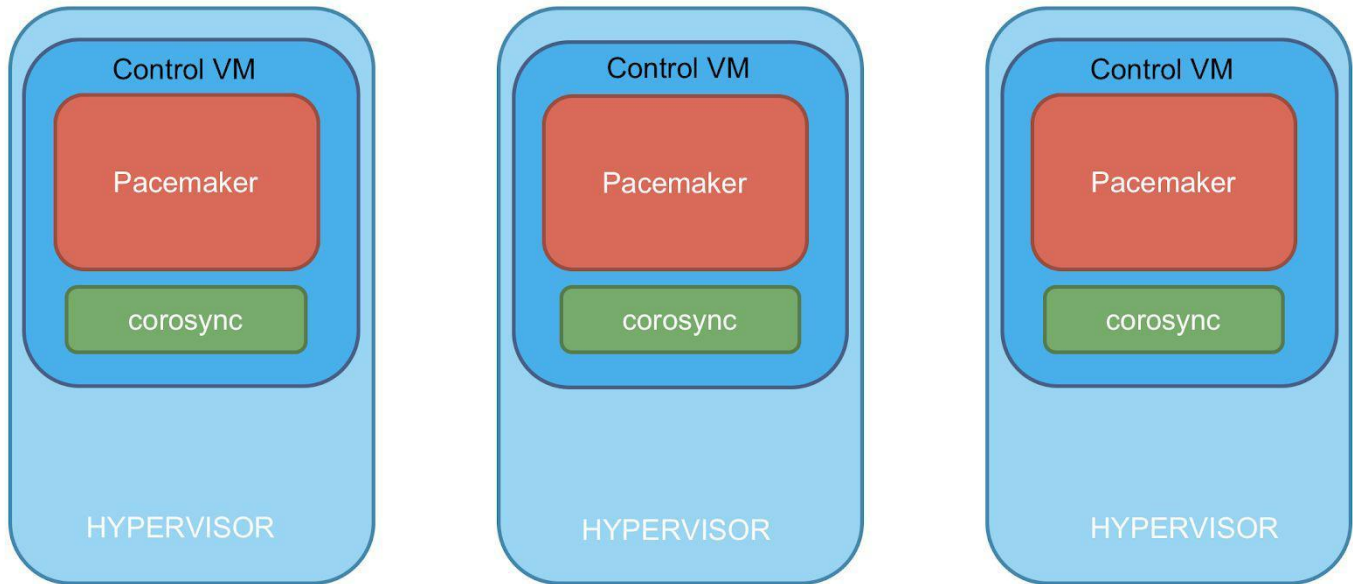


High Availability:

Figure - Contrail HA Architecture Overview



Number of Compute Nodes	< 20	< 50	50 - 200	200 - 1K	200-1k	> 1k
Number of Objects						
Number of Interfaces	2k	4k	8k	16k	32k	
Number of VNs	500	1k	4k	16k	32k	
Memory Requirement (GB)						
Controller (Ctrl + Config+ ConfigDB)	16	24	32	48	64	
Analytics Node	16	24	32	48	64	
Analytics DB Node	16	24	32	48	64	
Total Memory (GB)	48	72	96	144	192	
Number of Cores						Custom Install
Controller (Ctrl + Config+ ConfigDB)	8	12	12	16	16	
Analytics Node	8	12	12	16	16	
DB Node vCPU	8	12	12	16	16	
Total Cores	24	36	36	48	48	
Storage (GB)						
Controller (Ctrl + Config+ ConfigDB)	64	128	256	256	256	
Analytics Node	64	128	256	256	256	
DB Node	500	500	500	1000	2000	
Total Storage (GB)	628	756	1012	1512	2512	

Cluster Design

In order to establish communication between the various OpenStack services, the following 5 fundamental networks are essential in this deployment:

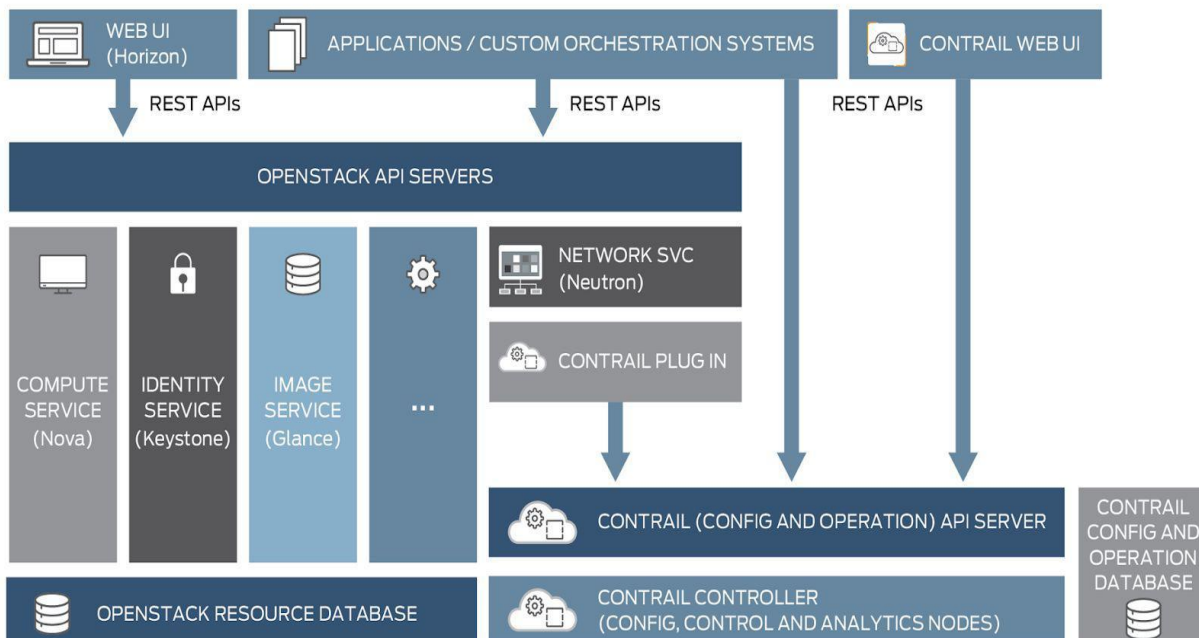
- Internal API network used for the actual VM data traffic
- PXE network used to provision the overcloud controller hosts base OS using the undercloud host's ironic service
- Storage network used to carry Ceph-related storage traffic
- Management network used for OpenStack API traffic
- External network leading to the internet which is used to pull packages from external repos

Contrail Cloud Integration with Openstack

Figure below illustrates the API-level interaction between OpenStack and Contrail configuration. The Contrail Neutron plugin enables the OpenStack Neutron service to make the necessary API calls into the Contrail configuration node to create, delete, and update network resources as defined in OpenStack. Contrail configuration node has a northbound interface which exposes REST APIs to orchestration systems such as OpenStack and Contrail Web UI that can be used to make the network configurations.

Contrail Host Details

In Etisalat environment Contrail Networking 4.1 will be deployed in HA (3 x bare metal servers) will be hosting 11 x Contrail VMs. This section describes the Contrail VM distribution across three bare metal servers, resources allocation and network design inside hypervisor.



Software Components

Software	Version	Description
Red Hat Openstack Platform	10	Openstack distribution.
Contrail Networking	4.1.0-8 (Newton)	Software Defined Networking (SDN) platform.
RHEL	7.4	Redhat OS
Linux Kernel	3.10.0-693.17.1.el7.x86_64	Kernel Version

Table - Software Components

Contrail Roles

There are four distinct contrail roles that will be deployed. Each in groups of three nodes each for High Availability, except for the Tor Services Node which is two nodes for High Availability.

Role	Amount	Description
Contrail Controller	3x	The Contrail Controller and Config roles.
Contrail Analytics	3x	Contrail Analytics node that collects network data and provides analytics.
Contrail Analytics Database	3x	Contrail Analytics Database to store the analytics information.

VM Size

Role	vCPUs	Disk	RAM
Contrail Controller	6	300 GB	30 GB
Contrail Analytics	6	300 GB	30 GB
Contrail AnalyticsDB	6	800 GB	30 GB
	0	0	

Contrail Deployment Work Flow

Undercloud

- Heat analyses templates and environments
- Heat calls
 - Neutron to create networks and ports
 - Ironi to create nodes
 - Nova to boot nodes
- Heat retrieves configuration information from service templates
- Heat generates hiera files containing configuration information
- Overcloud Hiera files are copied to Overcloud nodes

- Tripleo puppet modules are executed using data from hiera files
- Tripleo puppet modules create configurations and call service puppet modules
- Service puppet modules install packages required for services
- Service puppet modules configure services
- Service puppet modules start services

Overcloud

OOO Heat Templates and Environment Files

Contrail is deployed using two sets of YAML files. One set describes the environment, and the other set describes the individual nodes. They are found under tripleo-heat-templates/environments/contrail

File	Type	Description
contrail-services.yaml	Environment	Describes the services and count of nodes per service. Also links the node templates to service.
contrail-net.yaml	Environment	Describes the network topology including vlans, network cidrs, and vrouter settings.
ips-from-pool-all.yaml	Environment	All static addressing is set here.
contrail-nic-config.yaml	Node	Node template for contrail controller.
contrail-compute.yaml	Node	OSPD 10 compute.
controller.yaml	Node	OSPD 10 controller.
ceph-storage.yaml	Node	OSPD 10 Ceph storage.

Table - Heat Template Files Name

contrail-Services.yaml

```
# A Heat environment file which can be used to enable OpenContrail
# # extensions, configured via puppet
resource_registry:
  OS::Triple0::Services::NeutronDhcpAgent: OS::Heat::None
  OS::Triple0::Services::NeutronL3Agent: OS::Heat::None
  OS::Triple0::Services::NeutronMetadataAgent: OS::Heat::None
  OS::Triple0::Services::NeutronOvsAgent: OS::Heat::None
  OS::Triple0::Services::ComputeNeutronOvsAgent: OS::Heat::None
  OS::Triple0::NodeUserData: install_vrouter_kmod.yaml
  OS::Triple0::Services::ContrailHeat: ../../puppet/services/network/contrail-heat.yaml
  OS::Triple0::Services::ContrailAnalytics: ../../puppet/services/network/contrail-
    analytics.yaml
  OS::Triple0::Services::ContrailAnalyticsDatabase:
    ../../puppet/services/network/contrail-analytics-database.yaml
  OS::Triple0::Services::ContrailConfig: ../../puppet/services/network/contrail-
    config.yaml
  OS::Triple0::Services::ContrailControl:
    ../../puppet/services/network/contrail-control.yaml
  OS::Triple0::Services::ContrailDatabase: ../../puppet/services/network/contrail-
    database.yaml
  OS::Triple0::Services::ContrailWebUI:
    ../../puppet/services/network/contrail-webui.yaml
  OS::Triple0::Services::ContrailTsn:
    ../../puppet/services/network/contrail-tsn.yaml
  OS::Triple0::Services::ContrailDpdk:
    ../../puppet/services/network/contrail-dpdk.yaml
  OS::Triple0::Services::ComputeNeutronCorePlugin:
    ../../puppet/services/network/contrail-vrouter.yaml
  OS::Triple0::Services::NeutronCorePlugin: ../../puppet/services/network/contrail-
    neutron-plugin.yaml
  OS::Triple0::Services::NeutronSriovAgent:
    /usr/share/openstack-tripleo-heat-templates/puppet/services/neutron-
    sriov-agent.yaml
parameter_defaults:
  ServiceNetMap:
    ContrailAnalyticsNetwork: internal_api
    ContrailAnalyticsDatabaseNetwork: internal_api
    ContrailConfigNetwork: internal_api
    ContrailControlNetwork: internal_api
    ContrailDatabaseNetwork: internal_api
    ContrailWebuiNetwork: internal_api
    ContrailTsnNetwork: internal #use the tenant network
    ContrailVrouterNetwork: tenant #use the tenant network
    ContrailDpdkNetwork: tenant
# KeystoneAdminApiNetwork:
#   internal_api
# ContrailControlManageNamed:
#   true
# ContrailRepo: http://172.16.0.1/contrail
# EnablePackageInstall: true
# ContrailConfigIfmapUserName: api-server #params not used in v4
# ContrailConfigIfmapUserPassword: api-server #params not used in v4
# OvercloudControlFlavor: control
# OvercloudContrailControllerFlavor: contrail-controller
# OvercloudContrailAnalyticsFlavor: contrail-analytics
# OvercloudContrailAnalyticsDatabaseFlavor: contrail-analytics-database
# OvercloudContrailTsnFlavor: contrail-tsn
# OvercloudComputeFlavor: compute
# OvercloudContrailDpdkFlavor: compute-dpdk
# ControllerCount: 3
# ContrailControllerCount: 3
# ContrailAnalyticsCount: 3
```

```

#ContrailAnalyticsDatabaseCount: 3
#ContrailTsnCount: 0
#ComputeCount: 0
#ContrailDpdkCount: 0
#DnsServers: ["X"]
NtpServer: 10.0.0.1
NeutronCorePlugin:
neutron_plugin_contrail.plugins.opencontrail.contrail_plugin.NeutronPluginContrailCoreV2
NeutronServicePlugins:
'neutron_plugin_contrail.plugins.opencontrail.loadbalancer.v2.plugin.LoadBalancerPluginV2'
NeutronTunnelTypes: ''
NeutronMetadataProxySharedSecret: secret
ContrailControlRNDCSecret: sHE1SM8nsySdgsoRxwARtA==
#NovaComputeExtraConfig:
# # Required for Centos 7.3 and Qemu 2.6.0
# nova::compute::libvirt::libvirt_cpu_mode: 'none'

```

contrail-net.yaml

resource_registry:

```

OS::TripleO::ComputeVRouter::Net::SoftwareConfig: nic-config/compute-vrouter.yaml
OS::TripleO::ComputeSRIOV::Net::SoftwareConfig: nic-config/compute-sriov.yaml
OS::TripleO::ComputeSRIOVDPDK::Net::SoftwareConfig: nic-config/compute-sriov-dpdk.yaml
OS::TripleO::ContrailController::Net::SoftwareConfig: nic-config/contrail-sdn.yaml
OS::TripleO::ContrailAnalytics::Net::SoftwareConfig: nic-config/contrail-sdn.yaml
OS::TripleO::ContrailAnalyticsDatabase::Net::SoftwareConfig: nic-config/contrail-sdn.yaml
OS::TripleO::ContrailTsn::Net::SoftwareConfig: nic-config/contrail-tsn.yaml
OS::TripleO::Controller::Net::SoftwareConfig: nic-config/controller.yaml

```

```

OS::TripleO::NodeExtraConfigPost: post-install.yaml

```

parameter_defaults:

```

NovaSchedulerDefaultFilters:
["AggregateInstanceExtraSpecsFilter,RamFilter,ComputeFilter,AvailabilityZoneFilter,ComputeCapabilitiesFilter,ImagePropertiesFilter,PciPassthroughFilter,NUMATopologyFilter,ServerGroupAffinityFilter,ServerGroupAntiAffinityFilter"]
NovaSchedulerAvailableFilters:
["nova.scheduler.filters.all_filters","nova.scheduler.filters.pci_passthrough_filter.PciPassthroughFilter"]
NovaReservedHostMemory: 8192
ComputeKernelArgs: "intel_iommu=on default_hugepagesz=1GB hugepagesz=1G hugepages=100"
NovaVcpuPinSet:
"2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71"
HostIsolatedCoreList:
"2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71"
ComputeSRIOVExtraConfig:
tripleo::host::sriov::number_of_vfs: '["enp175s0f0:32", "enp175s0f1:32", "enp59s0f0:32", "enp59s0f1:32"]'
nova::compute::pci_passthrough: '"[{"devname":"enp175s0f0","physical_network":"physnet1"}, {"devname":"enp175s0f1","physical_network":"physnet2"}]"'
#neutron::global_physnet_mtu: 9000

```

```

ComputeSRIOVDPKEXtraConfig:
  tripleo::host::sriov::number_of_vfs: '["enp175s0f0:32", "enp175s0f1:32"]'
  nova::compute::pci_passthrough: '"[{\"devname\": \"enp175s0f0\",
\\\"physical_network\\\": \"physnet1\"}, {\"devname\": \"enp175s0f1\",
\\\"physical_network\\\": \"physnet2\"}]"'

GlanceBackend: file
ExtraConfig:
  tripleo::profile::base::sshd::options:
    PasswordAuthentication: 'yes'
    GSSAPIAuthentication: 'no'
    PermitRootLogin: 'yes'
    UseDNS: 'no'
  nova::debug: true
  glance::registry::debug: true
  glance::api::debug: true
  neutron::debug: true
  keystone::debug: true
  cinder::debug: true
PublicVirtualFixedIPs: [{'ip_address': '10.100.0.19'}]

#Control plane Cidr
ControlPlaneSubnetCidr: '22'

InternalApiNetCidr: 172.19.0.0/22
TenantNetCidr: 10.104.0.0/22
StorageNetCidr: 172.20.0.0/22
# StorageMgmtNetCidr: 172.21.0.0/24
# ManagementNetCidr:
10.227.159.0/24
ExternalNetCidr:
10.100.0.0/22

InternalApiAllocationPools: [{'start': '172.19.0.1', 'end': '172.19.0.253'}]
TenantAllocationPools: [{'start': '10.104.0.10', 'end': '10.104.0.222'}]
StorageAllocationPools: [{'start': '172.20.0.2', 'end': '172.20.0.253'}]
# StorageMgmtAllocationPools: [{'start': '172.21.0.2', 'end': '172.21.0.253'}]
# ManagementAllocationPools: [{'start': '10.227.159.16', 'end':
'10.227.159.254'}] ExternalAllocationPools: [{'start': '10.100.0.2',
'end': '10.100.0.253'}]

ManagementInterfaceDefaultRoute: 172.19.3.254
InternalApiDefaultRoute: 172.19.3.254
TenantDefaultRoute: 10.104.3.254
ExternalInterfaceDefaultRoute: 10.100.3.254
ControlPlaneDefaultRoute: 172.16.3.254
EC2MetadataIp: 172.16.0.1
DnsServers: ["8.8.8.8"]
NtpServer: pool.ntp.org
TimeZone: 'Asia/Dubai'

StorageMTU: 9000
NeutronGlobalPhysnetMtu: 9000

ControlPlaneIpVlanID: 16
InternalApiNetworkVlanID: 19
TenantNetworkVlanID: 104
StorageNetworkVlanID: 20
# StorageMgmtNetworkVlanID: 21

```

```

# ManagementNet
  workVlanID:
  ExternalNetwo
  rkVlanID: 100

#vRouter kernel mode configuration
VrouterPhysicalInterface: vlan104
VrouterGateway: 10.104.3.254
VrouterNetmask: 255.255.252.0
ControlVirtualInterface: eth0
#PublicVirtualInterface: vlan104
VlanParentInterface: bond-data
BondInterface: bond-data
#BondInterfaceMembers: 'enp175s0f0,enp175s0f1,enp216s0f0,enp216s0f0'
BondInterfaceMembers: 'enp175s0f0,enp175s0f1'
BondMode: 4
BondPolicy: 2
BondDpdkPolicy: 2
VlanDpdkParentInterface: bond-data
#ContrailDpdkHugePages:
#ContrailDpdkCoremask:
ContrailDpdkDriver: vfio-pci
ContrailSslEnabled: false

BondInterfaceLinuxOptions: "mode=802.3ad lacp_rate=fast miimon=100
xmit_hash_policy=layer3+4"

```

contrail-sdn.yaml

```
heat_template_version: 2015-04-30
```

```
description: >
```

```
  Software Config to drive os-net-config to configure
  multiple interfaces for the compute role.
```

```
parameters:
```

```
  Contr
```

```
  olPla
```

```
  neIp:
```

```
    default: ''
```

```
    description: IP address/subnet on the ctlplane network
```

```
    type: string
```

```
  ExternalIpSubnet:
```

```
    default: ''
```

```
    description: IP address/subnet on the external network
```

```
    type: string
```

```
  InternalApiIpSubnet:
```

```
    default: ''
```

```
    description: IP address/subnet on the internal API network
```

```
    type: string
```

```
  InternalApiDefaultRoute: # Not used by default in this template
```

```
    default: '10.0.0.1'
```

```
    description: The default route of the internal api network.
```

```
    type: string
```

```
  StorageIpSubnet:
```

```
    default: ''
```

```
    description: IP address/subnet on the storage network
```

```
    type: string
```

```
  StorageMgmtIpSubnet:
```



```

    default: ''
    description: IP address/subnet on the storage mgmt network
type:
string
Tenant
tIpSu
bnet:
defau
lt:
''

    description: IP address/subnet on the tenant network
    type: string
ManagementIpSubnet: # Only populated when including environments/network-management.yaml
    default: ''
    description: IP address/subnet on the management network
    type: string
ExternalNetworkVlanID:
    default: 10
    description: Vlan ID for the external network traffic.
    type: number
InternalApiNetworkVlanID:
    default: 20
    description: Vlan ID for the internal_api network traffic.
    type: number
StorageNetworkVlanID:
    default: 30
    description: Vlan ID for the storage network traffic.
    type: number
StorageMgmtNetworkVlanID:
    default: 40
    description: Vlan ID for the storage mgmt network traffic.
    type: number
TenantNetworkVlanID:
    default: 50
    description: Vlan ID for the tenant network traffic.
    type: number
ManagementNetworkVlanID:
    default: 60
    description: Vlan ID for the management network traffic.
    type: number
ControlPlaneSubnetCidr: # Override this via parameter_defaults
    default: '24'
    description: The subnet CIDR of the control plane network.
    type: string
ControlPlaneDefaultRoute: # Override this via parameter_defaults
    description: The default route of the control plane network.
    type: string
ExternalInterfaceDefaultRoute: # Not used by default in this template
    default: '10.0.0.1'
    description: The default route of the external network.
    type: string
ManagementInterfaceDefaultRoute: # Commented out by default in this template
    default: unset
    description: The default route of the management network.
    type: string
DnsServers: # Override this via parameter_defaults
    default: []
    description: A list of DNS servers (2 max for some implementations) that
will be added to resolv.conf.
    type: comma_delimited_list
EC2MetadataIp: # Override this via parameter_defaults

```

```
description: The IP address of the EC2 metadata server.
type: string
```

```
resources:
  OsNetConfigImpl:
    type: OS::Heat::StructuredConfig
    properties:
      group: os-apply-config
      config:
        os_net_config:
          network_config:
            -
              type: interface
              name: eth0
              use_dhcp: false
              dns_servers: {get_param: DnsServers}
              addresses:
                -
                  ip_netmask:
                    list_join:
                      - '/'
                      - - {get_param: ControlPlaneIp}
                        - {get_param: ControlPlaneSubnetCidr}
              routes:
                -
                  ip_netmask: 169.254.169.254/32
                  next_hop: {get_param: EC2MetadataIp}
            -
              type: interface
              name: eth1 # vlan 100 external
              use_dhcp: false
              addresses:
```

compute-vrouter.yaml

```
heat_template_version: 2015-04-30
```

```
description: >
  Software Config to drive os-net-config with 2 bonded
  nics on a bridge with VLANs attached for the compute
  role.
```

```
parameters:
  Contr
  olPla
  neIp:
    default: ''
    description: IP address/subnet on the ctlplane network
    type: string
  ExternalIpSubnet:
    default: ''
    description: IP address/subnet on the external network
    type: string
  InternalApiIpSubnet:
    default: ''
    description: IP address/subnet on the internal API network
    type: string
  StorageIpSubnet:
    default: ''
    description: IP address/subnet on the storage network
```

```

    type: string
StorageMgmtIpSubnet:
  default: ''
  description: IP address/subnet on the storage mgmt network
type:
string
Tenant
tIpSu
bnet:
defau
lt:
''
  description: IP address/subnet on the tenant network
  type: string
ManagementIpSubnet: # Only populated when including environments/network-management.yaml
  default: ''
  description: IP address/subnet on the management network
  type: string
BondInterfaceLinuxOptions:
  default: ''
  type: string
BondInterfaceOvsOptions:
  default: ''
  description: The ovs_options string for the bond interface.
    Set things like lacp=active and/or
    bond_mode=balance-slb using this option.
  type: string
#constraints:
# - allowed_pattern: "^(?!balance.tcp).*$"
#   description: |
#     The balance-tcp bond mode is known to cause packet loss and
#     should not be used in
BondInterfaceOvsOptions.
ExternalNetworkVlanID:
  default: 10
  description: Vlan ID for the external network traffic.
  type:
number
InternalApi
NetworkVlan
ID:
  default: 20
  description: Vlan ID for the internal_api network traffic.
  type:
number
Storage
Network
VlanID:
  default: 30
  description: Vlan ID for the storage network traffic.
  type:
number
StorageMgmt
NetworkVlan
ID:
  default: 40
  description: Vlan ID for the storage mgmt network traffic.
  type:
:
number
Tenant
Network

```

```
kVlanID:
D:
  default: 50
  description: Vlan ID for the tenant network traffic.
  type:
number
Management
NetworkVlanID:
  default: 60
  description: Vlan ID for the management network traffic.
  type: number
ControlPlaneSubnetCIDR: # Override this via
  parameter_defaults default: '24'
  description: The subnet CIDR of the control plane network.
  type: string
ControlPlaneDefaultRoute: # Override this via
  parameter_defaults description: The default
route of the control plane network. type: string
ExternalInterfaceDefaultRoute: # Not used by default in
this template default: '10.0.0.1'
  description: The default route of the external network.
  type: string
ManagementInterfaceDefaultRoute: # Commented out by default in
this template default: unset
  description: The default route of the management network.
  type: string
DnsServers: # Override this via
  parameter_defaults default: []
  description: A list of DNS servers (2 max for some implementations) that will be added to
resolv.conf.
  type: comma_delimited_list
EC2MetadataIP: # Override this via parameter_defaults
  description: The IP address of the EC2 metadata server.
  type: string
TenantDefaultRoute:
  description: Tenant network default route
  type: string
StorageMTU:
  description: MTU size for Storage network
  type: number

resources:
  OsNetConfigImpl:
    type: OS::Heat::StructuredConfig
    properties:
      group: os-apply-config
      config:
        os_net_config:
          network_config:
            -
              type: interface
              name: eno1
              use_dhcp: false
              dns_servers: {get_param: DnsServers}
              addresses:
                -
                  ip_netmask:
                    list_join:
                      - '/'
                      - - {get_param: ControlPlaneIP}
```

- {get_param: ControlPlaneSubnetCidr}

routes:

- - ip_netmask: 169.254.169.254/32
 - next_hop: {get_param: EC2MetadataIp}
- - #default: true
 - next_hop: {get_param: ControlPlaneDefaultRoute}

-

type: linux_bond
 name: bond-osp
 bonding_options: {get_param: BondInterfaceLinuxOptions} members:

- - type: interface
 - name: enp59s0f0
- - type: interface
 - name: enp59s0f1

-

type: vlan
 device: bond-osp
 vlan_id: {get_param: StorageNetworkVlanID}
 mtu: {get_param: StorageMTU}
 addresses:

- - ip_netmask: {get_param: StorageIpSubnet}

-

type: vlan
 device: bond-osp
 vlan_id: {get_param: ExternalNetworkVlanID}
 addresses:

- - ip_netmask: {get_param: ExternalIpSubnet}

routes:

- - default: true
 - next_hop: {get_param: ExternalInterfaceDefaultRoute}

-

type: vlan
 device: bond-osp
 vlan_id: {get_param: InternalApiNetworkVlanID}
 addresses:

- - ip_netmask: {get_param: InternalApiIpSubnet}

-

type: linux_bond
 name: bond-data
 bonding_options: {get_param: BondInterfaceLinuxOptions} members:

- - type: interface
 - name: enp175s0f0
- - type: interface