVM, and so on) services remain active during this outage, allowing instances to continue to run during the OpenStack server back up processing. The list of active OpenStack services and their names varies with the host operating system and configurations. The contents of the **/etc.init.d/** directory normally define the services on the OpenStack server.

2. Determine which services are running:

   ```
   sudo service --status-all|grep "running..."|grep
    "openstack-"
   ```

3. For each of the running services, issue the following command to stop the service, replacing `xxxxxxx` with the name of the service to be stopped.

```
sudo service xxxxxxx stop
```

7.1.2 Snapshot OpenStack databases

Take a snapshot of all OpenStack service databases by issuing the **mysqldump** command. Unlike the command that is documented by OpenStack, IBM recommends the addition of **--single-transaction** option to ensure that all logs are flushed and all databases are locked during the entire dump operation. OpenStack recommends using the **--opt** option, which only ensures that tables are locked per database during the dump.

Restriction: If your configuration uses an alternative DBMS to the MySQL, the **mysqldump** command might not work. Therefore, you must use an equivalent utility to dump OpenStack tables.

```
sudo mysqldump --opt --all-databases --single-transaction >
 openstack.sql
```

7.1.3 Back up the OpenStack server

Use one of the following back up methods for the OpenStack server.

A **file system back up** that includes all files of all directories on the server can be taken by using an incremental back up. The first back up establishes a full system back up and subsequent back ups will include only the files changed since the full back up. Issue the following command:

```
sudo dsmc incremental
```

A **selective back up** reduces the back up time when compared to the file system back up method, and minimizes the OpenStack controller/node outage time. You can use a shell script to back up each directory and the SQL file that is generated by the **mysqldump** command.

1. If you are using KVM as a Nova compute node, the **/var/lib/nova/instances** directory contains the KVM images of running instances. Back up the directory if you must maintain backups of all instance. You must ensure the consistency of the instances that are backed up. When you restore a KVM instance that was backed up from a running instance, it can cause the restored instance to reboot incorrectly.

   (Optional) Exclude the back up of the KVM instance directory, files, and all subdirectories by adding the following entries in the **/opt/tivoli/tsm/client/ba/bin/dsm.sys** file:

   ```
   exclude.dir /var/lib/nova/instances
   exclude /var/lib/nova/instances/.../*
   ```

2. If you are using a file-based back-end for Glance images, OpenStack stores boot image files in the **/var/lib/glance/images** directory. The image files can be large and result in extended back up times.

(Optional) Exclude the directory, files, and all subdirectories by adding the following entries in the **/opt/tivoli/tsm/client/ba/bin/dsm.sys** file.

```
exclude.dir /var/lib/glance/images
exclude /var/lib/glance/images/.../*
exclude dir /var/lib/cinder/tmp
exclude /var/lib/cinder/tmp/.../*
```

The following example shows a **dsm.sys** file with the KVM instance images and Glance images directories that excluded from backups:

```
SErvername  server_a
   nodename          TSMSTACK03
   PASSWORDAccess    generate
   COMMMethod        TCPip
   TCPPort           1500
   TCPServeraddress tsmserver.storage.usca.ibm.com
   errorLogName      /var/log/tsm/dsmerror.log
   exclude.dir       /var/lib/nova/instances
   exclude.dir       /var/lib/glance/images
   exclude dir       /var/lib/cinder/tmp
   exclude           /var/lib/nova/instances/.../*
   exclude           /var/lib/glance/images/.../*
   exclude           /var/lib/cinder/tmp/.../*
```

3. (Optional) Verify that the exclusions are properly specified by issuing a **dsmc q inclexcl** command.

4. For an incremental back up of specific service directories that are identified as critical by OpenStack, use the following commands in a shell script.

   Tip: The specific directories that are shown might have to be updated as OpenStack services are added or deprecated:

```
#!/usr/bin/env bash
sudo dsmc incremental -subdir=yes /etc/nova/
sudo dsmc incremental -subdir=yes /var/log/nova/
sudo dsmc incremental -subdir=yes /var/lib/nova/
sudo dsmc incremental -subdir=yes /etc/glance/
sudo dsmc incremental -subdir=yes /var/log/glance/
sudo dsmc incremental -subdir=yes /etc/keystone/
sudo dsmc incremental -subdir=yes /var/log/keystone/
sudo dsmc incremental -subdir=yes /var/lib/keystone/
sudo dsmc incremental -subdir=yes /etc/cinder/
sudo dsmc incremental -subdir=yes /var/log/cinder/
sudo dsmc incremental -subdir=yes /var/lib/cinder/
sudo dsmc incremental -subdir=yes /etc/swift/
sudo dsmc incremental -subdir=yes /etc/ceilometer/
sudo dsmc incremental -subdir=yes /var/log/ceilometer/
sudo dsmc incremental -subdir=yes /var/lib/ceilometer/
sudo dsmc incremental -subdir=yes /etc/neutron/
sudo dsmc incremental -subdir=yes /var/log/neutron/
sudo dsmc incremental -subdir=yes /var/lib/neutron/
sudo dsmc incremental ~/openstack.sql
```


7.1.4 Restart OpenStack services

Restart OpenStack services after back up processing is completed. Each service that was stopped at the beginning of the back up procedure must be restarted.

For each service stopped, issue the restart command:

```
service xxxxxxxx restart
```

where **xxxxxxxx** is the name of the service to be restarted.

7.2 Restoring an OpenStack server

7.2.1 Stop OpenStack services

Follow the instructions in 7*.1.1 "Stop OpenStack services"*, to stop all OpenStack services or the specific service to be restored.

7.2.2 Restore data from back up

Use one of the following restore methods, depending on the back up method that you used.

- If **file system back up** was taken**,** all files of all directories on the server can be restored from the latest back up. Issue the following command to restore the server.

  ```
  sudo dsmc restore
  ```

- You can selectively restore **specific service directories** for OpenStack services if you backed up those specific service directories. By using this recovery method, the restore time is reduced as compared to a file system restore, and minimizes the duration of the OpenStack controller or node outage. In the following example, all directories that are associated with the Nova (Compute) service and the MySQL database dump are restored from the last back up.

  ```
  sudo dsmc restore -subdir=yes /etc/nova/
  sudo dsmc restore -subdir=yes /var/log/nova/
  sudo dsmc restore -subdir=yes /var/lib/nova/
  sudo dsmc restore ~/openstack.sql
  ```

  The last **`sudo dsmc restore`** command in the example above restores the **`openstack.sql`** file that was created by the **`mysqldump`** command. The example assumes the **`openstack.sql`** file was created and backed up in the user's home directory.

7.2.3 Restore OpenStack databases

The **`mysqldump`** command creates an output file can be used to restore the all OpenStack databases and tables for an OpenStack server.

The SQL statements in **`openstack.sql`** file include the necessary DDL and DML statements to lock, drop, create, and insert rows into all OpenStack databases and tables.

You can restore all the databases and tables or select sections of the **openstack.sql** file to restore specific OpenStack services.

- Issue the **mysql** command to restore the all OpenStack databases. A different command might be necessary (for example **db2 -tvf openstack.sql**) to run the SQL statements if an alternative to the MySQL DBMS is used. To restore all databases and tables from the back up SQL file, issue the following command:

```
sudo mysql < openstack.sql
```

- To selectively restore tables for a specific OpenStack service, follow these steps:

  A) Copy the restored **openstack.sql** file. In the following example, a copy of **openstack.sql** is made to **nova.sql**.

```
cp openstack.sql nova.sql
```

  B) Edit the copy to keep only those SQL statements that are associated with the tables for the service to be restored. If only the Nova service is to be restored, the SQL statements for the Nova service tables are retained and all statements for other databases and tables are deleted by using a text editor. The selected statements are then saved in the **nova.sql** file.

  C) Issue the commands below to restore the Nova (Compute) service tables.

```
mysql nova < nova.sql
```

  For best results, restore all tables for an OpenStack service database, instead of individual or selective tables. This method ensures that the referential integrity is maintained between the tables within the service database.

7.2.4 Restart OpenStack services

Restart the OpenStack services that were stopped before the restore operation. Follow the instructions in *7.1.4* "*Restart OpenStack services".*

REFERENCES

OpenStack Command-Line Interface Reference:
http://docs.openstack.org/cli-reference/content/index.html

Tivoli Storage Manager Version 7.1, Backup-archive client options and commands:
http://www.ibm.com/support/knowledgecenter/SSGSG7_7.1.1/com.ibm.itsm.client.doc/r_client_ref.html?lang

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