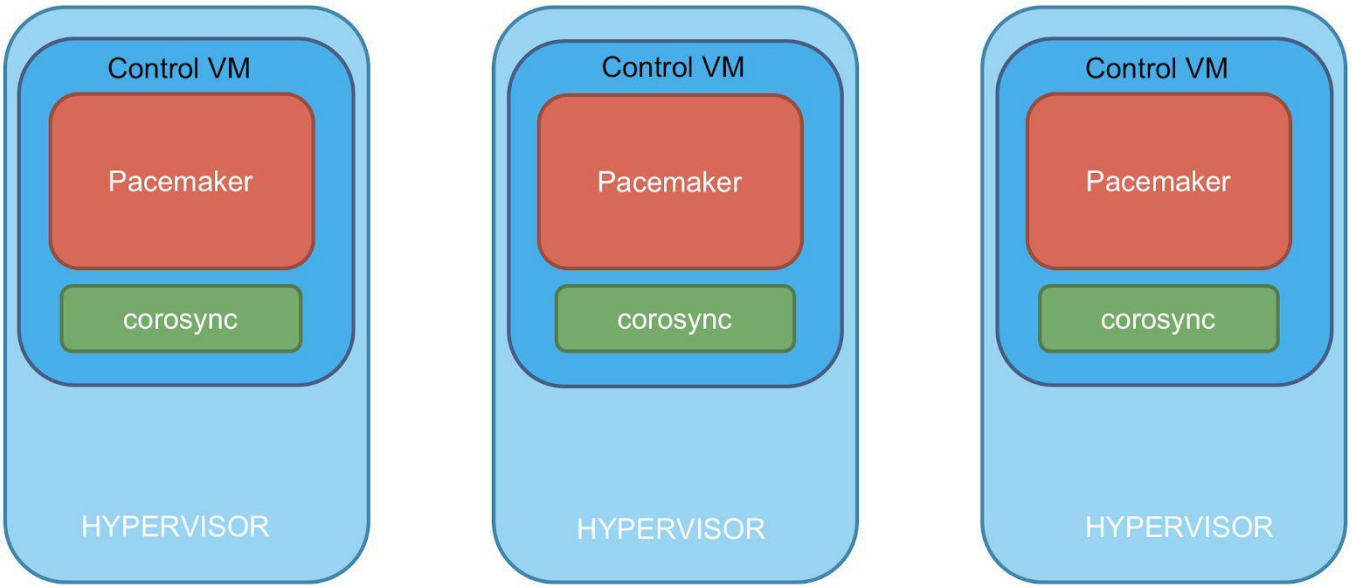
High Availability:

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:

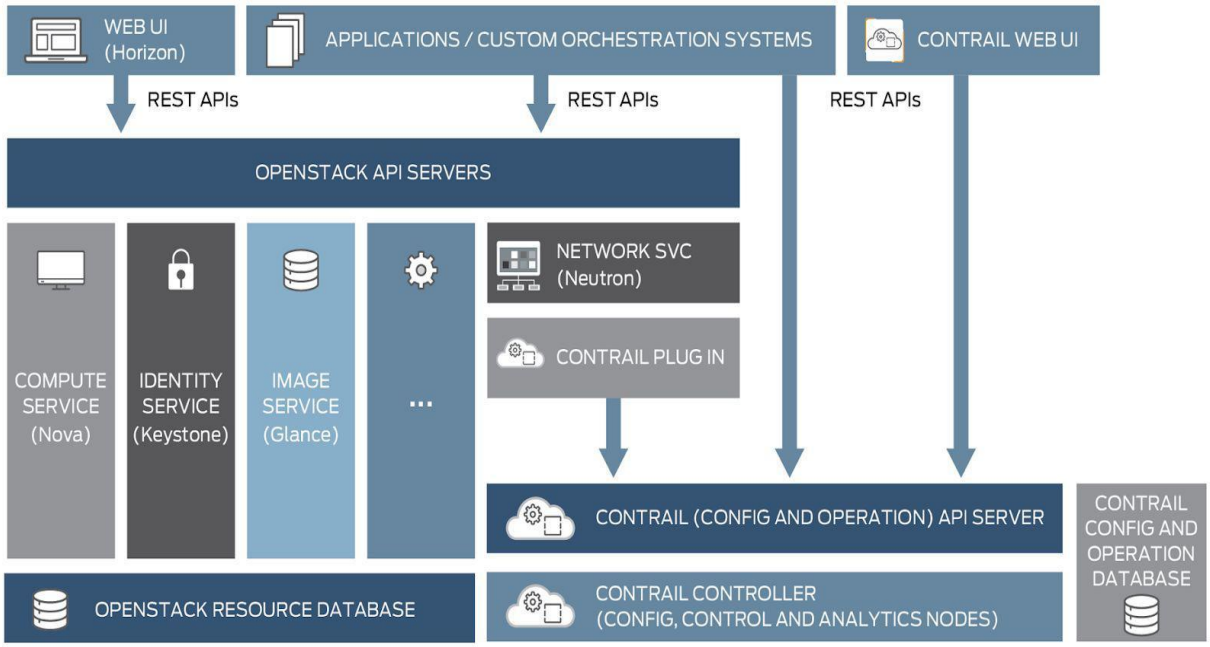
- Internal API network used for the actual VM data traffic
- PXE network used to provision the overcloud controller hosts base OS using the undercloud host's ironic service
- Storage network used to carry Ceph-related storage traffic
- Management network used for OpenStack API traffic
- External network 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
    - Ironic 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::TripleO::Services::NeutronDhcpAgent: OS::Heat::None
  OS::TripleO::Services::NeutronL3Agent: OS::Heat::None
  OS::TripleO::Services::NeutronMetadataAgent: OS::Heat::None
  OS::TripleO::Services::NeutronOvsAgent: OS::Heat::None
  OS::TripleO::Services::ComputeNeutronOvsAgent: OS::Heat::None
  OS::TripleO::NodeUserData: install_vrouter_kmod.yaml
  OS::TripleO::Services::ContrailHeat: ../../puppet/services/network/contrail-heat.yaml
  OS::TripleO::Services::ContrailAnalytics: ../../puppet/services/network/contrail-
  analytics.yaml
  OS::TripleO::Services::ContrailAnalyticsDatabase:
../../puppet/services/network/contrail-analytics-database.yaml
  OS::TripleO::Services::ContrailConfig: ../../puppet/services/network/contrail-
  config.yaml OS::TripleO::Services::ContrailControl:
  ../../puppet/services/network/contrail-control.yaml
  OS::TripleO::Services::ContrailDatabase: ../../puppet/services/network/contrail-
  database.yaml OS::TripleO::Services::ContrailWebUI:
  ../../puppet/services/network/contrail-webui.yaml OS::TripleO::Services::ContrailTsn:
  ../../puppet/services/network/contrail-tsn.yaml OS::TripleO::Services::ContrailDpdk:
  ../../puppet/services/network/contrail-dpdk.yaml
  OS::TripleO::Services::ComputeNeutronCorePlugin:
  ../../puppet/services/network/contrail-vrouter.yaml
  OS::TripleO::Services::NeutronCorePlugin: ../../puppet/services/network/contrail-
  neutron-plugin.yaml OS::TripleO::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
  #ControllerCount: 3
  #ContrailControllerCount: 3
  #ContrailAnalyticsCount: 3
  #ContrailAnalyticsDatabaseCount: 3
```

```
  #ContrailTsnCount: 0
  #ComputeCount: 0
  #ContrailDpdkCount: 0
  #DnsServers: [“X"]
  NtpServer: pool.ntp.org
  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,ComputeCapa
bilitiesFil
ter,ImagePropertiesFilter,PciPassthroughFilter,NUMATopologyFilter,ServerGroupAffinityFilter,Se
rverGroupAn
tiAffinityFilter"]
  NovaSchedulerAvailableFilters:
["nova.scheduler.filters.all_filters","nova.scheduler.filters.pci_passthrough_filter.PciPassth
roughFilter
"]
  NovaReservedHostMemory: 4096
  ComputeKernelArgs: "intel_iommu=on default_hugepagesz=1GB hugepagesz=1G hugepages=30"
  NovaVcpuPinSet:
"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"
  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':'192.168.211.11'}]
```

```
  #Control plane Cidr
  ControlPlaneSubnetCidr: '22'

  InternalApiNetCidr: 172.16.1.0/24
  TenantNetCidr: 10.104.1.0/24
  StorageNetCidr: 10.20.1.0/24
# ExternalNetCidr:
  192.168.211.0/24

  InternalApiAllocationPools: [{'start': '172.16.1.50', 'end': '172.19.0.253'}]
  TenantAllocationPools: [{'start': '10.104.1.50', 'end': '10.104.1.253'}]
  StorageAllocationPools: [{'start': '10.20.1.50', 'end': '172.20.0.253'}]
# ExternalAllocationPools: [{'start': '192.168.211.50', 'end':
  '192.168.211.253'}]

  TenantDefaultRoute: 10.104.1.1
  ExternalInterfaceDefaultRoute: 192.168.211.1
  ControlPlaneDefaultRoute: 172.16.1.1
  EC2MetadataIp: 172.16.0.1
  DnsServers: ["8.8.8.8"]
  NtpServer: pool.ntp.org
  TimeZone: 'Asia/Kolkata'

  StorageMTU: 9000
  NeutronGlobalPhysnetMtu:  9000

  InternalApiNetworkVlanID: 2001
  TenantNetworkVlanID: 2004
  StorageNetworkVlanID: 2003
# ExternalNetwo
    rkVlanID:
       2005



  #vRouter kernel mode configuration
  VrouterPhysicalInterface: vlan2004
  VrouterGateway: 10.104.1.1
  VrouterNetmask: 255.255.255.0
  #PublicVirtualInterface: vlan104
  VlanParentInterface: bond-data
  BondInterface: bond-data
  BondInterfaceMembers: 'em3,em4'
  BondMode: 4
  BondPolicy: 2
  BondDpdkPolicy: 2
  VlanDpdkParentInterface: bond-data
  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
Tenan
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: 2005
    description: Vlan ID for the external network traffic.
    type: number
  InternalApiNetworkVlanID:
    default: 2001
    description: Vlan ID for the internal_api network traffic.
    type: number
  StorageNetworkVlanID:
    default: 2003
    description: Vlan ID for the storage network traffic.
    type: number
  TenantNetworkVlanID:
    default: 2004
    description: Vlan ID for the tenant network traffic.
    type: number
  ManagementNetworkVlanID:
    default: 2001
    description: Vlan ID for the management network traffic.
    type: number
  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
Tenan
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: 2005
    description: Vlan ID for the external network traffic.
    type:
  number
  InternalApi
  NetworkVlan
  ID:
    default: 2001
    description: Vlan ID for the internal_api network traffic.
    type:
  number
  Storage
  Network
  VlanID:
    default: 2003
```

```
    description: Vlan ID for the storage network traffic.
    type:
  number
    Tena
  ntNetw
  orkVla
  nID:
    default: 2004
    description: Vlan ID for the tenant network traffic.
    type:
  number
  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: em1
              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: em3
    -
      type: interface
      name: em4
-
   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}
```