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New and Changed Information

The following table provides an overview of the significant changes up to this current release. The table does not provide an exhaustive list of all changes or of the new features up to this release.

Cisco ACI CNI plug-in Release Version	Feature
6.1(1)	Cisco Application Centric Infrastructure (ACI) supports Red Hat OpenShift 4.21 nested in Red Hat OpenStack Platform (OSP).

OpenShift 4.21 on OpenStack

Cisco Application Centric Infrastructure (ACI) supports Red Hat OpenShift 4.21 nested in Red Hat OpenStack Platform (OSP) 17.1. To enable this support, Cisco ACI provides customized Ansible modules to complement the upstream OpenShift installer. This document provides instructions and guidance that follows the recommended OpenShift on OpenStack User-Provisioned Infrastructure (UPI) installation process as outlined in the following documents:

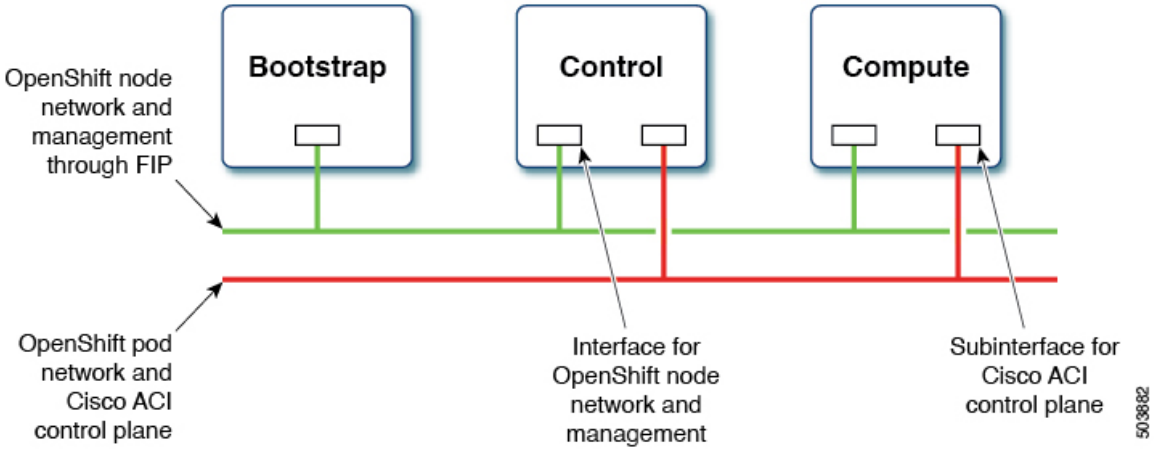
- *Installing a cluster on OpenStack with customizations* for OpenShift 4.21 on the Red Hat OpenShift website
- *Installing OpenShift on OpenStack User-Provisioned Infrastructure* on GitHub

Note If you have an existing OpenShift 4.20 cluster installed with Cisco ACI CNI, you can upgrade to OCP 4.21 by first upgrading the ACI CNI (refer to the Upgrading the Cisco ACI CNI Plug-in guide), and then following Red Hat documentation to upgrade from OpenShift 4.20 to 4.21.

Network Design and the Cisco ACI CNI Plug-in

This section provides information about the network design that takes advantage of the Cisco ACI Container Network Interface (CNI) plug-in.

The design separates OpenShift node traffic from the pod traffic on different Neutron networks. The separation results in the bootstrap, control, and compute virtual machines (VMs) having two network interfaces, as shown in the following illustration:



One interface is for the node network and the second is for the pod network. The second interface also carries Cisco ACI control plane traffic. A VLAN tagged subinterface is configured on the second interface to carry the pod traffic and the Cisco ACI control plane traffic.

This network design requires some changes to the Red Hat OpenShift Installer UPI Ansible modules. These changes are implemented in the Cisco-provided OpenShift Installer UPI Ansible modules, which are packaged in the OpenShift installer tar file (openshift_installer-6.1.1<z>.src.tar.gz) that is made available along with the other Cisco ACI CNI 6.1.(1) release artifacts. More specifically, the changes are to:

- Create a second Neutron network in a separate playbook.
- Modify the existing playbooks that launch the control, and compute virtual machines (VMs) to:
  - Create a second port on the second Neutron network and add it as a second interface to the VM configuration.
  - Add an extra attribute "nat_destination" to the Neutron floating IP address.
- Update the playbook that creates the first Neutron network to:
  1. Create the Neutron address-scope to map to a predefined Cisco ACI virtual routing and forwarding (VRF) context.
  2. Create a Neutron subnet-pool for the address-scope in the previous step.
  3. Change the subnet creation to pick a subnet from the subnet-pool in the previous step.
  4. Set the maximum transmission unit (MTU) for the neutron Network (which is picked up from the configuration file described later).
- In addition to creating a second network interface (and subinterfaces on that interface), the stock ignition files created by the “openshift-install create ignition-configs” step need to be updated. This is being done by additional playbooks, which are also provided.

Note The configuration required to drive some of the customization in this section done through new parameters in the inventory file.

Prerequisites for Installing OpenShift 4.21

To successfully install OpenShift Container Platform (OCP) 4.21 on OpenStack 17.1, you must meet the following requirements:

Cisco ACI

1. Configure a Cisco ACI Layer 3 outside connection (L3Out) in an independent Cisco ACI VRF and "common" Cisco ACI tenant so that endpoints can do the following:
   - Reach outside to fetch packages and images.
   - Reach the Cisco Application Policy Infrastructure Controller (APIC).
2. Configure a separate L3Out in an independent VRF that is used by the OpenShift cluster (configured in the acc-provision input file) so that the endpoints can do the following:
   - Reach API endpoints outside the OpenShift cluster.
   - Reach the OpenStack API server.

   The OpenShift pod network uses this L3Out.
3. Identify the Cisco ACI infra VLAN.
4. Identify another unused VLAN that you can use for OpenShift cluster service traffic.

   The service is configured in the `service_vlan` field in the `acc_provision` input file for the OpenShift cluster.

OpenStack

1. Install Red Hat OpenStack Platform (OSP) 17.1 with Cisco ACI Neutron plug-in (release 5.2(3)) in nested mode by setting the following parameters in the Cisco ACI `.yaml` Modular Layer 2 (ML2) configuration file:
   - `ACIOpflexInterfaceType: ovs`
   - `ACIOpflexInterfaceMTU: 8000`

   To update an existing installation (and if the above two parameters are not configured), see *Cisco ACI Installation Guide for Red Hat OpenStack Using the OpenStack Platform 17.1 Director* on Cisco.com.
2. Create an OpenStack project and the required quotas to host the OpenShift cluster and perform the other required configuration.

   Follow the procedure *Installing a cluster on OpenStack on your own infrastructure* for OpenStack 4.21 on the Red Hat OpenStack website.
3. Create an OpenStack Neutron external network, using the relevant Cisco ACI extensions and mapping to the OpenStack L3Out to include the following:
   - A subnet configured for Secure Network Address Translation (SNAT).
   - A subnet that is configured for floating IP addresses.

   Refer to the chapter "OpenStack External Network" in *Cisco ACI Installation Guide for Red Hat OpenStack Using the OpenStack Platform 17.1 Director* on Cisco.com.

Note All OpenStack projects can share the OpenStack L3Out and Neutron external network.

4. If direct access to the OpenShift node network is required (i.e by not using the Neutron Floating IPs) from endpoints that are not managed by the Cisco ACI fabric, identify every IP subnet from where this direct access is anticipated. These IP subnets will later be used to create Neutron subnet pools during the installation process.
5. Follow the instructions in the section "Red Hat Enterprise Linux CoreOS (RHCOS)" of *Installing OpenShift on OpenStack User-Provisioned Infrastructure* to obtain the RHCOS and create an OpenStack image:

```
$ openstack image create --container-format=bare --disk-format=qcow2 --file
rhcos-4.21.0-x86_64-openstack.x86_64.qcow2 rhcos-4.21
```

OpenShift

Identify the SNAT IP address that will be used by the Cisco ACI Container Network Interface (CNI) for source NATing the traffic from all the pods during installation. You will use the SNAT IP addresses in the `cluster_snat_policy_ip` configuration in the `aci_cni` section of the `inventory.yaml` file.

Installer Host

You need access to a Linux host to run installation scripts with access to node network and OpenStack Director API. It should have the following installed:

- Install Ansible 6.7 or later.

  Refer to *Installing Ansible* on the Ansible website.
- Python 3
- jq – JSON linting
- yq – YAML linting: **`sudo pip install yq`**
- python-openstackclient 5.4 or later: **`sudo pip install python-openstackclient==6.5.0`**
- openstacksdk 1.0 and later : **`sudo pip install openstacksdk==3.0.0`**
- python-swiftclient 3.9.0: **`sudo pip install python-swiftclient==4.5.0`**
- Kubernetes module for Ansible: **`sudo pip install openshift==0.13.2`**

Note Cisco has validated the above versions with ansible version 6.7.0 and python 3.8.10. However, subsequent minor releases are also expected to work.

This document uses the name `openupi` for the OpenShift cluster and the directory structure: `~/openupi/openshift-env/upi`.

```
$ cd ~/
$ mkdir -p openupi/openshift-env/upi
$ cd openupi/
$ tar xfz <path>/openshift_installer-6.1.1.<z>.src.tar.gz
$ cp openshift_installer/upi/openstack/* openshift-env/upi/
```

Installing OpenShift 4.21 on OpenStack 17.1

You initiate installation from the installer host that you prepared earlier.

Before you begin

Complete the tasks in the Prerequisites section .

Procedure

Step 1 Download and untar the `oc` client and `openshift-install` binary file:

```
$ cd ~/openupi/openshift-env/
$ wget
https://mirror.openshift.com/pub/openshift-v4/clients/ocp/latest-4.21/openshift-client-linux.tar.gz
$ tar xfz  openshift-client-linux.tar.gz
$ mv oc /usr/local/bin/
$ wget
https://mirror.openshift.com/pub/openshift-v4/clients/ocp/latest-4.21/openshift-install-linux.tar.gz
$ tar xfz openshift-install-linux.tar.gz
```

Note
The links in the preceding text refer to the OpenShift 4.21.14 release, which Cisco has validated. However, subsequent minor releases are also expected to work.

Step 2 Install the `acc-provision` package present in the Cisco ACI Container Network Interface (CNI) 6.1(1) release artifacts.

Note
Due to Python 3 dependencies that are currently available only on RHEL8, acc-provision tool is supported to only run on RHEL8 operating system.

Step 3 Run the acc-provision tool to configure the Cisco APIC for the OpenShift cluster, which will also generate the manifests for installing the Cisco ACI CNI plug-in.

Example:

```
$ cd ~/openupi
$ acc-provision -a -c acc-provision-input.yaml -u <user> -p <password> -o aci_deployment.yaml -f
openshift-4.21-openstack
```

This step generates the `aci_deployment.yaml` file and also a tar file containing the Cisco ACI CNI manifests with the name `aci_deployment.yaml.tar.gz`. Note the location of the `aci_deployment.yaml.tar.gz` file; you will need to specify it later in the `install-config.yaml` file.

The following is an example of an acc-provision input file: (Note that the acc-provision flavor used here is `openshift-4.21-openstack`.)

```
#
# Configuration for ACI Fabric
#
aci_config:
 system_id: <cluster-name>           # Every opflex cluster on the same fabric must have a distinct
 ID
 tenant:
   name: <openstack-tenant-name>
```

```
 apic_hosts:                            # List of APIC hosts to connect to for APIC API access
   - <apic-ip>
 apic_login:
   username: <username>
   password: <password>
 vmm_domain:                            # Kubernetes VMM domain configuration
   encap_type: vxlan                    # Encap mode: vxlan or vlan
   mcast_range:                         # Every vxlan VMM on the same fabric must use a distinct
range
       start: 225.125.1.1
       end: 225.125.255.255
 # The following resources must already exist on the APIC,
 # this is a reference to use them
 aep: sauto-fab3-aep          # The attachment profile for ports/VPCs connected to this cluster
 vrf:                         # VRF used to create all subnets used by this Kubernetes cluster
   name: l3out_2_vrf          # This should exist, the provisioning tool does not create it
   tenant: common             # This can be tenant for this cluster (system-id) or common
 l3out:                       # L3out to use for this kubernetes cluster (in the VRF above)
   name: l3out-2              # This is used to provision external service IPs/LB
   external_networks:
       - l3out_2_net          # This should also exist, the provisioning tool does not create it
#
# Networks used by Kubernetes
#
net_config:
 node_subnet: 10.11.0.1/27          # Subnet to use for nodes
 pod_subnet: 10.128.0.1/16          # Subnet to use for Kubernetes Pods
 extern_dynamic: 150.3.1.1/24       # Subnet to use for dynamically allocated ext svcs
 extern_static: 150.4.1.1/21        # Optional: Subnet for statically allocated external services
 node_svc_subnet: 10.5.168.1/21     # Subnet to use for service graph
 service_vlan: 1022                 # The VLAN used for external LoadBalancer services
 infra_vlan: 4093
 interface_mtu: 1400
```

Ensure that the *system_id* you use in the above acc-provision input file conforms to the Cisco ACI Object Naming and Numbering: Best Practices. This will also be the case for the *tenant name* you choose at the time of the OpenStack project creation (and which you will provide in the input file above).

Step 4 The **install**, **create**, **wait-for** OpenShift installer commands are run from the `openshift-env` directory.

Ensure that the `clouds.yaml` file is either present in the current working directory or in `~/.config/openstack/clouds.yaml` with the environment OS_CLOUD set to the correct cloud name.

See *Configuration* for python-openstackclient3.12.3.dev2 on the OpenStack website.

Step 5 Untar the `aci_deployment.yaml.tar.gz` file which the acc-provision tool generated earlier.

```
$ cd ~/openupi
$ tar xfz aci_deployment.yaml.tar.gz
```

Step 6 Create the `install-config.yaml` as described in the "Install Config" section of *Installing OpenShift on OpenStack User-Provisioned Infrastructure* for release 4.21 on GitHub.

```
$ cd ~/openupi/openshift-env
$ ./openshift-install create install-config --dir=upi --log-level=debug
```

The following is an example of an `install-config.yaml` file that sets Cisco ACI Container Network Interface (CNI) as the `networkType`:

```
apiVersion: v1
baseDomain: noiro.local
```

```
compute:
- architecture: amd64
 hyperthreading: Enabled
 name: worker
 platform: {}
 replicas: 0
controlPlane:
 architecture: amd64
 hyperthreading: Enabled
 name: master
 platform: {}
 replicas: 3
metadata:
 creationTimestamp: null
 name: openupi
networking:
 clusterNetwork:
 - cidr: 15.128.0.0/14
   hostPrefix: 23
 machineNetwork:
 - cidr: 15.11.0.0/27
 networkType: CiscoACI
 serviceNetwork:
 - 172.30.0.0/16
platform:
 openstack:
   cloud: openstack
   computeFlavor: aci_rhel_huge
   externalDNS: ["<ip>"]
   externalNetwork: sauto_l3out-2
lbFloatingIP: 60.60.60.199
   octaviaSupport: "0"
   region: ""
   trunkSupport: "1"
   clusterOSImage: rhcos-4.21
publish: External
proxy:
 httpsProxy: <proxy-ip>
 httpProxy: <proxy-ip>
 noProxy: "localhost,127.0.0.1,<add-more-as-relevant>,172.30.0.1,172.30.0.10,oauth-
     openshift.apps.openupi.noiro.local,console-openshift-
     console.apps.openupi.noiro.local,downloads-openshift-
     console.apps.openupi.noiro.local,downloads-openshift-
     console.apps.openupi.noiro.local,alertmanager-main-openshift-
     monitoring.apps.openupi.noiro.local"
pullSecret:
sshKey:
```

Step 7 Edit the file generated in the previous step to match your environment.

As noted in the example, the edits must include changing the `networkType` as described in the "Fix the Node Subnet" and "Empty Compute Pools" sections of *Installing OpenShift on OpenStack User-Provisioned Infrastructure* for Release 4.21 on GitHub.

Step 8 Edit the `inventory.yaml` file to match the relevant fields in the `install-config.yaml` and `acc-provision-input.yaml` files, as shown in the following example:

```
all:
 hosts:
   localhost:
     aci_cni:
       acc_provision_tar: <path>/aci_deployment.yaml.tar.gz
```

```
  kubeconfig: <path>/kubeconfig
ansible_connection: local
ansible_python_interpreter: "{{ansible_playbook_python}}"

# User-provided values
os_subnet_range: '15.11.0.0/27'
os_flavor_master: 'aci_rhel_huge'
os_flavor_worker: 'aci_rhel_huge'
os_image_rhcos: 'rhcos-4.21.'
os_external_network: 'l3out-2'
# OpenShift API floating IP address
os_api_fip: '60.60.60.6'
# OpenShift Ingress floating IP address
os_ingress_fip: '60.60.60.8'
# Subnet pool prefixes
cluster_network_cidrs: '15.128.0.0/14'

# Name of the SDN.
os_networking_type: 'CiscoACI'

# Number of provisioned Control Plane nodes
# 3 is the minimum number for a fully-functional cluster.
os_cp_nodes_number: 3
# Number of provisioned Compute nodes.
# 3 is the minimum number for a fully-functional cluster.
os_compute_nodes_number:0
os_apiVIP: '{{ os_subnet_range | next_nth_usable(5) }}'
os_ingressVIP: '{{ os_subnet_range | next_nth_usable(7)
}}'
```

Note

- The `inventory.yaml` file is updated after you run the `update_ign.py` script later in this procedure. We recommend that you make a copy of the `inventory.yaml` file at this stage so you can reuse it to install the same cluster again.
- The Cisco ACI CNI-specific configuration is added to the `aci_cni` section of the `inventory.yaml` file. The example in this step captures the required fields; however, more optional configurations are available. For a list of the options see the *Optional Configurations* section in this guide.

Note that after you run `update_ign.py` as described in Step 12, some default and derived values are added to the inventory file. For example, to see the configuration with all optional and derived values that are populated, see `openshift_installer/upi/openstack/inventory.yaml` on GitHub.

Step 9 Generate the OpenShift manifests and copy the Cisco ACI CNI manifests:

```
$ cd ~/openupi/openshift-env
$ ./openshift-install create manifests  --log-level debug --dir=upi
# Copy the ACI CNI manifests obtained earlier in Step 5
$ cp ../cluster-network-* upi/manifests/
$ rm -f upi/openshift/99_openshift-cluster-api_master-machines-*.yaml
$ rm -f upi/openshift/99_openshift-machine-api_master-control-plane-machine-set.yaml
```

Step 10 Disable the creation of the OpenStack Octavia load balancer for Cisco ACI network type.

```
$ cd ~/openupi/openshift-env/upi
$ ansible-playbook -i inventory.yaml disable-octavia.yaml
```

Step 11 Make control-plane nodes unschedulable.

Follow the instructions in the "Make control-plane nodes unschedulable" section of *Installing OpenShift on OpenStack User-Provisioned Infrastructure* for Release 4.21 on GitHub.

Step 12 Update the ignition files:

```
$ cd ~/openupi/openshift-env
$ ./openshift-install create ignition-configs --log-level debug --dir=upi
$ cd upi
$ export INFRA_ID=$(jq -r .infraID metadata.json)
$ echo "{\"os_net_id\": \"$INFRA_ID\"}" | tee netid.json
$ source ~/openupi/overcloudrc
# Run the update_ign.py from the Cisco OpenShift installer package
$ python update_ign.py # This assumes that the inventory file is already configured

$ swift upload bootstrap bootstrap.ign
(To be executed in undercloud after copying the ignition file or host having connectivity to openstack
 controller with overcloudrc)

$ swift post bootstrap --read-acl ".r:*,.rlistings"

(To be executed in undercloud after copying the ignition file host having connectivity to openstack
 controller with overcloudrc)
```

The commands in this step create the ignition files and update them according to Cisco ACI CNI and upload the `bootstrap.ign` file to swift storage. It also generates the `bootstrap-ignition-shim` as described in the "Bootstrap Ignition Shim" section of *Installing OpenShift on OpenStack User-Provisioned Infrastructure* for Release 4.21 on GitHub.

Step 13 Complete the following tasks by running Ansible playbooks obtained from the Cisco OpenShift installer package:

a) Create security groups and networks:

```
ansible-playbook -i inventory.yaml security-groups.yaml
ansible-playbook -i inventory.yaml network.yaml
ansible-playbook -i inventory.yaml update-network-resources.yaml
ansible-playbook -i inventory.yaml 021_network.yaml
```

b) For direct access to the OpenShift node network from endpoints that are not managed by the Cisco ACI fabric, create a Neutron subnet pool for every IP subnet from where this direct access is anticipated, as shown in the following example:

```
$ neutron subnetpool-create --pool-prefix <direct_access_src_subnet> --address-scope
node_network_address_scope <subnetpool_name>
```

In the preceding example, `node_network_address_scope` is the name of the Neutron address-scope that is created by the `network.yaml` file.

c) Install the control plane:

```
ansible-playbook -i inventory.yaml bootstrap.yaml
ansible-playbook -i inventory.yaml control-plane.yaml
```

d) Check that the bootstrap/control plane installation is complete:

```
./openshift-install wait-for bootstrap-complete --dir=upi --log-level=debug
```

e) After the control plane is installed, remove the bootstrap node:

```
ansible-playbook -i inventory.yaml down-bootstrap.yaml
```

f) (Optional) After the control plane is up, configure cluster Source IP Network Address Translation (SNAT) policy:

```
ansible-playbook -i inventory.yaml cluster_snat_policy.yaml
```

g) Launch the compute nodes by scaling the worker machinesets as described below:

```
$ oc get machineset -A
NAMESPACE    NAME    DESIRED    CURRENT    READY    AVAILABLE    AGE
openshift-machine-api    openupi-vkkn6-worker    0    0        5h10m
$ oc scale machineset -n openshift-machine-api    openupi-vkkn6-worker --replicas=1
```

Note
When the `control-plane.yaml` playbook is running, it automatically updates the machineset configuration to support multiple network interfaces which enables scaling the replicas as shown above, when non-zero **os_compute_nodes_number** is mentioned in the inventory file.

Step 14 If you created the compute nodes through Ansible playbooks, approve the pending Certificate Signing Requests.

```
oc get csr -ojson | jq -r '.items[] | select(.status == {} ) | .metadata.name' | xargs oc adm
certificate approve
```

Step 15 Update the default IngressController publish strategy to use the LoadBalancerService:

```
ansible-playbook -i inventory.yaml post-install.yaml
```

Step 16 Check the status of the installation:

```
./openshift-install wait-for install-complete --dir=upi --log-level=debug
```

Step 17 Destroy the cluster:

```
ansible-playbook -i inventory.yaml down-compute-nodes.yaml
ansible-playbook -i inventory.yaml down-control-plane.yaml
ansible-playbook -i inventory.yaml down-network.yaml
ansible-playbook -i inventory.yaml down-security-groups.yaml
```

After your run the playbooks in this step, the Cisco ACI BridgeDomain corresponding to the node network will also be deleted. To reinstall the cluster, run `acc-provision` again with the `-a` as described earlier in this document.

Optional Configurations

This section provides instructions for making several optional configurations.

Enable Multus CNI Plug-in in OpenShift 4.x Cluster with ACI CNI

You can enable Multus in a new cluster or in an already-installed cluster.

Enabling Multus in a new cluster installation

When running acc-provision, set the *disable-multus* argument to *False*.

```
$ acc-provision -a -c acc_provision_input.yaml -f openshift-4.21-openstack -u <username> -p <password> -o
aci_deployment.yaml --disable-multus false
```

The procedure below, is for enabling Multus in an already-installed cluster.

Procedure

Step 1 Generate a new ACI CNI deployment configuration.

```
$ acc-provision -c acc_provision_input.yaml -f openshift-4.21-openstack -u <username> -p <password>
 -o aci_deployment.yaml --disable-multus false
```

Note
The above command does not use the `-a` flag.

Step 2 Delete acicontainersoperator CR.

```
$ oc delete acicontainersoperator acicnioperator -n aci-containers-system
```

Step 3 Apply the new `aci_deployment.yaml` file.

```
$ oc apply -f aci_deployment.yaml
```

Step 4 Remove “disableMultiNetwork: true” from current OpenShift Network Object by editing `cluster-network-03-config.yaml`.

```
$ oc edit -f cluster-network-03-config.yaml
```

Enable CPMS to manage control plane nodes

You can leverage the Control Plane Machine Set (CPMS) resource to auto-manage the control plane nodes.

Follow these steps to enable CPMS:

Procedure

Step 1 Create machine objects for the existing control plane nodes.

This is an example of a machine config for the control-plane node.

```
apiVersion: machine.openshift.io/v1beta1
kind: Machine
metadata:
  labels:
    machine.openshift.io/cluster-api-cluster: openupi-tvqjc
    machine.openshift.io/cluster-api-machine-role: master
    machine.openshift.io/cluster-api-machine-type: master
  name: openupi-tvqjc-master-0
  namespace: openshift-machine-api
  annotations:
    machine.openshift.io/instance-id: 6c578563-f295-487a-a1c1-e81a942bfd28
spec:
  lifecycleHooks: {}
  metadata: {}
  providerSpec:
    value:
      apiVersion: openstackproviderconfig.openshift.io/v1alpha1
      cloudName: openstack
      cloudsSecret:
        name: openstack-cloud-credentials
        namespace: openshift-machine-api
      flavor: aci_rhel_medium
```

```
      image: rhcos-4.21
      kind: OpenstackProviderSpec
      metadata:
        creationTimestamp: null
      networks:
      - filter: {}
        subnets:
        - filter:
            name: openupi-tvqjc-nodes
            uuid:
            - ec2413e7-2b02-46ef-9a2f-bf308eeb5a0c
        uuid: c5f49c1d-3e78-47ff-af4e-3c89d47e4ae5
      - filter: {}
        subnets:
        - filter:
            name: openupi-tvqjc-acicontainers-nodes
            uuid:
            - d577cf9d-0920-4b60-bf2c-ae76b24e42e6
        uuid: a29eb31a-c590-47f1-a592-4a35e265c2b3
      securityGroups:
      - filter: {}
        name: openupi-tvqjc-master
      serverGroupName: openupi-tvqjc-master
      serverMetadata:
        Name: openupi-tvqjc-master
        openshiftClusterID: openupi-tvqjc
      tags:
      - openshiftClusterID=openupi-tvqjc
      trunk: true
      userDataSecret:
        name: master-user-data
  providerID: openstack:///6c578563-f295-487a-a1c1-e81a942bfd28
```

Use the manifest to create a machine object for each of the existing master nodes. Update these fields from the template:

- Replace `openupi-tvqjc` with OpenShift cluster ID of your cluster.
- `metadata.name`: Set this field with name of master node.
- `metadata.annotations.machine.openshift.io/instance-id`: Set this field with openstack server ID corresponds to this master node.
- `spec.providerSpec.value.flavor`: Set this field with openstack flavor name used for creating master nodes.
- `spec.providerSpec.value.image`: Set this field with openstack image name that corresponds to RHCOS image used for creating master nodes.
- `spec.providerSpec.value.networks`: Update this config section with openstack network/subnet details that will be used for creating master nodes.
- `spec.providerID`: Update UUID from this field with openstack server ID corresponds to this master node.

After you apply these manifests for each of the master nodes, verify that machines are created and show as "Running" by issuing the following command:

```
$ oc get machines -n openshift-machine-api
```

Step 2 Create a Control Plane Machine Set (CPMS) resource.

This is an example of a CPMS resource:

```
apiVersion: machine.openshift.io/v1
kind: ControlPlaneMachineSet
```

```
metadata:
  name: cluster
  namespace: openshift-machine-api
spec:
  replicas: 3
  selector:
    matchLabels:
      machine.openshift.io/cluster-api-cluster: openupi-tvqjc
      machine.openshift.io/cluster-api-machine-role: master
      machine.openshift.io/cluster-api-machine-type: master
  state: Active
  strategy:
    type: RollingUpdate
  template:
    machineType: machines_v1beta1_machine_openshift_io
    machines_v1beta1_machine_openshift_io:
      metadata:
        labels:
          machine.openshift.io/cluster-api-cluster: openupi-tvqjc
          machine.openshift.io/cluster-api-machine-role: master
          machine.openshift.io/cluster-api-machine-type: master
      spec:
        lifecycleHooks: {}
        metadata: {}
        providerSpec:
          value:
            apiVersion: openstackproviderconfig.openshift.io/v1alpha1
            cloudName: openstack
            cloudsSecret:
              name: openstack-cloud-credentials
              namespace: openshift-machine-api
            flavor: aci_rhel_medium
            image: rhcos-4.21
            kind: OpenstackProviderSpec
            metadata:
              creationTimestamp: null
            networks:
            - filter: {}
              subnets:
              - filter:
                  name: openupi-tvqjc-nodes
            - filter: {}
              subnets:
              - filter:
                  name: openupi-tvqjc-acicontainers-nodes
            securityGroups:
            - filter: {}
              name: openupi-tvqjc-master
            serverGroupName: openupi-tvqjc-master
            serverMetadata:
              Name: openupi-tvqjc-master
              openshiftClusterID: openupi-tvqjc
            tags:
            - openshiftClusterID=openupi-tvqjc
            trunk: true
            userDataSecret:
              name: master-user-data
```

Update these fields before applying the cofiguration:

- Replace `openupi-tvqjc` with OpenShift cluster ID of your cluster.

- `spec.template.spec.providerSpec.value.flavor`: Set this field with openstack flavor name used for creating master nodes.
- `spec.template.spec.providerSpec.value.image`: Set this field with openstack image name that corresponds to RHCOS image used for creating master nodes.
- `spec.template.spec.providerSpec.value.networks`: Update this config section with openstack network/subnet details that will be used for creating master nodes.

  Note
  For the ControlPlaneMachineSet to be in operation, you must set `spec.state` to `active`.

  `network/subnet` UUIDs are not supported in ControlPlaneMachineSet.

Step 3 After you create the Create a Control Plane Machine Set (CPMS) resource, the existing master nodes will be replaced with new ones. You can monitor its progress using these commands:

```
$ oc get controlplanemachineset -n openshift-machine-api # To check CPMS status

$ oc get machines -n openshift-machine-api # To check machines status

$ oc get nodes -l node-role.kubernetes.io/master # To check nodes status
```

Enable IP forwarding on worker nodes

To test the service with a node-port configuration, you must enable IP forwarding on the worker nodes.

Use this procedure to enable IP forwarding on the worker nodes.

Procedure

Step 1 Assign a floating IP to the worker VM.

Step 2 Allow SSH traffic by adding a security rule to permit SSH access in the security group associated with the worker nodes.

Step 3 Enable IP Forwarding on each worker node by SSHing into them and running this command:

```
sudo sysctl -w net.ipv4.ip_forward=1
```

Optional Inventory Configurations

In the section *Installing OpenShift 4.21 on OpenStack* , Step 8 we noted the required fields for Cisco ACI Container Network Interface (CNI) configuration in the aci_cni section of the inventory.yaml file. This section provides optional configurations and the default values.

Option			Description and Default Values
`cluster_snat_policy_ip`			By default, this value is not set. The Source IP Network Address Translation (SNAT) IP address is used to create a Cisco ACI-CNI SNAT policy that applies to the whole cluster. This SNAT policy is created by running the `cluster_snat_policy.yaml` Ansible playbook as described in *Installing OpenShift 4.21 on Openstack* section in this guide. (If this value is not set, do not run this playbook.)
`dns_ip`			By default, this value is not set. Set this field if you do not follow the procedure that is described in the section "Subnet DNS (optional)" in *Installing OpenShift on OpenStack User-Provisioned Infrastructure* on GitHub. The procedure controls the default resolvers that your Nova servers use. Use the value to set the `dns_nameservers` field of the subnet associated with the `*-primaryClusterNetwork` network. You can specify one or more DNS server IPs.
`network_interfaces`	`node`	`name`	The name of the node network interface as set by the RHCOS image. The default value is "`enp3s0`".
		`mtu`	The MTU set for the `*-primaryClusterNetwork` Neutron network. The default value is 1500.
	`opflex`	`name`	The name of the node network interface as set by the RHCOS image. The default value is "`enp4s0`".
		`mtu`	The MTU set for the `*-secondaryClusterAciNetwork` Neutron network. The default value is 1500.
		`subnet`	The default value is `192.168.208.0/20`. This is the CIDR used for the subnet that is associated with the `*-secondaryClusterAciNetwork` Neutron network. The size of this subnet should at least be as large as that of the one used for the `*-primaryClusterNetwork` Neutron network. It should also not overlap any other CIDR in the OpenShift project's address scope.

Caution In a fresh installation of OSP 17.1, network interface names on the nodes may differ from what is observed with earlier versions of OSP. Interfaces may appear as enp*s instead of ens*. This naming variation is controlled by the hw_machine_type parameter in Nova's configuration on compute nodes. To prevent installation issues, ensure the correct interface names are updated in the inventory.yaml file, as outlined in this section.

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