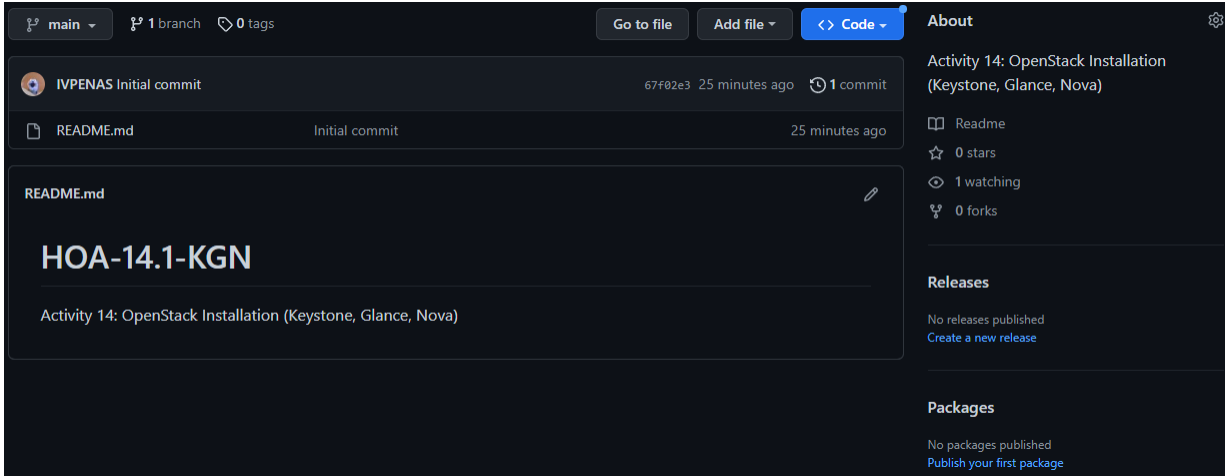


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Course/Section: CPE231 - CPE31S22	Date Submitted: 12/09/2022
Instructor: Dr. Jonathan V. Taylar	Semester and SY: 1 st Semester (SY: 2022 - 2023)
Activity 14: OpenStack Installation (Keystone, Glance, Nova)	
1. Objectives	
Create a workflow to install OpenStack using Ansible as your Infrastructure as Code (IaC).	
2. Intended Learning Outcomes	
<ol style="list-style-type: none"> 1. Analyze the advantages and disadvantages of cloud services 2. Evaluate different Cloud deployment and service models 3. Create a workflow to install and configure OpenStack base services using Ansible as documentation and execution. 	
3. Resources	
Oracle VirtualBox (Hypervisor) 1x Ubuntu VM or Centos VM	
4. Tasks	
<ol style="list-style-type: none"> 1. Create a new repository for this activity. 2. Create a playbook that converts the steps in the following items in https://docs.openstack.org/install-guide/ <ol style="list-style-type: none"> a. Keystone (Identity Service) b. Glance (Imaging Service) c. Nova (Compute Service) d. Create different plays in installing per server type (controller, compute etc.) and identify it as a group in the Inventory file. e. Add, commit and push it to your GitHub repo. 	
5. Output (screenshots and explanations)	
	
Figure 1.1. Creating a new repository entitled HOA-14.1-KGN	

```

penas@penas-VirtualBox:~$ git clone git@github.com:IVPENAS/HOA-14.1-KGN.git
Cloning into 'HOA-14.1-KGN'...
remote: Enumerating objects: 3, done.
remote: Counting objects: 100% (3/3), done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (3/3), done.
penas@penas-VirtualBox:~$ cd HOA-14.1-KGN
penas@penas-VirtualBox:~/HOA-14.1-KGN$ pwd
/home/penas/HOA-14.1-KGN
penas@penas-VirtualBox:~/HOA-14.1-KGN$ ls
ansible.cfg  inventory  README.md
penas@penas-VirtualBox:~/HOA-14.1-KGN$

penas@penas-VirtualBox:~/HOA-13.1-OpenStack$ ls
99-openstack.cnf  ansible.cfg  install_os.yml  inventory  README.md  roles
penas@penas-VirtualBox:~/HOA-13.1-OpenStack$ cp ansible.cfg inventory /home/penas/HOA-14.1-KGN

```

Figure 1.2. Cloning the created repository to the Local Machine; copying the pre-used configurations from the previous hands-on activity

Codes:

[Main console] *install_os.yml*:

```

GNU nano 6.2                                install_os.yml
- hosts: all
  become: true
  pre_tasks:

    - name: Updating and Upgrading the OS
      apt:
        name: "*"
        state: latest
        update_cache: true
        when: ansible_distribution == "Ubuntu"

- hosts: controller_node
  become: true
  roles:
    - Keystone
    - Glance
    - Nova

```

admin-openrc.sh

```

export OS_USERNAME=admin
export OS_PASSWORD=0uma999
export OS_PROJECT_NAME=admin
export OS_USER_DOMAIN_NAME=Default
export OS_PROJECT_DOMAIN_NAME=Default
export OS_AUTH_URL=http://controller:5000/v3
export OS_IDENTITY_API_VERSION=3
export OS_PROJECT_DOMAIN_ID=Default
export OS_USER_DOMAIN_ID=Default

```

```

penas@penas-VirtualBox:~/HOA-14.1-KGN$ mkdir roles
penas@penas-VirtualBox:~/HOA-14.1-KGN$ cd roles
penas@penas-VirtualBox:~/HOA-14.1-KGN/roles$ mkdir Glance Keystone Nova
penas@penas-VirtualBox:~/HOA-14.1-KGN/roles$ ls
Glance  Keystone  Nova

```

Figure 1.3. Creating Roles

[Roles] Keystone:

Codes:

```
#Installation of OS_Keystone
---
- name: Installing Keystone
  tags: keystone, ubuntu
  apt:
    name: keystone
    state: present
    when: ansible_distribution == "Ubuntu"

- name: Configuring the configuration file for Keystone database
  tags: keystone, edit, ubuntu
  lineinfile:
    path: /etc/keystone/keystone.conf
    regexp: "connection = sqlite:///var/lib/keystone/keystone.db"
    line: "connection = mysql+pymysql://keystone:Klnchl3lgcontroller/keystone"
    state: present

- name: Configuring the configuration file for Keystone token
  tags: keystone, edit, ubuntu
  lineinfile:
    path: /etc/keystone/keystone.conf
    line: "provider = fernet"
    state: present

- name: populate the Identity service database
  shell: "/bin/sh -c 'keystone-manage db_sync' keystone"

- name: Initializing Fernet Key repositories
  shell: 'keystone-manage fernet_setup --keystone-user keystone --keystone-group keystone'

- name: Initializing the Credential setup
  shell: 'keystone-manage credential_setup --keystone-user keystone --keystone-group keystone'

- name: Configuring the apache http server
  tags: add, keystone, ubuntu
  lineinfile:
    path: /etc/apache2/apache2.conf
    line: "ServerName controller"
    state: present

- name: Restarting the apache Service
  tags: keystone, ubuntu, restart
  service:
    name: apache2
    state: restarted

- name: Configuring the admin user-account via source
  shell: |
    export OS_USERNAME=admin
    export OS_PASSWORD=0uma999
    export OS_PROJECT_NAME=admin
    export OS_USER_DOMAIN_NAME=Default
    export OS_PROJECT_DOMAIN_NAME=Default
    export OS_AUTH_URL=http://controller:5000/v3
    export OS_IDENTITY_API_VERSION=3
```

Playrun:

```
penas@penas-VirtualBox: ~/HOA-14.1-KGN$ ansible-playbook --ask-become-pass install_os.yml
BECOME password:

PLAY [all] *****

TASK [Gathering Facts] *****
ok: [workstation]

TASK [Updating and Upgrading the OS] *****
ok: [workstation]

PLAY [controller_node] *****

TASK [Gathering Facts] *****
ok: [workstation]

TASK [Keystone : Installing Keystone] *****
changed: [workstation]

TASK [Keystone : Configuring the configuration file for Keystone database] *****
changed: [workstation]

TASK [Keystone : Configuring the configuration file for Keystone token] *****
changed: [workstation]

TASK [Keystone : Initializing Fernet Key repositories] *****
changed: [workstation]

TASK [Keystone : Initializing the Credential setup] *****
changed: [workstation]

TASK [Keystone : Configuring the apache http server] *****
changed: [workstation]

TASK [Keystone : Restarting the apache Service] *****
changed: [workstation]

TASK [Keystone : Configuring the admin user-account via source] *****
changed: [workstation]

PLAY RECAP *****
workstation : ok=11 changed=8 unreachable=0 failed=0 skipped=0 rescued=0 ignored=0
```

Glance:

Codes:

```
- name: Creating a new admin-openrc.sh file
tags: glance, ubuntu, file
copy:
  src: admin-openrc.sh
  dest: /home/penas
  owner: root
  group: root
  mode: 0744

- name: Installing Glance
apt:
  name: glance
  state: present
when: ansible_distribution == "Ubuntu"

- name: Configuring the conf file of Glance
tags: glance, ubuntu
lineinfile:
  path: /etc/glance/glance-api.conf
  regexp: "connection = sqll:///var/lib/glance/glance.sqlite"
  line: "connection = mysql+pymysql+://glance:0uma999@controller/glance"
  state: present

- name: Configuring the conf file of authtoken
tags: glance, ubuntu
lineinfile:
  path: /etc/glance/glance-api.conf
  regexp: "www_authenticate_uri = <None>"
  line: "www_authenticate_uri = http://controller:5000"
  state: present

- name: Configuring the conf file of authtoken pt. 2
tags: glance, ubuntu
lineinfile:
  path: /etc/glance/glance-api.conf
  regexp: "memcached_servers = <None>"
  line: "memcached_servers = controller:11211"
  state: present

- name: Configuring the conf file of authtoken pt. 3
tags: glance, ubuntu
lineinfile:
  path: /etc/glance/glance-api.conf
  regexp: "auth_type = <None>"
  line: "auth_type = password"

- name: Restarting the Glance service
service:
  name: glance-api
```

```
PLAY [all] *****
TASK [Gathering Facts] *****
ok: [workstation]

TASK [Updating and Upgrading the OS] *****
ok: [workstation]

PLAY [controller_node] *****
TASK [Gathering Facts] *****
ok: [workstation]

TASK [Glance : Creating a new admin-openrc.sh file] *****
ok: [workstation]

TASK [Glance : Installing Glance] *****
ok: [workstation]

TASK [Glance : Configuring the conf file of Glance] *****
ok: [workstation]

TASK [Glance : Configuring the conf file of authtoken] *****
ok: [workstation]

TASK [Glance : Configuring the conf file of authtoken pt. 2] *****
ok: [workstation]

TASK [Glance : Configuring the conf file of authtoken pt. 3] *****
ok: [workstation]

TASK [Glance : Restarting the Glance service] *****
changed: [workstation]

PLAY RECAP *****
workstation          : ok=10   changed=1    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

Nova:

Codes:

```
- name: Installing Nova
apt:
  name: nova-compute
  state: latest
when: ansible_distribution == "Ubuntu"

- name: Configuring nova.conf files
tags: nova, edit, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "transport_url = rabbit://"
  line: "transport_url == rabbit://openstack:0uma999@controller"
  state: present

- name: Configuring Identity User Services (auth_strategy)
lineinfile:
  path: /etc/nova/nova.conf
  line: "auth_strategy = keystone"
  state: present
check_mode: yes

- name: Configuring the file of keystone_auth token
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "www_authenticate_uri = <None>"
  line: "www_authenticate_uri = http://controller:5000"
  state: present

- name: Configuring the file of keystone_auth token (Memcached) pt. 1
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "memcached_servers = <None>"
  line: "memcached_servers = controller:11211"
  state: present

- name: Configuring the file of keystone_auth token pt. 2
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "auth_type = <None>"
  line: "auth_type = password"
  state: present

- name: Adding the configuration file for auth token pt. 2
lineinfile:
  path: /etc/nova/nova.conf
  insertafter: "[keystone_auth token]"
  line: "user_domain_name = Default"
  state: present

- name: Adding the configuration file for auth token pt. 3
lineinfile:
  path: /etc/nova/nova.conf
  insertafter: "[keystone_auth token]"
  line: "project_name = service"
  state: present

- name: Adding the configuration file for auth token pt. 4 (Username)
lineinfile:
  path: /etc/nova/nova.conf
  insertafter: "[keystone_auth token]"
  line: "username = admin"
  state: present

- name: Adding the configuration file for auth token pt. 5 (password)
lineinfile:
  path: /etc/nova/nova.conf
  insertafter: "[keystone_auth token]"
  line: "password = 0uma999"
  state: present

- name: Configuring the nova.conf remote console access (vnc) for neutron section (IP)
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "my_ip = <host_ipv4>"
  line: "my_ip = 192.168.56.116"
  state: present

- name: Configuring the nova.conf remote console access (vnc) for neutron section (IP) pt. 1
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "auth_url = <None>"
  line: "auth_url = http://controller:5000"
  state: present

- name: Configuring the nova.conf remote console access (auth token) for neutron section
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "auth_type = <None>"

- name: Configuring the nova.conf remote console access (auth token) for neutron section pt. 2
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "project_domain_name = <None>"
  line: "project_domain_name = default"
  state: present

- name: Configuring the nova.conf remote console access (auth token) for neutron section pt. 3
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "user_domain_name = <None>"
  line: "user_domain_name = default"
  state: present

- name: Configuring the nova.conf remote console access (auth token) for neutron section pt. 4
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "region_name = <None>"
  line: "region_name = RegionOne"
  state: present

- name: Configuring the nova.conf remote console access (auth token) for neutron section pt. 5
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "project_name = <None>"
  line: "project_name = service"
  state: present

- name: Configuring the nova.conf remote console access (auth token) for neutron section pt. 6
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "username = <None>"
  line: "username = neutron"
  state: present

- name: Configuring the nova.conf remote console access (auth token) for neutron section pt. 7
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "password = <None>"
  line: "password = 0uma666"
  state: present

- name: Configuring the nova.conf remote console access (vnc) for neutron section pt. 1
lineinfile:
  path: /etc/nova/nova.conf
  line: "enabled = true"
  state: present
check_mode: yes

- name: Configuring the nova.conf remote console access (vnc) for neutron section pt. 2
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "server_listen = 127.0.0.1"
  line: "server_listen = 0.0.0.0"
  state: present

- name: Configuring the nova.conf remote console access (vnc) for neutron section pt. 3
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "server_proxyclient_address = 127.0.0.1"
  line: "server_proxyclient_address = $my_ip"
  state: present

- name: Configuring the nova.conf remote console access (vnc) for neutron section pt. 4
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "novncproxy_base_url = http://127.0.0.1:6080/vnc_auto.html"
  line: "novncproxy_base_url = http://controller:6080/vnc_auto.html"
  state: present

- name: Configuring the nova.conf remote console access (glance) for neutron section
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "api_servers = <None>"
  line: "api_servers = http://controller:9292"
  state: present

- name: Configuring the nova.conf remote console access (oslo_concurrency) for neutron section
tags: nova, ubuntu
lineinfile:
  path: /etc/nova/nova.conf
  regexp: "lock_path = <None>"
  line: "lock_path = /var/lib/nova/tmp"
  state: present
```

```

- name: Configuring the nova.conf remote console access (placement) for neutron section
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "auth_url = <None>"
    line: "auth_url = http://controller:5000"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 2
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "auth_type = <None>"
    line: "auth_type = password"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 3
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "project_domain_name = <None>"
    line: "project_domain_name = Default"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 4
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "user_domain_name = <None>"
    line: "user_domain_name = Default"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 5
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "region_name = <None>"
    line: "region_name = RegionOne"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 6
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "project_name = <None>"
    line: "project_name = service"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 7
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "username = <None>"
    line: "username = placement"
    state: present

- name: Configuring the nova.conf remote console access (placement) for neutron section pt. 8
  tags: nova, ubuntu
  lineinfile:
    path: /etc/nova/nova.conf
    regexp: "password = <None>"
    line: "password = kinchi31"
    state: present

- name: Restarting the Nova service
  service:
    name: nova-compute
    state: restarted

```

Playbook:

```

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 6] *****
ok: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 7] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 8] *****
changed: [workstation]

TASK [Nova : Restarting the Nova service] *****
changed: [workstation]

PLAY RECAP *****
workstation : ok=39  changed=24  unreachable=0  failed=0  skipped=0  rescued=0  ignored=0

```

```

TASK [Updating and Upgrading the OS] *****
ok: [workstation]

PLAY [controller_node] *****

TASK [Gathering Facts] *****
ok: [workstation]

TASK [Nova : Installing Nova] *****
ok: [workstation]

TASK [Nova : Configuring nova.conf files] *****
changed: [workstation]

TASK [Nova : Configuring Identity User Services (auth_strategy)] *****
changed: [workstation]

TASK [Nova : Configuring the file of keystone_authtoken] *****
ok: [workstation]

TASK [Nova : Configuring the file of keystone_authtoken (Memcached) pt. 1] *****
ok: [workstation]

TASK [Nova : Configuring the file of keystone_authtoken pt. 2] *****
changed: [workstation]

TASK [Nova : Adding the configuration file for authtoken] *****
ok: [workstation]

TASK [Nova : Adding the configuration file for authtoken pt. 1] *****
ok: [workstation]

TASK [Nova : Adding the configuration file for authtoken pt. 2] *****
ok: [workstation]

TASK [Nova : Adding the configuration file for authtoken pt. 3] *****
ok: [workstation]

TASK [Nova : Adding the configuration file for authtoken pt. 4 (Username)] *****
changed: [workstation]

TASK [Nova : Adding the configuration file for authtoken pt. 5 (password)] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (vnc) for neutron section (IP)] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (vnc) for neutron section (IP) pt. 1] *****
changed: [workstation]

```

```

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section pt. 2] **
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section pt. 3] **
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section pt. 4] **
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section pt. 5] ***
ok: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section pt. 6] ***
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (authoken) for neutron section pt. 7] ***
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (vnc) for neutron section pt. 1] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (vnc) for neutron section pt. 2] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (vnc) for neutron section pt. 3] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (vnc) for neutron section pt. 4] *****
ok: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (glance) for neutron section] *****
ok: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (oslo_concurrency) for neutron section] *
ok: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section] *****
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 2] **
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 3] **
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 4] **
changed: [workstation]

TASK [Nova : Configuring the nova.conf remote console access (placement) for neutron section pt. 5] **
changed: [workstation]

```

[Proofs]

```

penas@penas-VirtualBox:~/HOA-14.1-KGN$ systemctl status nova-compute
● nova-compute.service - OpenStack Compute
   Loaded: loaded (/lib/systemd/system/nova-compute.service; enabled; vendor preset: enabled)
   Active: active (running) since Fri 2022-12-09 08:12:20 PST; 228ms ago
     Main PID: 59842 (nova-compute)
       Tasks: 1 (limit: 1635)
        Memory: 24.0M
          CPU: 198ms
      CGroup: /system.slice/nova-compute.service
              └─59842 /usr/bin/python3 /usr/bin/nova-compute --config-file=/etc/nova/nova.conf --config-file=/etc/nova/nova.conf

Dec 09 08:12:20 penas-VirtualBox systemd[1]: Started OpenStack Compute.
penas@penas-VirtualBox:~/HOA-14.1-KGN$ systemctl status glance-api.service
● glance-api.service - OpenStack Image Service API
   Loaded: loaded (/lib/systemd/system/glance-api.service; enabled; vendor preset: enabled)
   Active: active (running) since Fri 2022-12-09 08:02:02 PST; 10min ago
     Docs: man:glance-api(1)
     Main PID: 57363 (glance-api)
       Tasks: 2 (limit: 1635)
        Memory: 127.1M
          CPU: 5.849s
      CGroup: /system.slice/glance-api.service
              └─57363 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/glance/glance-api.conf --config-dir=/etc/glance/
              └─57532 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/glance/glance-api.conf --config-dir=/etc/glance/

Dec 09 08:02:02 penas-VirtualBox systemd[1]: Started OpenStack Image Service API.
penas@penas-VirtualBox:~/HOA-14.1-KGN$ service apache2 status
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
   Active: active (running) since Fri 2022-12-09 08:02:35 PST; 9min ago
     Docs: https://httpd.apache.org/docs/2.4/
     Main PID: 58814 (apache2)
       Tasks: 75 (limit: 1635)
        Memory: 31.3M
          CPU: 282ms
      CGroup: /system.slice/apache2.service
              └─58814 /usr/sbin/apache2 -k start
              └─58815 "(wsgi:keystone-pu" -k start
              └─58816 "(wsgi:keystone-pu" -k start
              └─58817 "(wsgi:keystone-pu" -k start
              └─58818 "(wsgi:keystone-pu" -k start
              └─58819 "(wsgi:keystone-pu" -k start
              └─58820 /usr/sbin/apache2 -k start
              └─58821 /usr/sbin/apache2 -k start

Dec 09 08:02:35 penas-VirtualBox systemd[1]: Starting The Apache HTTP Server...
Dec 09 08:02:35 penas-VirtualBox systemd[1]: Started The Apache HTTP Server.
penas@penas-VirtualBox:~/HOA-14.1-KGN$

```

Github Link: <https://github.com/IVPENAS/HOA-14.1-KGN.git>

Reflections:

Answer the following:

1. Describe Keystone, Glance and Nova services

From the previous activity, the student was introduced to OpenStack which it is an open-source cloud software platform that provides either private and public cloud infrastructure as a service (IaaS) solution, that consists of components that allow users to manipulate the components such as Identity Service, Compute Service, and Imaging Service which are present in this activity namely: [1] **Keystone**, is an OpenStack Identity management service *that implements and creates customizable authentication and authorization* that validates the user/project credentials, *managing user databases* like Apache2, *and service discovery* for the users. It is used simultaneously with Imaging/Virtual Machine Image Management Services like [2] **Glance**, where it allows users *to discover, retrieve and register Virtual Machine Images along with Container Images* that can be used either storage backend services between Switch or Ceph, since Glance supports image service solely Compute Service was needed which the [3] **Nova** will be introduced, in which it was the main part of IaaS system as it was designed to *compute, networking, storage, image services, and provide quick access on computing resources* to be executed which is a part of managing virtual machine server.

Conclusions:

This Present Activity, entitled as ‘OpenStack Installation (Keystone, Glance, Nova)’ was interconnected on the previous activity which is ‘OpenStack Prerequisite Installation’, where as the students installs the selected components of OpenStack which are [1] Keystone as the Identity Management Service where it implements and creates customizable authentication and authorization for verification purposes and managing user databases which in this activity the student used Apache, [2] Glance as the Image Management Service which allows users to discover, retrieve and register Virtual Machine Images and Container Images, and [3] Nova as the Computation Management Service, since Glance only supports image service the services of Nova was needed to be used as it operates to do image services and quick access on resources for the Virtual Machine Server.