Oracle® Communications

Cloud Native Core, Cloud Native Environment User Guide

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Oracle Communications Cloud Native Core, Cloud Native Environment User Guide, Release 25.2.200

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Preface

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Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
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Acronyms

The following table lists the acronyms and the terminologies used in the document.

Table Acronyms and Terminologies

Acronyms	Definition
5G NF	3GPP 5G Network Function
Bastion Host	The Bastion Host is a node that hosts general orchestration support for the site. The Bastion Node runs as a virtual machine on a Kubernetes Master Host for BareMetal deployments. Whereas, for vCNE deployments the Bastion is a separate virtual machine within the OpenStack or VMWare Cloud. It is used to host the automation environment and run the install automation. The install automation provisions and configures all other hosts, nodes, and switches within the frame. After the installation process is completed, the Bastion Host continues to serve as the customer gateway to cluster operations and control.
BFG	Border Gateway Protocol
BIOS	Basic Input Output System
CCV	Custom Configurable Volumes
CLI	Command Line Interface
Cluster	A collection of hosts and nodes dedicated to providing a cloud native runtime environment for containerized services and applications. The cluster is comprised of the collection of Master and Worker Nodes and is managed by Kubernetes.
CNE	Oracle Communications Cloud Native Core, Cloud Native Environment
CNC Console	Oracle Communications Cloud Native Configuration Console
CNLB	Cloud Native Load Balancer
Computer or Machine	A computer is a machine or device that performs processes, calculations, and operations based on instructions provided by a software or hardware program. Machine and computer are equivalent and interchangeable. Therefore, a virtual machine or physical machine is equivalent to a virtual computer or physical computer.
Container	An encapsulated software service. All 5G applications and Operations, Administration, Maintenance (OAM) functions are delivered as containerized software. The purpose of the CNE is to host containerized software providing 5G Network Functions (NFs) and services.
CSI	Container Storage Interface
DB	Database
DBMS	Database Management System
DHCP(D) or DHCP	Dynamic Host Configuration Protocol
DNF	Dandified YUM
DNS	Domain Name Server
DNSSEC	Domain Name System Security Extensions
FQDN	Fully Qualified Domain name
GRUB	Grand Unified Bootloader
GUI	Graphical User Interface
HDD	Hard Disk Drive

Table (Cont.) Acronyms and Terminologies

Acronyms	Definition
Host	A **host** is a computer that is loaded with an Operating System (OS) and is accessible over a network. This includes physical or virtual machines. Though **host** and **node** have different meanings, they can often be confused. Therefore, in this document, the **host** refers to the role of the physical computer in the CNE solution, and **Host OS** refers to the operating system running on the physical computer.
HP	Hewlett Packard
HPE	Hewlett Packard Enterprise
HTTP	HyperText Transfer Protocol
Installer Bootstrap Host	As an early step in the site installation process, one of the hosts is minimally provisioned to act as an Installer Bootstrap Host. The Installer Bootstrap Host has a very short lifetime since its job is to provision a Bastion Host. The Bastion Host performs the remainder of the CNE installation. The Installer Bootstrap Host is also known as the Bootstrap Host. Later in the installation process, this Bootstrap Host (RMS1) is reprovisioned as a Kubernetes Master Host.
iLO	HPE Integrated Lights-Out Management System
IP	Internet Protocol, can be used as shorthand to refer to an IP layer 3 address.
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IRF	Intelligent Resilient Framework
ISO	International Organization for Standardization; generally used as shorthand to refer to an ISO 9660 optical disk file system image
KVM	Keyboard, Video, Mouse. This abbreviation is a homograph of another meaning for the same abbreviation. Where these are used within the document, the document will provide context to understand which one is being referenced.
KVM	Kernel Virtual Machine. This abbreviation is a homograph of another meaning for the same abbreviation. Where these are used within the document, the document will provide context to understand which one is being referenced.
K8s	Shorthand alias for Kubernetes
K8s Controller Node	Some nodes in the system such as RMS 1, 2, and 3 are dedicated to providing container management. These nodes are responsible for managing all of the containerized workloads that run on the Kubernetes Worker Nodes.
K8s Worker Node	Some nodes in the system such as the blade servers within the enclosure, are dedicated to hosting containerized software and providing the 5G application services.
LACP	Link Aggregation Control Protocol
LAG	Link Aggregation Group
LB	Load Balancer
LBVM	Load Balancer Virtual Machine
MAC	Media Access Control address

Table (Cont.) Acronyms and Terminologies

Acronyms	Definition
Management Host	The Management Host is a physical machine in the RMS frame that contains a special configuration to support hardware installation and configuration of other components within a frame. For CNE, there is one machine, RMS1, with dedicated connectivity to out of band (OOB) interfaces on the Top of Rack switches. The OOB interfaces provide the connectivity required to initialize ToR switches. When referring to a machine as a **Management Host**, the context is related to its OOB connections that are unique to the RMS1 configuration.
MBE	Minimal Bootstrapping Environment
MTU	Maximum Transmission Unit
NFS	Network File System
NIC	Network Interface Card
Node	In general use, a "**node**" is any system or device connected to a network. A "**node**" is usually a networking endpoint. In this document, a "**node**" refers to a service within the CNE, such as "**Kubernetes Controller Node**", which provides the Kubernetes etcd data and serves as a management entity for the cluster.
NTP	Network Time Protocol
OAM	Operations, Administration, Maintenance
OL	Oracle Linux
OS	Operating System
OSD	Object Storage Device
OSDC	Oracle Software Download Center
OSPF	Open Shortest Path First
PAP	Peer Address Pool
PKI	Public Key Infrastructure
POAP	PowerOn Auto Provisioning
PSA	Pod Security Admission
PSP	Pod Security Policies
PVC	Persistent Volume Claim
PXE	Pre-Boot Execution Environment
RAID	Redundant Array of Independent Disks
RAM	Random Access Memory
RBSU	ROM Based Setup Utility
Rack Mount Server (RMS)	Rack Mount Server denotes a profile for a specific computer designed to support a server function. An RMS is mounted directly into a frame and is individually powered and networked.
RPM	Red Hat Package Manager
SAS	Serial Attached SCSI
Server	A server is a physical computer. Servers are rack-mounted servers (RMS).
SSD	Solid State Drive
STP	Spanning Tree Protocol
TAR	Short for Tape Archive, and sometimes referred to as tarball, a file that has the TAR file extension is a file in the Consolidated Unix Archive format.
TCP	Transmission Control Protocol

Table (Cont.) Acronyms and Terminologies

Acronyms	Definition
TGZ	Tar and GNUzip
TLA	Three Letter Acronym
TLD	Top-Level Domain
ToR	Top of Rack - Colloquial term for the pair of Cisco 93180YC-EX or any other switches
UEFI	Unified Extensible Firmware Interface
ULN	Unbreakable Linux Network
URL	Uniform Resource Locator
VCD	VMware Cloud Director
vCNE	Virtualized CNE. A Virtualized CNE is a cloud native environment that is deployed on VMs instead of Bare Metal servers.
VDC	Virtual Data Center
VLAN	Virtual Local Area Network
VM	Virtual Machine
VRRP	Virtual Router Redundancy Protocol
VRF	Virtual Routing and Forwarding
vPC	Virtual Port Channel
VSP	Virtual Serial Port
YUM	Yellowdog Updator, Modified (a Linux Package Manager)

What's New in This Guide

This section introduces the documentation updates for release 25.2.2xx.

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Generic Updates:
Updated the versions of the following common services in the Frequently Used Common Services section:

- Prometheus: 3.6.0
- Prometheus Operator: 0.85.0
- Kyverno: 1.15.0
- MetalLB: 0.15.2
- OCI Grafana: 7.5.17
- Jaeger: 1.72.0
- Oracle OpenSearch / Dashboard: 2.19.1
- Calico: 3.30.3
- Helm: 3.19.1
- containerd: 2.1.4
- Kubernetes: 1.34.2

Maintenance Procedures:

- Added the section Updating OpenStack TLS Certificate that explains how to update the TLS certificate for CNE running on OpenStack.
- Added the section Enabling Public Endpoint for CNE (Kubernetes) API Server that provides an overview of the implementation for exposing the Kubernetes API Server as a public endpoint.
- Modified the section Updating CNLB Network Attachments to:
  - Include BareMetal support
  - Added the Common Issues and Solutions section that provides steps to resolve common errors encountered when running the network update procedure.

Observability

- Updated the section CNE Metrics to add Mpstat and Network Metrics.

1 Introduction

This document provides information to operate and maintain Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) clusters.

1.1 Overview

CNE is an essential infrastructure code that provisions, configures, and manages cloud native environments.

1.2 References

Refer to the following documents for more information about CNE:

- *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*
- *Oracle Communications Cloud Native Core, Cloud Native Environment Network Impact Report*
- *Oracle Communications Cloud Native Core Release Notes*
- *Oracle Communications Cloud Native Core Licensing Information User Guide*
- *Oracle Communications Cloud Native Core Solution Upgrade Guide*
- *Oracle Communications Cloud Native Core Security Guide*

1.3 Key Terms

The following table lists the terminologies used in this document.

Table 1-1 Key Terms

Term	Definition
Host	A **host** is a computer that is loaded with an Operating System (OS) and is accessible over a network. This includes physical or virtual machines. Though **host** and **node** have different meanings, they can often be confused. Therefore, in this document, the **host** refers to the role of the physical computer in the CNE solution, and **Host OS** refers to the operating system running on the physical computer.
Node	In general use, a "**node**" is any system or device connected to a network. A "**node**" is usually a networking endpoint. In this document, a "**node**" refers to a service within the CNE, such as "**Kubernetes Controller Node**", which provides the Kubernetes etcd data and serves as a management entity for the cluster.
Computer or Machine	A computer is a machine or device that performs processes, calculations, and operations based on instructions provided by a software or hardware program. Machine and computer are equivalent and interchangeable. Therefore, a virtual machine or physical machine is equivalent to a virtual computer or physical computer.

Table 1-1 (Cont.) Key Terms

Term	Definition
Server	A server is a physical computer. Servers are rack-mounted servers (RMS).
Rack Mount Server (RMS)	RMS denotes a profile for a specific computer designed to support a server function. An RMS is mounted directly into a frame and is individually powered and networked.
Management Host	The Management Host is a physical machine in the RMS frame that contains a special configuration to support hardware installation and configuration of other components within a frame. For CNE, there is one machine, RMS1, with dedicated connectivity to out of band (OOB) interfaces on the Top of Rack switches. The OOB interfaces provide the connectivity required to initialize ToR switches. When referring to a machine as a **Management Host**, the context is related to its OOB connections that are unique to the RMS1 configuration.
Bastion Host	The Bastion Host is a node that hosts general orchestration support for the site. The Bastion Node runs as a virtual machine on a Kubernetes Master Host for BareMetal deployments. Whereas, for vCNE deployments the Bastion is a separate virtual machine within the OpenStack or VMWare Cloud. It is used to host the automation environment and run the install automation. The install automation provisions and configures all other hosts, nodes, and switches within the frame. After the installation process is completed, the Bastion Host continues to serve as the customer gateway to cluster operations and control.
Installer Bootstrap Host	As an early step in the site installation process, one of the hosts is minimally provisioned to act as an Installer Bootstrap Host. The Installer Bootstrap Host has a very short lifetime since its job is to provision a Bastion Host. The Bastion Host performs the remainder of the OCCNE installation. The Installer Bootstrap Host is also known as the Bootstrap Host. Later in the installation process, this Bootstrap Host (RMS1) is reprovisioned as a Kubernetes Master Host.
K8s Controller Node	Some nodes in the system such as RMS 1, 2, and 3 are dedicated to providing container management. These nodes are responsible for managing all of the containerized workloads that run on the Kubernetes Worker Nodes.
K8s Worker Node	Some nodes in the system such as the blade servers within the enclosure, are dedicated to hosting containerized software and providing the 5G application services.
Container	An encapsulated software service. All 5G applications and Operations, Administration, Maintenance (OAM) functions are delivered as containerized software. The purpose of the OCCNE is to host containerized software providing 5G Network Functions (NFs) and services.
Cluster	A collection of hosts and nodes dedicated to providing a cloud native runtime environment for containerized services and applications. The cluster is comprised of the collection of Master and Worker Nodes and is managed by Kubernetes.
Virtualized CNE	A Virtualized CNE is a cloud native environment that is deployed on VMs instead of Bare Metal servers.

2
Deployment Models

Oracle Communications Cloud Native Core, Cloud Native Environment (CNE) can be installed either on BareMetal servers or virtual machines. For more information about how to install and configure CNE for each deployment model, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*. The following sections explain different CNE deployments.

2.1 BareMetal Deployment

CNE BareMetal deployment is hardware agnostic and can be installed on any servers such as HP Gen 10 and Oracle Netra X8-2. CNE requires the following servers for BareMetal deployments:

- Three Kubernetes controller servers
- Six Kubernetes worker servers. However, CNE supports BareMetal deployment using three worker servers for getting started with CNE.

There are no additional hardware required for installing or booting the Bootstrap Host and the Bastion Hosts since they are created as virtual machines on the Kubernetes controller nodes. For more information on installing and configuring Bootstrap Host and Bastion Hosts, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

CNE allows you to set up your BareMetal cluster using any ToR switch for routing. For more information about configuring the ToR switches, see the "Configuring Top of Rack Switches" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

2.2 Virtualized Deployment

CNE can be installed on OpenStack or VMware virtualized infrastructures. CNE uses Terraform to acquire virtual resources such as virtual machines, networking, security rules, and so on, from the virtual infrastructures. CNE is installed onto these virtual resources. The following virtual machines are required for a virtualized deployment of CNE:

- 1 Bootstrap Host VM (can be uninstalled after installation is complete)
- 2 Bastion Host VMs
- 3 Kubernetes controller VMs
- A minimum of 6 Kubernetes worker VMs

For more information on installing and configuring Bootstrap Host and Bastion Hosts, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

3 CNE Services

CNE provides the following common services for all the installed applications:

- Runtime Environment - CNE provides a runtime environment in which you can run all the cloud native applications.
- Automation - CNE provides automation solutions to deploy, upgrade, and maintain cloud native applications.
- Security - CNE provides multi-level security measures to protect against malicious attacks.
- Redundancy - CNE provides redundancy or high availability through the specification of anti-affinity rules at the infrastructure level.
- Observability - CNE provides services to capture metrics, logs, and traces for both itself (CNE) and the cloud native applications.
- Maintenance Access - CNE provides a Bastion Host to access the Kubernetes cluster for maintenance purposes.

3.1 Runtime Environment

The primary function of CNE is to provide a runtime environment by using Kubernetes for cloud native applications.

> **Note**
>
> CNE 25.2.2xx supports Kubernetes version 1.34.x.

3.1.1 Kubernetes Cluster

The Kubernetes cluster in CNE contains three controller nodes. Kubernetes uses these controller nodes to coordinate the execution of application workloads across many worker nodes.

The Kubernetes cluster manages control node failures as follows:

- Kubernetest sustains the loss of one controller node with no impact to the CNE service.
- Kubernetest tolerates the loss of two controller nodes without losing the cluster configuration data. In a case where two controller nodes are lost, application workload continues to run on the worker node. However, no changes can be made to the cluster configuration data. Due to this, the system experiences the following constrains:
  - New applications cannot be installed.
  - Changes to application-specific custom resources, that are used to change an application's configuration, cannot be performed.
  - Most `kubectl` commands, especially those that require interacting with the control plane, doesn't work. Commands that don't depend on realtime data from the control plane can still work depending on the situation.

It is recommended to have a minimum of six worker nodes for a proper functioning of CNE. The maximum number of worker nodes depend on your requirement. However, CNE allows you to setup a BareMetal deployment with a minimal resources of three worker nodes which is only ideal for testing and getting started with CNE. For more information about installing and upgrading CNE with bare minimum resources, see the "Installing BareMetal CNE using Bare Minimum Servers" and "Upgrading BareMetal CNE Deployed using Bare Minimum Servers" sections respectively in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Kubernetes distributes workloads across all the available worker nodes. The Kubernetes placement algorithm attempts to balance workloads across all available worker nodes, such that no worker node is overloaded. Kubernetes also attempts to honor the affinity or anti-affinity rules specified by applications.

Additional Kubernetes cluster details are as follows:

- Cluster configuration data, as well as application-specific custom resources, are stored in `etcd`.
- Workloads in the Kubernetes cluster are run by the containerd runtime.
- NTP time synchronization is maintained by chrony.

Limited Kubernetes Cluster Nodes for CNLB

For CNLB based deployments of CNE, limited Kubernetes nodes can be used to run CNLB nodes. This allows to create CNE cluster with limited number of CNLB compliant Kubernetes nodes. It is useful when there is a constraint on the number of external IP addresses available (every Kubernetes node in cluster will require Ingress/Egress external addressees if the option is not enabled). This option helps in scenarios where cluster size is larger compared to the number of CNLB replicas.

3.1.2 Networking

In-cluster Networking

CNE includes the Calico plug-in for networking within the Kubernetes cluster. Calico provides network security solutions for containers. Calico is known for its performance, flexibility, and power.

External Networking

You must configure at least one external network to allow the applications that run in CNE to communicate with applications that are outside of the CNE platform.

You can also configure multiple external networks to CNE to allow specific applications to communicate on networks that are dedicated for specific purposes. For more information on configuring external networks, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Support for Floating IPs in OpenStack

Floating IPs are additional public IP addresses that are associated with instances such as control nodes, worker nodes, Bastion Host, and LBVMs. Floating IPs can be quickly re-assigned and switched from one instance to another using an API interface, thereby ensuring high availability and less maintenance. You can activate the Floating IP feature after installing or upgrading CNE. For information about enabling or disabling the Floating IP feature, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

3.1.3 Storage

Bare Metal Deployment Storage

When CNE is deployed on Bare Metal servers, it constructs a Ceph storage cluster from the disk drives attached to the servers designated as Kubernetes worker nodes. The Ceph cluster is then integrated with Kubernetes so that CNE common services and applications that run on CNE can use the Ceph cluster for persistent data storage.

Virtual Deployment Storage

When CNE is deployed on a virtual infrastructure, it delivers a *cloud provider* that corresponds to the Kubernetes cloud provider interface. For more information, see cloud provider interface. The cloud provider interacts with the Kubernetes cluster and the storage manager to provide storage when the applications request it. For example, OpenStack supports *Cinder* storage manager and VMware supports *vSphere* storage manager.

After Kubernetes has access to persistent storage, CNE then creates several Kubernetes `StorageClass` classes for the common services and applications to use.

- CNE creates a storage class named `Standard`, which allows applications to store application-specific data. `Standard` is the default storage class and is used when the applications create a Persistent Volume Claim (PVC) with no StorageClass reference.
- CNE creates one storage class to allow Prometheus to store metrics data.
- CNE creates two storage classes to allow OpenSearch to store log and trace data.

3.1.4 Traffic Segregation

CNE provides the following options to segregate ingress and egress traffic:

- Load Balancer Virtual Machine (LBVM)
- Cloud Native Load Balancer (CNLB)

You can choose either of the options to configure and segregate network traffic during the installation. By default, CNE uses LBVM for ingress and egress traffic segregation. If you want to use CNLB for traffic segregation, then you must perform the CNLB-specific predeployment configurations while installing CNE. For more information about CNLB-specific configurations, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Traffic Segregation Using Load Balancer Virtual Machine (LBVM)

When this option is selected, CNE uses Load Balancer Virtual Machines (LBVM) to segregate ingress and egress traffic.
Ingress Traffic Distribution:
Each application must create a Kubernetes Service of the type **LoadBalancer** to allow the clients from an external network to connect with the applications within the CNE. Each **LoadBalancer** service is assigned to a service IP from an external network. CNE provides load balancers to ensure that ingress traffic from external clients is distributed evenly across Kubernetes worker nodes that host the application pods.

For BareMetal deployments, the top of rack (ToR) switches perform the load balancing function. For virtualized deployments, dedicated virtual machines perform the load balancing function.

For more information on selecting an external network for an NF application, see the installation instructions in *NF-Specific Installation, Upgrade, and Fault Recovery Guide*.

> **Note**
>
> CNE does not support **NodePort** services because they are considered insecure in a production environment.

Support for externalTrafficPolicy: CNE supports `externalTrafficPolicy` to control the traffic distribution. This feature can be configured with two options:

- `externalTrafficPolicy=Local`: When this attribute is set to `Local`, the Kubernetes service routes traffic only to the nodes where the endpoint pods are running. For example, if a pod for the service is running on Node A, the external traffic will be sent to Node A. This setting is useful when you want to keep traffic local to the nodes running the service pods, potentially optimizing the traffic for reduced latency or specific node-level configurations.
- `externalTrafficPolicy=Cluster` (default value): When this attribute is set to `Cluster`, external traffic is not restricted to the nodes running the service's pods. The traffic can be directed to any node in the Kubernetes cluster and then it is internally forwarded to the node where the pod is running.

This feature does not impact the original functionality. To use this feature, Network Functions (NFs) must deploy their services with the `externalTrafficPolicy` set to `Local`, and update their Helm charts and manifest file to include this attribute.

Egress Traffic Delivery:
CNE uses the Load Balancers used for ingress traffic distribution to deliver egress requests to servers outside the CNE cluster. CNE Load Balancers also perform Egress Network Address Translation (NAT) on the egress requests to ensure that the source IP field of all egress requests contains an IP address that belongs to the external network to which the egress request is delivered. This is done to ensure that the egress requests are not rejected by security rules on the external networks.

For more information on selecting an external network for an NF application, see the installation instructions in *NF-Specific Installation, Upgrade, and Fault Recovery Guide*.

Traffic Segregation Using Cloud Native Load Balancer (CNLB)

When this option is selected, CNE uses Cloud Native Load Balancer (CNLB) for managing ingress and egress network. CNLB is as an alternate to the existing LBVM, lb-controller, and egress-controller solutions. You can enable or disable this feature only at the time of a fresh CNE installation. To use CNLB, you must preconfigure the ingress and egress network details in the `cnlb.ini` file before installing CNE. For more information about enabling and configuring CNLB, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

3.1.5 DNS Query Services

CoreDNS is used to resolve Domain Name System (DNS) queries for services within the Kubernetes cluster. DNS queries for services outside the Kubernetes cluster are routed to DNS nameservers running on the Bastion Hosts, which in turn use customer-specified DNS servers outside the CNE to resolve these DNS queries.

3.1.5.1 Local DNS

Local DNS feature is a reconfiguration of core DNS (CoreDNS) to support external hostname resolution. Local DNS allows the pods and services running inside the CNE cluster to connect with the ones running outside the CNE cluster using core DNS. That is, when Local DNS is enabled, CNE routes the connection to external hosts through core DNS rather than the nameservers on the Bastion Hosts. For information about activating this feature, see Activating Local DNS.

Local DNS provides Local DNS API, that runs on each Bastion server, to define the external hostnames as custom records. These records are used to identify and locate hosts, services, or NFs outside the CNE cluster. Local DNS supports adding and removing the following records:

- A Records: allows to define the hostname and the IP address to locate the service
- SRV Records: allows to define the location (hostname and port number) of a specific service and how your domain handles the service

For information about adding and removing these records, see Adding and Removing DNS Records.

For additional details about this feature, see Activating and Configuring Local DNS.

3.2 Automation

CNE provides considerable automation throughout the phases of an application's deployment, upgrade, and maintenance cycles.

3.2.1 Deployment

CNE provides the ***Helm*** application to automate the deployment of applications into the Kubernetes cluster. The applications must provide a ***Helm chart*** to perform automated deployment. For more information about deploying an application in CNE, see Maintenance Procedures section.

You can deploy CNE automatically through custom scripts provided with the CNE platform. For more information about installing CNE, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

3.2.2 Upgrade

CNE provides ***Helm*** to automate the upgrade of applications in the Kubernetes cluster. The applications must provide a ***Helm chart*** to perform an automated software upgrade. For more information about an application upgrade in CNE, see Maintenance Procedures section.

You can upgrade the CNE platform automatically through the execution of a Continuous Delivery (CD) pipeline. For more information on CNE upgrade instructions, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

3.2.3 Maintenance

CNE provides a combination of automated and manual procedures for performing maintenance operations on the Kubernetes cluster and common services. For more instructions about performing maintenance operations, see Maintenance Procedures section.

3.3 Security

CNE provides multilevel security measures to protect against malicious attacks.

- All Kubernetes nodes and Bastion Hosts are security-hardened to prevent unauthorized access.
- Maintenance operations on the Kubernetes cluster can only be performed from the Bastion Hosts to prevent Denial of Service (DOS) attacks against the Kubernetes cluster.
- Kubernetes control plane and Kubernetes worker nodes communicate over secure communication channels to protect sensitive cluster data.
- Kyverno policy framework is deployed in CNE with base line policies. This ensures that the containers and resources running in CNE are compliant.
- Kyverno pod security policies ensure that malicious applications don't corrupt the Kubernetes controller, worker nodes, and cluster data. Kyverno provides the set of policies equivalent to those provided by the built-in Kubernetes PSP as Kubernetes PSP is deprecated.
- Bastion Host container registry is secured with TLS and can be accessed from CNE only.
- CNE supports both TLS 1.2 and TLS 1.3 for establishing secure connections. Currently, the minimum supported TLS version for CNE internal and external communication is TLSv12. However, in the upcoming releases, CNE will support only TLSv13 for security and governance compliance.
- Kubernetes secrets are encrypted before they are stored using secretbox. This ensures that the Kubernetes secrets are secure and accessible to authorized users only.

For more information on security hardening, see *Oracle Communications Cloud Native Core, Security Guide*.

3.4 Redundancy

This section provides detail about maintaining redundancy in Kubernetes, ingress load balancing, common services, and Bastion Host.

Infrastructure

In virtualized infrastructures, CNE requires the specification of antiaffinity rules to distribute Kubernetes controller and worker nodes across several physical servers. In Bare Metal infrastructures, each Kubernetes controller and worker node are placed on its own physical server.

Kubernetes

For the Kubernetes cluster, CNE runs three controller nodes with an etcd node on each controller node.

The etcd node allows the cluster to:

- sustain the loss of one controller node with no impact on the service.
- sustain the loss of two controller nodes without losing the cluster data in the etcd database. However, in cases where two controller nodes are lost, Kubernetes is placed in *read-only* mode. In the *read-only* mode, the creation of new pods and the deployment of new services are not possible.

- restore etcd data from the backup when all the three controller nodes fail. When all the three controller nodes fail, all the cluster data in etcd is lost, and it is essential to restore data from the backup to run the operations.

CNE uses internal load balancers to distribute API requests from applications running in worker nodes evenly across all controller nodes.

Common Services

- OpenSearch uses three master nodes, three ingress nodes, and five data nodes by default. The number of data nodes provisioned can be configured as per the requirement. For more details, see the "Common Installation Configuration" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*. The system can withstand failure of one node in each of these groups with no impact on the service.
- Fluentd OpenSearch runs as a `DaemonSet`, where one Fluentd OpenSearch pod runs on each Kubernetes worker node. When the worker node is up and running, Fluentd OpenSearch sends the logs for that node to OpenSearch.
- Two Prometheus instances are run simultaneously to provide redundancy. Each Prometheus instance independently collects and stores metrics from all CNE services and all applications running in the CNE Kubernetes cluster. Automatic deduplication removes the repetitive metric information in Prometheus.

> **Note**
>
> The `occne-logstash` indices which used to collect occne-infra logs is disabled from 23.1.x release onwards. By default, CNE supports the following indices:
>
> - `logstash`: consists of 12 primary shards and 1 replica, and rotates daily
> - `jaeger-span`: consists of 5 primary shards and 1 replica, and rotates daily
> - `jaeger-service`: consists of 5 primary shards and 1 replica, and rotates daily

Kubernetes distributes common service pods across Kubernetes worker nodes such that even the loss of one worker node has no impact on the service. Kubernetes automatically reschedules the failed pods to maintain redundancy.

Ingress and Egress Traffic Delivery

- For virtual installations, the Load Balancer VMs (LBVM) perform both ingress and egress traffic delivery.
- Two Load Balancer VMs are run for each configured external network in virtual installations. These LB VMs run in an active or standby configuration. Only one LB VM (the active LB VM) processes the ingress traffic for a given external network.
- The active LB VM is continuously monitored. If the active LB VM fails, the standby LB VM is automatically promoted to be the active LB VM.
- If the virtual infrastructure is able to recover the failed LB VM, The recovered LB VM automatically becomes the standby LB VM, and load balancing redundancy is restored. If the infrastructure is NOT able to recover the failed LB VM, you must perform the *Restoring a Failed Load Balancer* fault recovery procedure described in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide* to restore load balancing redundancy.

Bastion Hosts

- There are two Bastion Hosts per CNE.
- Bastion Hosts run in an active or standby configuration.
- Bastion Host health is monitored from an application that runs in the Kubernetes cluster, and instructs standby Bastion Host to take over when active Bastion Host fails.
- A DaemonSet running on each Kubernetes worker node ensures that the worker node always retrieves container images and Helm charts from the active Bastion Host.
- Container images, Helm charts, and other files essential to CNE internal operations are synchronized from the active Bastion Host to the standby Bastion Host periodically. This way, when an active Bastion Host fails, the standby appears as an identical replacement upon switchover.

3.5 Observability

CNE provides services to capture metrics, logs, and traces for both itself and the cloud native applications. You can use the observability data for problem detection, troubleshooting, and preventive maintenance. CNE also includes tools to filter, view, and analyze the observability data.

3.5.1 Metrics

Metrics collection

Prometheus collects the application metrics and CNE metrics from the following services:

- The servers (Bare Metal) or VMs (virtualized) that host the Kubernetes cluster. The ***node-exporter*** service collects hardware and Operating system (OS) metrics exposed by the Linux OS.
- The ***kube-state-metrics*** service collects information about the state of all Kubernetes objects. Since Kubernetes uses objects to store information about all nodes, deployments, and pods in the Kubernetes cluster, ***kube-state-metrics*** effectively captures metrics on all aspects of the Kubernetes cluster.
- All of the CNE services generate metrics that Prometheus collects and stores.

Metrics storage

Prometheus stores the application metrics and CNE metrics in an internal time-series database.

Metrics filtering and viewing

Grafana allows you to view and filter metrics from Prometheus. CNE offers some default Grafana dashboards which can be cloned and customized as per your requirement. For more information about these default dashboards, see CNE Grafana Dashboards.

For more information about CNE Metrics, see Metrics.

3.5.2 Alerts

CNE uses ***AlertManager*** to raise alerts. These alerts notify the user when any of its common services are in abnormal conditions. CNE delivers alerts and Simple Network Management

Protocol (SNMP) traps to an external SNMP trap manager. For more information about the detailed CNE definition and description of each alert, see Alerts section.

Applications deployed on CNE can define their alerts to inform the user of problems specific to each application. For instructions about applications loading the alerting rules, see Maintenance Procedures.

3.5.3 Logs

Logs collection

Fluentd OpenSearch collects logs for applications installed in CNE and CNE services logs.

Logs storage

CNE stores its logs in Oracle OpenSearch. Each log message is written to an OpenSearch index. The source of the log message determines which index the record is written to is as follows:

- If the applications in the CNE generates the logs, these logs are stored in the current day's application index named *logstash-YYYY.MM.DD*.
- If the CNE services generate the logs, these logs are stored in the current day's CNE index named *occne-logstash-YYYY.MM.DD*.

CNE creates new log indices each day. Each day's indices are uniquely named by appending the current date to the index name as a suffix. For example, all application logs generated on November 13, 2021, are written to the *logstash-2021.11.13* index. By default, indices are retained for seven days.

Only current-day indices are writable and they are configured for efficient storage of new log messages. Current-day indices are called "hot" indices and stored on "hot" data nodes. At the end of each day, new current-day indices are created. At the same time, the previous day's indices are marked as read-only, so no new log messages are written to them, and compressed, to allow for more efficient storage. These previous-day indices are considered "warm" indices, and are stored on "warm" data nodes.

Log filtering and viewing

Oracle OpenSearch Dashboard filters and views logs that are available in OpenSearch.

3.5.4 Traces

Trace collection

Jaeger collects traces from applications deployed in CNE.

> **Note**
>
> Jaeger captures only a small percentage of all application message flows. The default capture rate is .01% (1 in 10,000 message flows).

Traces are not collected from CNE services.

Trace storage

CNE stores its traces in Oracle OpenSearch. The applications deployed in CNE generate traces and stores them in the *jaeger-trace-YYYY.MM.DD* index. CNE creates a new Jaeger index each day. For example, all traces generated by applications on November 13, 2021, are written to the *jaeger-trace-2021.11.13* index.

Trace filtering and viewing

Oracle OpenSearch Dashboard filters and views the traces that are available in Oracle OpenSearch.

3.6 Maintenance Access

To access the Kubernetes cluster for maintenance purposes, CNE provides 2 Bastion Hosts. Each Bastion Host provides command-line access to several troubleshooting and maintenance tools such as kubectl, Helm, and Jenkins.

3.7 Frequently Used Common Services

This section provides some of the frequently used common services and their version supported by CNE 25.2.2xx. You can find the complete list of third-party services in the dependencies TGZ file provided as part of the software delivery package.

Table 3-1 Frequently Used Common Services

Common Service	Supported Version	Usage
AlertManager	0.28.0	Alertmanager is a component that works in conjunction with Prometheus to manage and dispatch alerts. It handles the routing and notification of alerts to various receivers.
Grafana	7.5.17 (OCI Grafana)	Grafana is a popular open-source platform for monitoring and observability. It provides a user-friendly interface for creating and viewing dashboards based on various data sources.
Prometheus	3.6.0	Prometheus is a popular open-source monitoring and alerting toolkit. It collects and stores metrics from various sources and allows for alerting and querying.
Calico	3.30.3	Calico provides networking and security for NFs in Kubernetes with scalable, policy-driven connectivity.
cert-manager	1.12.4	cert-manager automates certificate management for secure NFs in Kubernetes.
Containerd	2.1.4	Containerd manages container lifecycles for running NFs efficiently in Kubernetes.

Table 3-1 (Cont.) Frequently Used Common Services

Common Service	Supported Version	Usage
Fluentd - OpenSearch	1.17.1	Fluentd is an open-source data collector that streamlines data collection and consumption, allowing for improved data utilization and comprehension.
Helm	3.19.1	Helm, a package manager, simplifies deploying and managing network functions (NFs) on Kubernetes with reusable, versioned charts for easy automation and scaling.
Istio	1.24.0	Istio extends Kubernetes to establish a programmable, application-aware network. Istio brings standard, universal traffic management, telemetry, and security to complex deployments.
Jaeger	1.72.0	Jaeger provides distributed tracing for 5G NFs, enabling performance monitoring and troubleshooting across microservices.
Kubernetes	1.34.2	Kubernetes orchestrates scalable, automated network function (NF) deployments for high availability and efficient resource utilization.
Kyverno	1.15.0	Kyverno is a Kubernetes policy engine that helps manage and enforce policies for resource configurations within a Kubernetes cluster.
MetalLB	0.15.2	MetalLB provides load balancing and external IP management for 5G NFs in Kubernetes environments.
Oracle OpenSearch	2.19.1	OpenSearch provides scalable search and analytics for 5G NFs, enabling efficient data exploration and visualization.
Oracle OpenSearch Dashboard	2.19.1	OpenSearch Dashboard visualizes and analyzes data for 5G NFs, offering interactive insights and custom reporting.
Prometheus Operator	0.85.0	The Prometheus Operator is used for managing Prometheus monitoring systems in Kubernetes. Prometheus Operator, simplifies the configuration and management of Prometheus instances.
Velero	1.16.2	Velero backs up and restores Kubernetes clusters for 5G NFs, ensuring data protection and disaster recovery.
metrics-server	0.7.2	Metrics Server is used in Kubernetes for collecting resource usage data from pods and nodes.
snmp-notifier	2.0.0	snmp-notifier sends SNMP alerts for 5G NFs, providing real-time notifications for network events.

4 Resource Utilization

CNE constrains resources such as CPU and RAM to each common service. Resource constraints help to ensure that the services don't consume excess resources.

During initial CNE deployment, each service is provided an initial CPU and RAM allocation. Each service is allowed to consume each resource (CPU and RAM) to a specified upper limit while it continues to run.

For services where the resource consumption limit remains the same as the initial allocation or in a case where increasing the CPU or RAM limits underneath a running application can cause service disruption, the initial allocation limit and the upper limit are set to the same value. The resource requests and limits are provided in the following table:

> **Note**
>
> Observability tools such as Prometheus,OpenSearch, Fleuntd, and Jaeger perform resource intensive operations. Even a small change of events can increase the resource consumption exponentially. For example:
>
> - Changing the log severity level from `WARN` to `INFO` increases the CPU and memory usage dramatically.
> - Adding new metric labels or enabling new monitors have big impact on the performance of metric ingestion and can cause resource starvation.
> - Adding more traces to Jaeger spikes the ingestion rate in OpenSearch and causes the data nodes to starve.
>
> Therefore, for observability tools, the limits provided in the following table must not be considered as production ready values as they vary greatly depending on the workload on CNE. It is strongly recommended to consult with the workload teams to get indicators for observability resource allocation.

Table 4-1 CPU and RAM Resource Requests and Limits

Service	CPU Initial Request (m)	CPU Limit (m)	RAM Initial Request (Mi)	RAM Limit (Mi)	Instances
Prometheus	2000	4000	16384	16384	2
Prometheus Node Exporter	800	800	512	512	1 per node
Prometheus Operator	100	200	100	200	1
Prometheus AlertManager	20	20	64	64	2
Prometheus Kube State Metrics	20	20	32	100	1
Promxy	100	100	512	512	1
OpenSearch Master	1000	1000	100	2048	3
OpenSearch Data	1000	4000	16384	101904 (100Gi)	7
OpenSearch Client	1000	3000	100	32609(32Gi)	3

Table 4-1 (Cont.) CPU and RAM Resource Requests and Limits

Service	CPU Initial Request (m)	CPU Limit (m)	RAM Initial Request (Mi)	RAM Limit (Mi)	Instances
OpenSearch Dashboard	100	100	512	512	1
occne-metrics-server	100	100	200	200	1
occne-alertmanager-snmp-notifier	100	100	128	128	1
Fluentd OpenSearch	100	500	128	12228(12Gi)	1 per worker node
Jaeger Collector	500	1250	512	1024	1
Jaeger query	256	500	128	512	1
MetalLB Controller (for CNLB disabled CNE only)	100	100	100	100	1
MetalLB Speaker (for CNLB disabled CNE only)	100	100	100	100	1 per worker node
LB Controller (vCNE only) (for CNLB disabled CNE only)	10	500	128	1024	1
Egress Controller (for CNLB disabled CNE only)	100	1000	200	500	1 per worker node
Bastion Controller	10	200	128	256	1
Kyverno	100	200	256	512	3
CNLB-App (for CNLB enabled CNE only)	500	4000	1024	1024	4
CNLB-Manager (for CNLB enabled CNE only)	500	4000	1024	1024	1
Multus Thick (for CNLB enabled CNE only)	250	500	256	512	1 per node

The overall common services resource usage varies on each worker node. The common services listed in Table 4-1 are evenly distributed across all worker nodes in the Kubernetes cluster.

5 Metrics

CNE uses Prometheus to collect metrics from CNE services. These metrics are used by the alert rules defined by CNE to detect abnormal conditions. This section provides details about CNE metrics.

5.1 Cloud Native Load Balancer Metrics

CNE provides custom CNLB metrics that can be used to observe the cluster and monitor the cluster health from Prometheus, these metrics can be used in Grafana for interactive monitoring of the cluster.

Egress Network Metrics

Table 5-1 cnlb_egr_outpkt

Field	Details
Description	Total outgoing packets from the egress IP.
Type	Counter
Dimensions	`egress_ip`: `active_pod_ip`:

Table 5-2 cnlb_egr_inpkt

Field	Details
Description	Total incoming packets to the egress IP.
Type	Counter
Dimensions	`egress_ip`: `active_pod_ip`:

Table 5-3 cnlb_egr_inbytes

Field	Details
Description	Total incoming bytes to the egress IP.
Type	Counter
Dimensions	`egress_ip`: `active_pod_ip`:

Table 5-4 cnlb_egr_outbytes

Field	Details
Description	Total outgoing bytes from the egress IP.
Type	Counter

Table 5-4 (Cont.) cnlb_egr_outbytes

Field	Details
Dimensions	`egress_ip`: `active_pod_ip`:

Internal Multus (Interface) Metrics

Table 5-5 cnlb_interface_int_inpkt

Field	Details
Description	Total incoming packets on internal multus master interface.
Type	Counter
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-6 cnlb_interface_int_outpkt

Field	Details
Description	Total outgoing packets from internal multus master interface.
Type	Counter
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-7 cnlb_interface_ext_inpkt

Field	Details
Description	Total incoming packets on external multus master interface.
Type	Counter
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-8 cnlb_interface_ext_outpkt

Field	Details
Description	Total outgoing packets from external multus master interface.
Type	Counter

Table 5-8 (Cont.) cnlb_interface_ext_outpkt

Field	Details
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Service Ingress IPVS & Connection Metrics

Table 5-9 connections_total

Field	Details
Description	Total connection count for backend_ip (active tracked for each backend/service).
Type	Gauge
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-10 cnlb_inbyte

Field	Details
Description	Total incoming bytes from remote to service IP.
Type	Gauge
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-11 cnlb_inpkt

Field	Details
Description	Total incoming packets received from remote to service IP (scrape interval).
Type	Gauge
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-12 cnlb_outbyte

Field	Details
Description	Total outgoing bytes from app pod to remote.
Type	Gauge
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

Table 5-13 cnlb_outpkt

Field	Details
Description	Total outgoing packets sent from app pod to remote.
Type	Gauge
Dimensions	`active_cnlb_pod`: `service_ip`: `backend_ip`: `app_name`:

5.2 CNE Metrics

CNE offers custom metrics that enable more detailed monitoring of node behavior. These metrics are gathered from cluster nodes and provide insights into each vCPU as well as every network interface on each node.

Mpstat Metrics

These metrics are collected by saving the output of the `mpstat` command in a list and processing it as needed. After Prometheus scrapes the gauges, the list is cleared, retaining only the most recent value. Each metric displays data for every vCPU on the selected host.

Table 5-14 cne_metrics_mpstat_idle_average

Field	Details
Description	Captures the *%idle* value every second, stores it on a list and returns the average of it.
Type	Gauge
Dimensions	`host`: `vcpu`:

Table 5-15 cne_metrics_mpstat_idle_low_watermark

Field	Details
Description	Captures the *%idle* value every second and stores it on a list and returns the lowest value.
Type	Gauge

Table 5-15 (Cont.) cne_metrics_mpstat_idle_low_watermark

Field	Details
Dimensions	`host`: `vcpu`:

Table 5-16 cne_metrics_mpstat_isoft_average

Field	Details
Description	Captures the *%soft* value every second, stores it on a list and returns the average of it.
Type	Gauge
Dimensions	`host`: `vcpu`:

Table 5-17 cne_metrics_mpstat_soft_high_watermark

Field	Details
Description	Captures the *%idle* value every second and stores it on a list and returns the highest value.
Type	Gauge
Dimensions	`host`: `vcpu`:

Network Metrics

These metrics are collected by storing the output of the `ip -s -s link ls {interface}` command in a list. The Gauge value is updated using the delta between the most recent entry and the previous one in the list. After Prometheus scrapes the gauges, the list is cleared, keeping only the latest value. Each metric displays data for every network interface on the selected host.

Table 5-18 cne_metrics_network_bytes_sent

Field	Details
Description	Captures the *delta* value for *TX: bytes* sent by each interface every second.
Type	Gauge
Dimensions	`host`: `interface`:

Table 5-19 cne_metrics_network_packets_sent

Field	Details
Description	Captures the *delta* value for *TX: packets* sent by each interface every second.
Type	Gauge

Table 5-19 (Cont.) cne_metrics_network_packets_sent

Field	Details
Dimensions	`host`: `interface`:

Table 5-20 cne_metrics_network_errors_sent

Field	Details
Description	Captures the *delta* value for *TX: errors* sent by each interface every second.
Type	Gauge
Dimensions	`host`: `interface`:

Reference: For more information on how to visualize these metrics on Grafana, see #unique_60.

6 Alerts

Alerts are used to detect abnormal conditions in CNE and notify the user when any of the common services are not operating normally.

Each alert rule uses the values of one or more metrics stored in Prometheus to identify the abnormal conditions. Prometheus periodically evaluates each rule to ensure that CNE is operating normally. When rule evaluation indicates an abnormal condition, Prometheus sends an alert to the AlertManager. The resulting alert contains information about what part of the CNE cluster is affected for troubleshooting. Each alert is assigned with a severity level to inform the user of the seriousness of the alerting condition. This section provides details about CNE alerts.

6.1 Kubernetes Alerts

This section provides details about Kubernetes alerts.

Table 6-1 DISK_SPACE_LOW

Field	Details
Description	Cluster-name : {{ $externalLabels.cluster }} Disk space is almost RUNNING OUT for kubernetes node {{ $labels.kubernetes_node }} for partition {{ $labels.mountpoint }}. Available space is {{$value }}%(< 20% left). Instance = {{ $labels.instance }}
Summary	Cluster-name : {{ $externalLabels.cluster }} Disk space is RUNNING OUT on node {{ $labels.kubernetes_node }} for partition {{ $labels.mountpoint }}
Cause	Disk space is running out on node. More than 80% of the allocated resources is consumed on the node.
Severity	Critical
SNMP Trap ID	1001
Affects Service (Y/N)	N
Recommended Actions	• In case of vCNE, the flavour of the worker nodes can be increased to a larger flavor with more storage. • Additional space can also be reclaimed by running "`podman system prune -fa`" to remove any unreferenced image layers. • Verify how much space is being consumed by `/var/log` partition. If it is consuming a lot of space, logs can be rotated or shrinked to reclaim some space.

Table 6-2 CPU_LOAD_HIGH

Field	Details
Description	CPU load is high on host <*node name*>CPU load {{ $value }} %Instance : {{ $labels.instance }}
Summary	CPU load is high on host {{ $labels.kubernetes_node }}

Table 6-2 (Cont.) CPU_LOAD_HIGH

Field	Details
Cause	CPU load is more than 80% of the allocated resources on the node.
Severity	Major
SNMP Trap ID	1002
Affects Service (Y/N)	N
Recommended Actions	• In case of vCNE, the flavour of the worker nodes can be increased to a larger flavour with more number of VCPUs • Manually evict unnecessary pods from the node with high CPU load to reduce load on the node. • Draining and uncordon node also help in rebalancing CPU load on worker nodes

Table 6-3 LOW_MEMORY

Field	Details
Description	Node {{ $labels.kubernetes_node }} available memory at {{ $value | humanize }} percent.
Summary	Node {{ $labels.kubernetes_node }} running out of memory
Cause	The available memory of a node is consumed more than 80% of the allocated memory.
Severity	Major
SNMP Trap ID	1007
Affects Service (Y/N)	N
Recommended Actions	• In case of vCNE, flavour of the worker nodes can be increased having larger RAM size. • Manually evict unnecessary pods from the node with high memory load to reduce load on the node. • Draining and uncordon node help in rebalancing the CPU load on worker nodes.

Table 6-4 OUT_OF_MEMORY

Field	Details
Description	Node {{ $labels.kubernetes_node }} out of memory
Summary	Node {{ $labels.kubernetes_node }} out of memory
Cause	Node available memory is consumed more than 90% of the allocated memory.
Severity	Critical
SNMP Trap ID	1008
Affects Service (Y/N)	Y
Recommended Actions	• In case of vCNE, flavour of the worker nodes can be increased having larger RAM size. • Manually evict unnecessary pods from the node with high memory load to reduce load on that node.

Table 6-5 NTP_SANITY_CHECK_FAILED

Field	Details
Description	NTP service sanity check failed on node {{ $labels.kubernetes_node }}
Summary	Clock is not synchronized on node {{ $labels.kubernetes_node }}
Cause	Clock is not synchronized on the node.
Severity	Minor
SNMP Trap ID	1009
Affects Service (Y/N)	N
Recommended Actions	Steps to synchronize chronyd on node: 1. log in to the node on which you want to synchronize clock. 2. Run the following command: `sudo su;` 3. Run the following command: `systemctl restart chronyd;` 4. Watch chronyc tracking. 5. Run the following command: `sudo reboot` • If the issue is not resolved, Contact Oracle support.

Table 6-6 NETWORK_INTERFACE_FAILED

Field	Details
Description	Network interface {{ $labels.device }} on node {{ $labels.kubernetes_node }} is unavailable.
Summary	Network interface {{ $labels.device }} on node {{ $labels.kubernetes_node }} is unavailable.
Cause	Network interface is unavailable on the node.
Severity	Critical
SNMP Trap ID	1010
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

Table 6-7 PVC_NEARLY_FULL

Field	Details
Description	Persistent volume claim {{ $labels.persistentvolumeclaim }} has {{ $value }}% of allocated space remaining.
Summary	Persistent volume claim {{ $labels.persistentvolumeclaim }} is nearly full.
Cause	PVC storage is filled to 80% of allocated space.
Severity	Major
SNMP Trap ID	1011
Affects Service (Y/N)	N

Table 6-7 (Cont.) PVC_NEARLY_FULL

Field	Details

Recommended Actions	1. Manually clean up PVC data for Prometheus:
	
	`$ kubectl get pods -o wide`
	`$ kubectl get pvc -n occne-infra`
	`$ Login to the nodes where Prometheus is deployed`
	`$ sudo su; lsblk`
	`$ Above command will give the path of the PVC(fetched in 2nd command), cd into it`
	`$ cd prometheus-db/`
	`$ rm -rf *`
	
	For Oracle OpenSearch:
	
	`$ kubectl get pods -o wide`
	`$ kubectl get pvc -n occne-infra`
	`$ Login to the nodes where Oracle OpenSearch-Data/Master nodes are deployed`
	`$ sudo su; lsblk`
	`$ Above command will give the path of the PVC(fetched in 2nd command), cd into it`
	`$ cd nodes/0`
	`$ rm -rf *`
	
	2. Use the following procedures to increase the size of PVC.
	• For Prometheus, see Changing Metrics Storage Allocation.
	• For Oracle OpenSearch, see Changing Oracle OpenSearch Storage Allocation.

Table 6-8 PVC_FULL

Field	Details
Description	Persistent volume claim {{ $labels.persistentvolumeclaim }} has {{ $value }}% of allocated space remaining.
Summary	Persistent volume claim {{ $labels.persistentvolumeclaim }} is full.
Cause	PVC storage is filled to 90% of the allocated space.
Severity	Critical
SNMP Trap ID	1012
Affects Service (Y/N)	Y
Recommended Actions	NA

Table 6-9 NODE_UNAVAILABLE

Field	Details
Description	Kubernetes node {{ $labels.kubernetes_node }} is not in Ready state.
Summary	Kubernetes node {{ $labels.kubernetes_node }} is unavailable.
Cause	Node is not in ready state.
Severity	Critical
SNMP Trap ID	1013
Affects Service (Y/N)	Y
Recommended Actions	First, check if the given node is in running or shutoff state. If the node is in shutoff state, try restarting it from Openstack or iLo If the node is in running state, then perform the following steps: 1. Log in to the node. 2. Check the kubelet status and try to reboot it.

Table 6-10 ETCD_NODE_DOWN

Field	Details
Description	Etcd is not running or is unavailable.
Summary	Etcd is down.
Cause	Etcd is not running.
Severity	Critical
SNMP Trap ID	1014
Affects Service (Y/N)	Y
Recommended Actions	Refer to the following document to restore the failed etcd: https://kubernetes.io/docs/tasks/administer-cluster/configure-upgrade-etcd/#restoring-an-etcd-cluster

Table 6-11 CEPH_OSD_NEARLY_FULL

Field	Details
Description	Utilization of storage device {{ $labels.ceph_daemon }} has crossed 75% on host {{ $labels.hostname }}.
Summary	OSD storage device is nearly full.
Cause	OSD storage device is 75% full.
Severity	Major
SNMP Trap ID	1036
Affects Service (Y/N)	N
Recommended Actions	Contact Oracle support.

Table 6-12 CEPH_OSD_FULL

Field	Details
Description	Utilization of storage device {{ $labels.ceph_daemon }} has crossed 80% on host {{ $labels.hostname }}.
Summary	OSD storage device is critically full.
Cause	OSD storage device is 80% full.
Severity	Critical
SNMP Trap ID	1037
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

Table 6-13 CEPH_OSD_DOWN

Field	Details
Description	Storage node {{ $labels.ceph_daemon }} is down.
Summary	Storage node {{ $labels.ceph_daemon }} is down.
Cause	Ceph OSD is down.
Severity	Major
SNMP Trap ID	1038
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

Table 6-14 VSPHERE_CSI_CONTROLLER_FAILED

Field	Details
Description	The vSphere CSI controller process failed.
Summary	The vSphere CSI controller process failed.
Cause	`Vsphere_csi_controller` is down.
Severity	Critical
SNMP Trap ID	1042
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

6.2 Common Services Alerts

This section provides details about common services alerts.

Table 6-15 OPENSEARCH_CLUSTER_HEALTH_RED

Field	Details
Description	Cluster Name : {{ $externalLabels.cluster }} All the primary and replica shards are not allocated in Oracle OpenSearch cluster {{ $labels.cluster }} for instance {{ $labels.instance }}
Summary	Cluster Name : {{ $externalLabels.cluster }} Both primary and replica shards are not available.

Table 6-15 (Cont.) OPENSEARCH_CLUSTER_HEALTH_RED

Field	Details
Cause	Some or all of the shards (primary) are not ready.
Severity	Critical
SNMP Trap ID	1043
Affects Service (Y/N)	Y

Recommended Actions	Check the index for which the primary and replica shard is not able to be created and check for the indices that are in yellow or red state. Remove them by using the following procedure:
	1. Run the following command on Bastion Host to check if any indices are in yellow or red state:
	`kubectl -n occne-infra exec -it occne-opensearch-client-0 -- curl localhost:9200/_cat/indices`
	2. Run the following command to delete the indices in yellow or red state:
	`kubectl -n occne-infra exec -it occne-opensearch-client-0 -- curl localhost:9200/_cat/indices | grep 'yellow|red' | awk '{ print $3 }' | xargs -I{} kubectl -n occne-infra exec -it opensearch-client-0 -- curl -XDELETE localhost:9200/{}`
	3. Run the following command to verify if the indices with yellow or red state are deleted:
	`kubectl -n occne-infra exec -it opensearch-client-0 -- curl localhost:9200/_cat/indices`
	4. Restart the OpenSearch cluster in the following sequence: Master → Data → Client.
	If this procedure did not resolve the issue, then clean up all the indexes to restore OpenSearch in GREEN state.

Table 6-16 OPENSEARCH_CLUSTER_HEALTH_YELLOW

Field	Details
Description	Cluster Name : {{ $externalLabels.cluster }} The primary shard has been allocated in {{ $labels.cluster }} for Instance {{ $labels.instance }} but replicas for the shard cloud not be allocated.
Summary	Cluster Name : {{ $externalLabels.cluster }} The primary shard is allocated but replicas are not.

Table 6-16 (Cont.) OPENSEARCH_CLUSTER_HEALTH_YELLOW

Field	Details
Cause	Indicates that OpenSearch has allocated all of the primary shards, but some or all of the replicas have not been allocated. This issue is observed in some cases after a node restart or shutdown.
Severity	Major
SNMP Trap ID	1044
Affects Service (Y/N)	N

Recommended Actions	The yellow alarms are observed often after a shutdown or restart of a node. Most of the times, Oracle OpenSearch recovers on its own. If not, perform the following procedure to remove the replicas from the problematic index whose replica is not able to be allocated.
	
	`PUT /logstash-2021.08.21/_settings`
	`{`
	`"index" : {`
	`"number_of_replicas":0`
	`}`
	`}`

Table 6-17 OPENSEARCH_TOO_FEW_DATA_NODES_RUNNING

Field	Details
Description	Cluster Name : {{ $externalLabels.cluster }} There are only {{$value}} OpenSearch data nodes running in {{ $labels.cluster }} cluster.
Summary	Cluster Name : {{ $externalLabels.cluster }} {{ $labels.cluster }} cluster running on less than total number of data nodes.
Cause	1. Data nodes are either crashed or are in 0/1 state due to insufficient space in PVC. 2. PVC is full.
Severity	Critical
SNMP Trap ID	1045
Affects Service (Y/N)	N
Recommended Actions	• Check the OpenSearch data or master pods' running status • If any of the OpenSearch pods are in the "not ready" state but running, check whether its associated PVC is full or not. • If PVC is not full, then contact Oracle support. • Ensure that the count of the data nodes is equal to 5, the value of the `opensearch_data_replicas_count = 5` variable. When more data nodes are added, the alert must be corrected accordingly.

Table 6-18 PROMETHEUS_NODE_EXPORTER_NOT_RUNNING

Field	Details
Description	Prometheus Node Exporter is NOT running on host {{ $labels.kubernetes_node }}.
Summary	Prometheus Node Exporter is NOT running.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/ CPU, or issues with image used by pod.
Severity	Critical
SNMP Trap ID	1006
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the issue then Increase the Resources by editing the Node-Exporter Daemonset and search for resources section in it and increase the CPU or RAM accordingly. `$ kubectl edit ds occne-kube-prom-stack-prometheus-node-exporter -n occne-infra` 2. If Resource utilization is not the issue, then Contact Oracle support.

Table 6-19 FLUENTD_OPENSEARCH_NOT_AVAILABLE

Field	Details
Description	Fluentd-OpenSearch is not running or is otherwise unavailable.
Summary	Fluentd-OpenSearch is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/ CPU, or issues with image used by pod.
Severity	Critical
SNMP Trap ID	1050
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the Fluentd-OpenSearch daemonset and search for resources section in it and increase the CPU or RAM accordingly. `$ kubectl edit ds occne-fluentd-opensearch -n occne-infra` 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-20 OPENSEARCH_DOWN

Field	Details
Description	OpenSearch is not running or is otherwise unavailable.
Summary	OpenSearch is down.
Cause	1. Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff"state due to insufficient memory or CPU, or issues with image used by pod. 2. OpenSearch cluster is unavailable.
Severity	Critical
SNMP Trap ID	1047
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the "occne-opensearch-cluster" statefulset. Search for resources section in the statefulset and increase the CPU or RAM accordingly. 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-21 OPENSEARCH_DASHBOARD_DOWN

Field	Details
Description	OpenSearch dashboard is not running or is otherwise unavailable.
Summary	OpenSearch dashboard is down.
Cause	1. Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with image used by pod. 2. Opensearch dashborad is unavailable.
Severity	Major
SNMP Trap ID	1049
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

Table 6-22 PROMETHEUS_DOWN

Field	Details
Description	All Prometheus instances are down. No metrics will be collected until at least one Prometheus instance is restored.
Summary	Metrics collection is down.

Table 6-22 (Cont.) PROMETHEUS_DOWN

Field	Details
Cause	1. Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with image used by pod. 2. PVC is full.
Severity	Critical
SNMP Trap ID	1017
Affects Service (Y/N)	Y

Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the Prometheus CRD. Search for resources section in the CRD and increase the CPU/RAM accordingly.
	`kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n occne-infra`
	2. If resource utilization is not the issue, then contact Oracle support.
	3. Increase the PVC Size by referring to the Changing Metrics Storage Allocation section.
	4. Run the following commands to manually clean up the PVC data:
	`$ kubectl get pods -o wide`
	`$ kubectl get pvc -n occne-infra`
	`$ Login to the nodes where Prometheus is deployed`
	`$ sudo su; lsblk`
	`$ Above command will give the path of the PVC(fetched in 2nd command), cd into it`
	`$ cd prometheus-db/`
	`$ rm -rf *`

Table 6-23 ALERT_MANAGER_DOWN

Field	Details
Description	All alert manager instances are down. No alerts will be received until at least one alert manager instance is restored.
Summary	Alert notification is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff"state due to insufficient memory/CPU, or issues with image used by pod.
Severity	Critical
SNMP Trap ID	1018
Affects Service (Y/N)	Y

Table 6-23 (Cont.) ALERT_MANAGER_DOWN

Field	Details
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the Alertmanager CRD. Search for resources section in the Alertmanager CRD and increase the CPU or RAM accordingly. `kubectl edit alertmanager occne-kube-prom-stack-kube-alertmanager -n occne-infra` 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-24 SNMP_NOTIFIER_DOWN

Field	Details
Description	SNMP Notifier is not running or is unavailable.
Summary	SNMP Notifier is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff"state due to insufficient memory/ CPU, or issues with image used by pod.
Severity	Critical
SNMP Trap ID	1019
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the "occne-snmp-notifier" deployment. Search for the resources section in the deployment and increase the CPU or RAM accordingly. 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-25 JAEGER_DOWN

Field	Details
Description	Jaeger collector is not running or is unavailable.
Summary	Jaeger is down.
Cause	1. Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with image used by pod. 2. OpenSerach is not available.
Severity	Critical
SNMP Trap ID	1020
Affects Service (Y/N)	N

Table 6-25 (Cont.) JAEGER_DOWN

Field	Details
Recommended Actions	1. If resource utilization is the issue then Increase the Resources by editing the "occne-tracer-jaeger-collector" Deployment and search for resources section in it and increase the CPU or RAM accordingly. 2. If resource utilization is not the issue, then contact Oracle support. 3. Bring OpenSearch cluster back into healthy state by following the resolution mentioned in the OPENSEARCH_CLUSTER_HEALTH_RED alert. All Master, Client and Data pods must be up and running.

Table 6-26 METALLB_SPEAKER_DOWN

Field	Details
Description	The MetalLB speaker on worker node {{ $labels.instance }} is down.
Summary	A MetalLB speaker is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/ CPU, or issues with image used by pod.
Severity	Major
SNMP Trap ID	1021
Affects Service (Y/N)	N
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the Metallb-speaker daemonset. Search for resources section in the daemonset and increase the CPU or RAM accordingly. `$ kubectl edit ds occne-metallb-speaker -n occne-infra` 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-27 METALLB_CONTROLLER_DOWN

Field	Details
Description	The MetalLB controller is not running or is unavailable.
Summary	The MetalLB controller is down.
Cause	1. Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory or CPU, or issues with the image used by the pod.
Severity	Critical
SNMP Trap ID	1022

Table 6-27 (Cont.) METALLB_CONTROLLER_DOWN

Field	Details
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the "occne-metallb-controller" deployment. Search for the resources section in the deployment and increase the CPU or RAM accordingly. 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-28 GRAFANA_DOWN

Field	Details
Description	Grafana is not running or is unavailable.
Summary	Grafana is down.
Cause	1. Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with image used by pod. 2. Prometheus is not available.
Severity	Major
SNMP Trap ID	1024
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the "occne-kube-prom-stack-grafana" deployment. Search for the resources section in the deployment and increase the CPU or RAM accordingly. 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-29 LOAD_BALANCER_NO_HA

Field	Details
Description	A single load balancer serving the {{ $labels.external_network }} network has failed. Load balancing will continue to operate in simplex mode.
Summary	A load balancer for the {{ $labels.external_network }} network is down.
Cause	One of the LBVM is down.
Severity	Major
SNMP Trap ID	1025
Affects Service (Y/N)	N

Table 6-29 (Cont.) LOAD_BALANCER_NO_HA

Field	Details
Recommended Actions	Replace the failed LBVM. For the procedure to replace a failed LBVM, See the "Restoring a Failed Load Balancer" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Table 6-30 LOAD_BALANCER_NO_SERVICE

Field	Details
Description	All Load Balancers serving the {{ $labels.external_network }} network have failed. External access for all services on this network is unavailable.
Summary	Load balancing for the {{ $labels.external_network }} network is unavailable.
Cause	Both LBVMs are down as a result, the external network is down.
Severity	Critical
SNMP Trap ID	1026
Affects Service (Y/N)	Y
Recommended Actions	Replace one LBVM, wait for lb_monitor to convert it from STANDBY to ACTIVE state (run lb_monitor.py manually if needed) and then replace another LBVM. For the procedure to replace a failed LBVM, See the "Restoring a Failed Load Balancer" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Table 6-31 LOAD_BALANCER_FAILED

Field	Details
Description	Load balancer {{ $labels.name }} at IP {{ $labels.ip_address }} on the {{ $labels.external_network }} network has failed. Perform Load Balancer recovery procedure to restore.
Summary	A load balancer failed.
Cause	One of the LBVMs or both the LBVMs are down.
Severity	Major
SNMP Trap ID	1027
Affects Service (Y/N)	Y

Table 6-31 (Cont.) LOAD_BALANCER_FAILED

Field	Details
Recommended Actions	Although this alert is not always service affecting, the Load Balancer must be restored to restore high availability for load balancing. Replace one of the LBVMs or both the LBVMs. For the procedure to replace a failed LBVM, See the "Restoring a Failed Load Balancer" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Table 6-32 PROMETHEUS_NO_HA

Field	Details
Description	A Prometheus instance has failed. Metrics collection will continue to operate in simplex mode.
Summary	A Prometheus instance is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/ CPU, or issues with image used by pod.
Severity	Major
SNMP Trap ID	1028
Affects Service (Y/N)	N

Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the Prometheus CRD. Search for the resources section the Prometheus CRD and increase the CPU or RAM accordingly.
	`kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n occne-infra`
	2. If resource utilization is not the issue then contact Oracle support.
	3. Increase PVC size by referring to the Changing Metrics Storage Allocation section.
	4. Manually clean-up PVC data:
	`$ kubectl get pods -o wide`
	`$ kubectl get pvc -n occne-infra`
	`$ Login to the nodes where Prometheus is deployed`
	`$ sudo su; lsblk`
	`$ Above command will give the path of the PVC(fetched in 2nd command), cd into it`
	`$ cd prometheus-db/`
	`$ rm -rf *`

Table 6-33 ALERT_MANAGER_NO_HA

Field	Details
Description	An AlertManager instance has failed. Alert management will continue to operate in simplex mode.
Summary	An AlertManager instance is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU ir issues with the image used by pod.
Severity	Major
SNMP Trap ID	1029
Affects Service (Y/N)	N
Recommended Actions	1. If resource utilization is the issue, then increase the resources by editing the Alertmanager CRD. Search for the resources section in the Alertmanager CRD and increase the CPU or RAM accordingly. `kubectl edit alertmanager occne-kube-prom-stack-kube-alertmanager -n occne-infra` 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-34 PROMXY_METRICS_AGGREGATOR_DOWN

Field	Details
Description	Promxy failed. Metrics will be retrieved from a single Prometheus instance only.
Summary	Promxy is down.
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with image used by pod.
Severity	Major
SNMP Trap ID	1032
Affects Service (Y/N)	Y
Recommended Actions	As metrics are retrieved from a single Prometheus instance, there may be gaps in the retrieved data. Promxy must be restarted to restore the full data retrieval capabilities. 1. If resource utilization is the issue, then increase the resources by editing the "occne-promxy" deployment. Search for the resources section in the deployment and increase the CPU or RAM accordingly. 2. If resource utilization is not the issue, then contact Oracle support.

Table 6-35 VCNE_LB_CONTROLLER_FAILED

Field	Details
Description	The vCNE LB Controller process failed.
Summary	The vCNE LB Controller process failed.
Cause	Pod is repeatedly crashing and is in the "CrashLoopBackOff", 0/1, or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with the image used by the pod.
Severity	Major
SNMP Trap ID	1039
Affects Service (Y/N)	Y
Recommended Actions	1. If resource utilization is the cause, then increase the resource by editing the "occne-lb-controller-server" deployment. Search for the resources section in the deployment and increase the CPU or RAM accordingly. 2. If resource utilization is not the cause, then contact Oracle support.

Table 6-36 VMWARE_CSI_CONTROLLER_FAILED

Field	Details
Description	The VmWare CSI Controller process failed.
Summary	The VmWare CSI Controller process failed.
Cause	The CSI Controller process failed. **Note:** This alert is raised only when CNE is installed on a VMware infrastructure.
Severity	Critical
SNMP Trap ID	1042
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

Table 6-37 EGRESS_CONTROLLER_NOT_AVAILABLE

Field	Details
Description	Egress controller is not running or is unavailable.
Summary	Egress controller is down
Cause	Pod is repeatedly crashing and is in "CrashLoopBackOff" or 0/1 or "ImagePullBackOff" state due to insufficient memory/CPU, or issues with image used by pod.
Severity	Critical
SNMP Trap ID	1048
Affects Service (Y/N)	Y

Table 6-37 (Cont.) EGRESS_CONTROLLER_NOT_AVAILABLE

Field	Details
Recommended Actions	1. If resource utilization is the cause, then increase the resource by editing the "occne-egress-controller" daemonset. Search for the resources section in the daemonset and increase the CPU or RAM accordingly. 2. If resource utilization is not the cause, then contact Oracle support.

Table 6-38 OPENSEARCH_DATA_PVC_NEARLY_FULL

Field	Details
Description	OpenSearch Data Volume {{ $persistentvolumeclaim }} has {{ $value }}% of allocated space remaining. Once full, this will cause OpenSearch cluster to start throwing index_block_exceptions, either increase Opensearch data PVC or remove unnecessary indices.
Summary	OpenSearch Data Volume is nearly full.
Cause	OpenSearch data PVCs are nearly full.
Severity	Major
SNMP Trap ID	1051
Affects Service (Y/N)	Y
Recommended Actions	Perform one of the following recommendations: • Increase the PVC size of OpenSearch cluster data for which the alert is raised. • Delete the old indices from OpenSearch Dashboards > dev tools > DELETE <index_name_to_be_deleted>.

6.3 Bastion Host Alerts

This section provides details about Bastion Host alerts.

Table 6-39 BASTION_HOST_FAILED

Field	Details
Description	Bastion Host {{ $labels.name }} at IP address {{ $labels.ip_address }} is unavailable.
Summary	Bastion Host {{ $labels.name }} is unavailable.
Cause	One of the Bastion Hosts failed to respond to liveness tests.
Severity	Major
SNMP Trap ID	1040
Affects Service (Y/N)	N
Recommended Actions	Contact Oracle support.

Table 6-40 ALL_BASTION_HOSTS_FAILED

Field	Details
Description	All Bastion Hosts are unavailable.
Summary	All Bastion Hosts are unavailable.
Cause	All Bastion Hosts fail to respond to liveness tests.
Severity	Critical
SNMP Trap ID	1041
Affects Service (Y/N)	Y
Recommended Actions	Contact Oracle support.

7
Maintenance Procedures

This chapter provides detailed instructions about how to maintain the CNE platform.

7.1 Accessing the CNE

This section describes the procedures to access an CNE for maintenance purposes.

7.1.1 Accessing the Bastion Host

This section provides information about how to access a CNE Bastion Host.

Prerequisites

- SSH private key must be available on the server or VM that is used to access the Bastion Host.
- The SSH private keys generated or provided during the installation must match the authorized key (public) present in the Bastion Hosts. For more information about the keys, see the installation prerequisites in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Procedure

All commands must be run from a server or VM that has network access to the CNE Bastion Hosts. To access the Bastion Host, perform the following tasks.

7.1.1.1 Logging in to the Bastion Host

This section describes the procedure to log in to the Bastion Host.

1. Determine the Bastion Host IP address.
   Contact your system administrator to obtain the IP addresses of the CNE Bastion Hosts. The system administrator can obtain the IP addresses from the OpenStack Dashboard, VMware Cloud Director, or by other means such as from the BareMetal Hosts.
2. To log in to the Bastion Host, run the following command:

   > **Note**
   >
   > The default value for `<user_name>` is `cloud-user` (for vCNE) or `admusr` (for Baremetal).

   ```
   $ ssh -i /<ssh_key_dir>/<ssh_key_name>.key
   <user_name>@<bastion_host_ip_address>
   ```

7.1.1.2 Copying Files to the Bastion Host

This section describes the procedure to copy the files to the Bastion Host.

1. Determine the Bastion Host IP address.
   Contact your system administrator to obtain the IP addresses of the CNE Bastion Hosts. The system administrator can obtain the IP addresses from the Openstack Dashboard, VMware Cloud Director, or by other means such as from the BareMetal Hosts.
2. To copy files to the Bastion Host, run the following command:

   ```
   $ scp -i /<ssh_key_dir>/<ssh_key_name>.key <source_file>
   <user_name>@<bastion_host_ip_address>:/<path>/<dest_file>
   ```

7.1.1.3 Managing Bastion Host

The Bastion Host comes with the following built-in scripts to manage the Bastion Hosts:

- is_active_bastion
- get_active_bastion
- get_other_bastions
- update_active_bastion.sh

These scripts are used to get details about Bastion Hosts, such as checking if the current Bastion Host is the active one and getting the list of other Bastions. This section provides the procedures to manage Bastion Hosts using these scripts.

These scripts are located in the `/var/occne/cluster/$OCCNE_CLUSTER/artifacts/` directory. You don't have to change the directory to run these scripts. You can run these scripts from anywhere within a Bastion Host like a system command as the directory containing the scripts is a part of `$PATH`.

All the scripts interact with the bastion-controller pod and its database directly by querying it or updating it through Kubectl. The commands fails to run in the following conditions:

- If the lb-controller pod is not running.
- If the kubectl admin configuration is not set properly.

For more information about the possible errors and troubleshooting, seeTroubleshooting Bastion Host.

7.1.1.3.1 Verifying if the Current Bastion Host is the Active One

This section describes the procedure to verify if the current Bastion Host is the active one using the `is_active_bastion` script.

- Run the following command to check if the current Bastion Host is the active Bastion Host:

  ```
  $ is_active_bastion
  ```

  On running the command, the system runs the `is_active_bastion` script to compare the current Bastion IP against the active Bastion IP retrieved from the database of the bastion-

controller pod. If the IP stored at the bastion-controller database is equal to the IP of the Bastion where the script is run from, then the system displays the following response:

```
IS active-bastion
```

If the IP addresses don't match, the system displays the following response indicating, the current Bastion Host is not the active one:

```
NOT active-bastion
```

7.1.1.3.2 Getting the Host IP or Hostname of the Current Bastion Host

This section provides details about getting the Host IP or Hostname of the current Bastion Host using the `get_active_bastion` script.

- Run the following command to get the Host IP of the current Bastion Host:

  ```
  $ get_active_bastion
  ```

  On running the command, the system runs the `get_active_bastion` script to get the IP address of the Bastion from the `bastion-controller` DB:

  Sample output:

  ```
  192.168.200.10
  ```

- Run the following command to get the Hostname of the current Bastion Host.

  ```
  $ DBFIELD=name get_active_bastion
  ```

  The `DBFIELD=name` parameter in the command is the additional parameter that is passed to get the Hostname from the `bastion-controller` DB.

  Sample output:

  ```
  occne1-rainbow-bastion-1
  ```

7.1.1.3.3 Getting the List of Other Bastion Hosts

This section provides details about getting the list of other Bastion Hosts in the cluster using the `get_other_bastions` script.

- Run the following command to get the Hostnames of other Bastion Hosts in the cluster:

  ```
  $ get_other_bastions
  ```

  Sample output:

  ```
  occne1-rainbow-bastion-2
  ```

- Run the following command to get the Host IPs of the other Bastion Hosts in the cluster.

  ```
  $ DBFIELD=ipaddr get_other_bastions
  ```

  The `DBFIELD=ipaddr` parameter in the command is the additional parameter to get the Host IPs from the `bastion-controller` DB.

  Sample output:

  ```
  192.168.200.11
  ```

- You can provide additional parameters to filter the list of other Bastion Hosts in the cluster.

  For example, you can use the `CRITERIA="state == 'HEALTHY'"` or `CRITERIA="state != 'FAILED'` filter criteria to fetch the list of other Bastion Hosts in the cluster that are active:

  ```
  $ CRITERIA="state == 'HEALTHY'" get_other_bastions
  ```

  Sample output:

  ```
  occne1-rainbow-bastion-2
  ```

7.1.1.3.4 Changing the Bastion Host to Active

This section provides the steps to make a standby Bastion Host as active using the `update_active_bastion.sh` script.

- Run the following command to make the current Bastion Host as the active Bastion Host:

  ```
  $ update_active_bastion.sh
  ```

  On running the command, the system runs the `get_active_bastion` script to compare the current Bastion IP with the active Bastion IP retrieved from the `bastion-controller` pod DB. If the IP stored in the `bastion-controller` DB is equal to the IP of the Bastion where the script is run from, then the system takes no action as the current Bastion is already the active Bastion. Otherwise, the system updates the DB with the current IP of the Bastion Host, making it the new active Bastion.

  Sample output showing the response when the current Bastion is already the active Bastion:

  ```
  2023-11-24:17-17-34: Setting 192.168.200.10 as bastion
  Bastion already set to 192.168.200.10
  ```

  Sample output showing the response when the current Bastion is updated as the active Bastion:

  ```
  2023-11-24:17-29-09: Setting 192.168.200.11 as bastion
  ```

7.1.1.4 Troubleshooting Bastion Host

This section describes the issues that you may encounter while using Bastion Host and their troubleshooting guidelines.

Permission Denied Error While Running Kubernetes Command

Problem:
Users may encounter "Permission Denied" error while running Kubernetes commands if there is no proper access.

Error Message:

```
error: error loading config file "/var/occne/cluster/occne1-rainbow/artifacts/
admin.conf": open /var/occne/cluster/occne1-rainbow/artifacts/admin.conf:
permission denied
```

Resolution:
Verify permission access to `admin.conf`. The user running the command must be able to run basic `kubectl` commands to use the Bastion scripts.

Commands Take Too Long to Respond and Fail to Return Output

Problem:
A command may take too long to display any output. For example, running the `is_active_bastion` command may take too long to respond leading to the timed out error.

Error Message:

```
error: timed out waiting for the condition
```

Resolution:

- Verify the status of the bastion-controller. This error can occur if the pods are not running or in a crash state due to various reasons such as lack of resources at the cluster.
- Print the bastion controller logs to check the issue. For example, print the logs and check if a loop crash error is caused due to lack of resources.

  ```
  $ kubectl logs -n ${OCCNE_NAMESPACE} deploy/occne-bastion-controller
  ```

  Sample output:

  ```
  Error from server (BadRequest): container "bastion-controller" in pod
  "occne-bastion-controller-797db5f845-hqlm6" is waiting to start:
  ContainerCreating
  ```

Command Not Found Error

Problem:
User may encounter `command not found` error while running a script.

Error Message:

```
-bash: is_active_bastion: command not found
```

Resolution:
Run the following command and verify that the `$PATH` variable is set properly and contains the artifacts directory.

> **Note**
>
> By default, CNE sets up the path automatically during the installation.

```
$ echo $PATH
```

Sample output showing the correct `$PATH`:

```
/home/cloud-user/.local/bin:/home/cloud-user/bin:/usr/local/bin:/usr/bin:/usr/
local/sbin:/usr/sbin:/var/occne/cluster/occne1-rainbow/artifacts/
istio-1.18.2/bin/:/var/occne/cluster/occne1-rainbow/artifacts
```

7.2 General Configuration

This section describes the general configuration tasks for CNE.

7.2.1 Configuring SNMP Trap Destinations

This section describes the procedure to set up SNMP notifiers within CNE, such that the AlertManager can send alerts as SNMP traps to one or more SNMP receivers.

1. Perform the following steps to verify the cluster condition before setting up multiple trap receivers:
   a. Run the following command and verify that the `alertmanager` and `snmp-notifier` services are running:

      ```
      $ kubectl get services --all-namespaces | grep -E 'snmp-notifier|
      alertmanager'
      ```

      Sample output:

      ```
      NAMESPACE     NAME
      TYPE           CLUSTER-IP      EXTERNAL-IP
      PORT(S)                                  AGE
      occne-infra    occne-kube-prom-stack-kube-alertmanager
      LoadBalancer   10.233.16.156   10.75.151.178
      80:31100/TCP                        11m
      occne-infra    occne-alertmanager-snmp-
      notifier                              ClusterIP      10.233.41.30
      <none>          9464/TC                              11m
      ```

b. Run the following command and verify that the `alertmanager` and `snmp-notifier` pods are running:

```
$ kubectl get pods --all-namespaces | grep -E 'snmp-notifier|
alertmanager'
```

Sample output:

```
occne-infra     alertmanager-occne-kube-prom-stack-kube-
alertmanager-0          2/2     Running   0          18m
occne-infra     alertmanager-occne-kube-prom-stack-kube-
alertmanager-1          2/2     Running   0          18m
occne-infra     occne-alertmanager-snmp-notifier-744b755f96-
m8vbx                           1/1     Running   0          18m
```

2. Perform the following steps to edit the default `snmp-destination` and add a new `snmp-destination`:

a. Run the following command from Bastion Host to get the current `snmp-notifier` resources:

```
$ kubectl get all -n occne-infra | grep snmp
```

Sample output:

```
pod/occne-alertmanager-snmp-notifier-75656cf4b7-gw55w 1/1 Running 0 37m
service/occne-alertmanager-snmp-notifier ClusterIP 10.233.29.86 <none>
9464/TCP 10h
deployment.apps/occne-alertmanager-snmp-notifier 1/1 1 1 10h
replicaset.apps/occne-alertmanager-snmp-notifier-75656cf4b7 1 1 1 37m
```

b. The `snmp-destination` is the interface IP address of the trap receiver to get the traps. Edit the deployment to modify `snmp-destination` and add a new `snmp-destination` when needed:

i. Run the following command to edit the deployment:

```
$ kubectl edit -n occne-infra deployment occne-alertmanager-snmp-
notifier
```

ii. From the vi editor, move down to the `snmp-destination` section. The default configuration is as follows:

```
- --snmp.destination=127.0.0.1:162
```

iii. Add a new destination to receive the traps.
For example:

```
 - --snmp.destination=192.168.200.236:162
```

iv. If want to add multiple trap receivers, add them in multiple new lines.

For example:

```
- --snmp.destination=192.168.200.236:162
- --snmp.destination=10.75.135.11:162
- --snmp.destination=10.33.64.50:162
```

v. After editing, use the `:x` or `:wq` command to save the exit.
Sample output:

```
deployment.apps/occne-alertmanager-snmp-notifier edited
```

c. Perform the following steps to verify the new replicaset and delete the old replicaset:

i. Run the following command to get the resource and check the restart time to verify that the pod and replicaset are regenerated:

```
$  kubectl get all -n occne-infra | grep snmp
```

Sample output:

```
pod/occne-alertmanager-snmp-notifier-88976f7cc-xs8mv
1/1     Running   0             90s
service/occne-alertmanager-snmp-notifier
ClusterIP      10.233.29.86    <none>
9464/TCP                                          10h
deployment.apps/occne-alertmanager-snmp-notifier           1/1
1            1           10h
replicaset.apps/occne-alertmanager-snmp-
notifier-75656cf4b7           0         0         0       65m
replicaset.apps/occne-alertmanager-snmp-
notifier-88976f7cc            1         1         1       90s
```

ii. Identify the old replicaset from the previous step and delete it.
For example, the restart time of the `replicaset.apps/occne-alertmanager-snmp-notifier-75656cf4b7` in the previous step output is 65m. This indicates that it is the old replica set. Use the following command to delete the old replicaset:

```
$ kubectl delete -n occne-infra replicaset.apps/occne-alertmanager-
snmp-notifier-75656cf4b7
```

d. Port 162 of the server must be open and have some application to catch the traps to test if the new trap receiver receives the SNMP traps. This step may vary depending on the type of server. The following codeblock provides an example for Linux server:

```
$ sudo iptables -A INPUT -p udp -m udp --dport 162 -j ACCEPT
$ sudo dnf install -y tcpdump
$ sudo tcpdump -n -i <interface of the ip address set in snmp-
destination> port 162
```

7.2.2 Changing Network MTU

This section describes the procedure to modify the Maximum Transmission Unit (MTU) of the Kubernetes internal network after the initial CNE installation.

Prerequisites:

- Ensure that the cluster runs in a healthy state.
- The commands in this procedure must be primarily run from the active CNE Bastion Host unless specified otherwise.

> **Note**
>
> Ensure that the `secrets.ini` file is present and is rightly configured. Refer to the "Configuring secrets.ini and occne.ini Files" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

Changing MTU on Internal Interface for vCNE (OpenStack or VMware)

1. From the active Bastion, run the following command to instantiate a container that is used as a workspace and contains the necessary tools:

   ```
   $ podman run -it --rm --rmi --network host --name DEPLOY_${OCCNE_CLUSTER} -
   v /var/occne/cluster/${OCCNE_CLUSTER}:/host -e 'OCCNEINV=/host/hosts -i /
   host/occne.ini' ${CENTRAL_REPO}:5000/occne/provision:${OCCNE_VERSION} bash
   ```

   > **Note**
   >
   > The prompt changes from Bastion's prompt to Provision Container's prompt. For example, `bash-5.1`.

2. Run the following command to print the default primary interface name and make a note of it to be used in the following step:

   > **Note**
   >
   > - The default interface name may vary depending on the platform.
   > - Ansible sets a primary interface as the default. This can be used to determine the default connection name for the internal network.
   > - The interface name must be consistent across all nodes in a cluster. This is the expected and default setting and you cannot proceed with the procedure if the interface names are different.

   ```
   $ ansible -i $OCCNEINV k8s-cluster -m ansible.builtin.setup -a
   'gather_subset=!all,network filter=ansible_default_ipv4' | grep -e
   interface -e SUCCESS
   ```

Sample output:

```
occne-k8s-ctrl-1 | SUCCESS => {
            "interface": "eth0",
occne-k8s-ctrl-3 | SUCCESS => {
            "interface": "eth0",
occne-k8s-node-4 | SUCCESS => {
            "interface": "eth0",
occne-k8s-node-3 | SUCCESS => {
            "interface": "eth0",
occne-k8s-node-2 | SUCCESS => {
            "interface": "eth0",
occne-k8s-node-1 | SUCCESS => {
            "interface": "eth0",
occne-k8s-ctrl-2 | SUCCESS => {
            "interface": "eth0",
```

In this example, the default interface name is "`eth0`" and all the nodes have the same default interface name as expected.

3. Set up an environment variable using the default interface name obtained in the previous step:

   ```
   $ export DEFAULT_NIC_NAME="<value collected from the above step>"
   ```

   For example:

   ```
   $ export DEFAULT_NIC_NAME="eth0"
   ```

   You can verify the environment variable by running the following command:

   ```
   $ echo $DEFAULT_NIC_NAME
   ```

4. Perform the following steps to modify the MTU value using ansible:
   a. Run the following command to set the new MTU value as desired:

      ```
      $ export NEW_MTU=<MTU value>
      ```

   b. Run the following ansible command to modify each interface using the environment variable:

      ```
      $ ansible -i $OCCNEINV k8s-cluster -m shell -a 'sudo nmcli con mod "$
      (nmcli -f GENERAL.CONNECTION -m tabular -t dev show
      '$DEFAULT_NIC_NAME')" 802-3-ethernet.mtu '$NEW_MTU'; sudo nmcli con up
      "$(nmcli -f GENERAL.CONNECTION -m tabular -t dev show
      '$DEFAULT_NIC_NAME')"'
      ```

      Sample output:

      ```
      occne-k8s-node-3 | CHANGED | rc=0 >>
      Connection successfully activated (D-Bus active path: /org/freedesktop/
      NetworkManager/ActiveConnection/6)
      occne-k8s-node-4 | CHANGED | rc=0 >>
      ```

```
Connection successfully activated (D-Bus active path: /org/freedesktop/
NetworkManager/ActiveConnection/6)
occne-k8s-node-2 | CHANGED | rc=0 >>
Connection successfully activated (D-Bus active path: /org/freedesktop/
NetworkManager/ActiveConnection/6)
occne-k8s-node-1 | CHANGED | rc=0 >>
Connection successfully activated (D-Bus active path: /org/freedesktop/
NetworkManager/ActiveConnection/6)
occne-k8s-ctrl-3 | CHANGED | rc=0 >>
Connection successfully activated (D-Bus active path: /org/freedesktop/
NetworkManager/ActiveConnection/6)
occne-k8s-ctrl-2 | CHANGED | rc=0 >>
Connection successfully activated (D-Bus active path: /org/freedesktop/
NetworkManager/ActiveConnection/6)
occne-k8s-ctrl-1 | CHANGED | rc=0 >>
Connection successfully activated (D-Bus active path: /org/freedesktop/
NetworkManager/ActiveConnection/6)
```

5. Run the following ansible commands to print the newly set MTU value across the cluster:
   a. Run the following command to show the connection MTU:

      ```
      $ ansible -i $OCCNEINV k8s-cluster -m shell -a 'nmcli -f
      GENERAL.NAME,802-3-ethernet.mtu con show "$(nmcli -f GENERAL.CONNECTION
      -m tabular -t dev show '$DEFAULT_NIC_NAME')"'
      ```

      Sample output:

      ```
      occne-k8s-node-3 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      occne-k8s-node-2 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      occne-k8s-node-4 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      occne-k8s-node-1 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      occne-k8s-ctrl-1 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      occne-k8s-ctrl-3 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      occne-k8s-ctrl-2 | CHANGED | rc=0 >>
      802-3-ethernet.mtu:                     8980
      GENERAL.NAME:                           System eth0
      ```

   b. Run the following command to show the MTU using IP command:

      ```
      $ ansible -i $OCCNEINV k8s-cluster -m shell -a "ip link
      show $DEFAULT_NIC_NAME"
      ```

Sample output:

```
occne-k8s-node-3 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:eb:1b:f5 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
occne-k8s-node-4 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:fd:b4:c6 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
occne-k8s-node-2 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:82:0b:d7 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
occne-k8s-ctrl-1 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:b5:41:e6 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
occne-k8s-node-1 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:01:5f:c6 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
occne-k8s-ctrl-3 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:48:1d:ac brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
occne-k8s-ctrl-2 | CHANGED | rc=0 >>
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 8980 qdisc fq_codel
state UP mode DEFAULT group default qlen 1000
    link/ether fa:16:3f:d4:bb:23 brd ff:ff:ff:ff:ff:ff
    altname enp0s3
    altname ens3
```

Changing MTU on All Interfaces of BareMetal VM Host and VM Guest

> **Note**
>
> - The MTU value on the VM host depends on the ToR switch configuration:
>   - *cisco Nexus9000 93180YC-EX* has "`system jumbomtu`" up to *9216*.
>   - If you're using `port-channel/vlan-interface/uplnk-interface-to-customer-switch`, then run the "`system jumbomtu <mtu>`" command and configure "`mtu <value>`" up to the value obtained from the command.
>   - If you're using other types of ToR switches, you can configure the MTU value of VM host up to the maximum MTU value of the switch. Therefore, check the switches for the maximum MTU value and configure the MTU value accordingly.
> - The following steps are for a standard setup with bastion-1 or master-1 on host-1, bastion-2 or master-2 on host-2, and master-3 on host-3. If you have a different setup, then modify the commands accordingly. Each step in this procedure is performed to change MTU for the VM host and the Bastion on the VM host.

1. SSH to k8s-host-2 from bastion-1:

   ```
   $ ssh k8s-host-2
   ```

2. Run the following command to show all the connections:

   ```
   $ nmcli con show
   ```

3. Run the following commands to modify the MTU value on all the connections:

   > **Note**
   >
   > Modify the connection names in the following commands according to the connection names obtained from step 2.

   ```
   $ sudo nmcli con mod bond0 802-3-ethernet.mtu <MTU value>
   $ sudo nmcli con mod bondbr0 802-3-ethernet.mtu <MTU value>
   $ sudo nmcli con mod "vlan<mgmt vlan id>-br" 802-3-ethernet.mtu <MTU value>
   ```

4. Run the following commands if there is `vlan<ilo_vlan_id>-br` on this host:

   ```
   $ sudo nmcli con mod "vlan<ilo vlan id>-br" 802-3-ethernet.mtu <MTU value>
   $ sudo nmcli con up "vlan<ilo vlan id>-br"
   ```

> **Note**
>
> - The following `sudo nmcli con up` commands takes effect on the MTU values modified in the previous step. Ensure that you perform the following steps in the given in the given order. Not following the correct order can make the host-2 and bastion-2 unreachable.
> - The base interface has higher MTU during the sequence. For the `bond0` interface, `bond0 MTU` is greater than or equal to the `bondbr0 MTU` and `vlan bridge` interface. The `bond0.<vlan id>` interface MTU is modified when `vlan<vlan id>-br` interface is modified and restarted.

5. Run the following commands if the <MTU value> is lower than the old value:

   ```
   $ sudo nmcli con up "vlan<mgmt vlan id>-br"
   $ sudo nmcli con up bond0br0
   $ sudo nmcli con up bond0
   ```

6. Run the following commands if the <MTU value> is higher than the old value:

   ```
   $ sudo nmcli con up bond0
   $ sudo nmcli con up bond0br0$
   $ sudo nmcli con up "vlan<mgmt vlan id>-br"
   ```

7. After the values are updated on VM host, run the following commands to shut down all the VM guests:

   ```
   $ sudo virsh list --all
   $ sudo virsh shutdown <VM guest>
   ```

   where, `<VM guest>` is the VM guest name obtained from the `$ sudo virsh list --all` command.

8. Run the `virsh list` command until the status of the VM guest is changed to `"shut off"`:

   ```
   $ sudo virsh list --all
   ```

9. Run the following command to start the VM guest:

   ```
   $ sudo virsh  start <VM guest>
   ```

   where, `<VM guest>` is the name of the VM guest.

10. Exit from host-2 and return to bastion-1. Wait until bastion-2 is reachable and run the following command to SSH to bastion-2:

    ```
    $ ssh bastion-2
    ```

11. Run the following command to list all connections in bastion-2:

    ```
    $ nmcli con show
    ```

12. Run the following commands to modify the MTU value on all the connections in bastion-2:

> **Note**
>
> Modify the connection names in the following commands according to the connection names obtained in step 2.

```
$ sudo nmcli con mod "System enp1s0" 802-3-ethernet.mtu <MTU value>
$ sudo nmcli con mod "System enp2s0" 802-3-ethernet.mtu <MTU value>
$ sudo nmcli con mod "System enp3s0" 802-3-ethernet.mtu <MTU value>
$ sudo nmcli con up "System enp1s0"
$ sudo nmcli con up "System enp2s0"
$ sudo nmcli con up "System enp3s0"
```

13. Wait until bastion-2 is reachable and run the following command to SSH to bastion-2:

    ```
    $ ssh bastion-2
    ```

14. Repeat steps 9 and 10 to change the MTU value on k8s-host-1 and bastion-1.
15. Repeat steps 1 to 10 to change the MTU values on k8s-host-3 and restart all VM guests on it. You can use bastion-1 or bastion-2 for performing this step.

> **Note**
>
> For the VM guests that are controller nodes, perform only the `virsh shutdown` and `virsh start` commands to restart the VM guests. The MTU values of these controller nodes are updated in the following section.

Changing MTU on enp1s0 or bond0 Interface for BareMetal Controller or Worker Nodes

1. Run the following command to launch the provision container:

   ```
   $ podman run -it --rm --network host -v /var/occne/cluster/$
   {OCCNE_CLUSTER}:/host winterfell:5000/occne/provision:<release> /bin/bash
   ```

   Where, <release> is the currently installed release.

   This creates a Bash shell session running within the provision container.

2. Run the following commands to change enp1s0 interfaces for controller nodes and validate MTU value of the interface:

   a. Change enp1s0 interfaces for controller nodes:
   Replace <MTU value> in the command with a real integer value.

   ```
   $ ansible -i /host/hosts.ini kube-master -m shell -a 'sudo  nmcli con
   mod "System enp1s0" 802-3-ethernet.mtu <MTU value>;  sudo  nmcli con up
   "System enp1s0"'
   ```

   b. Validate the MTU value of the interface:

   ```
   $ ansible -i /host/hosts.ini kube-master -m shell -a 'ip link show
   enp1s0'
   ```

3. Run the following commands to change bond0 interfaces for worker nodes and validate the MTU value of the interface:
   a. Change bond0 interfaces for controller nodes:
      Replace <MTU value> in the command with a real integer value.

      ```
      $ ansible -i /host/hosts.ini kube-node -m shell -a 'sudo  nmcli con mod
      bond0 802-3-ethernet.mtu <MTU value>;  sudo  nmcli con up bond0'
      ```

   b. Validate the MTU value of the interface:

      ```
      $ ansible -i /host/hosts.ini kube-node -m shell -a 'ip link show bond0'
      $ exit
      ```

Changing MTU on vxlan Interface (vxlan.calico) for BareMetal and vCNE

1. Log in to the Bastion host and run the following command:

   ```
   $ kubectl edit daemonset calico-node -n kube-system
   ```

2. Locate the line with FELIX_VXLANMTU and replace the current `<MTU value>` with the new integer value:

   > **Note**
   >
   > `vxlan.calico` has an extra header in the packet. The modified MTU value must be at least 50 lower than the MTU set in previous steps to work.

   ```
   - name: FELIX_VXLANMTU
           value: "<MTU value>"
   ```

3. Use `:x` to save and exit the vi editor and run the following command to perform a rollout restart:

   ```
   $ kubectl rollout restart daemonset calico-node -n kube-system
   ```

4. Run the following command to provision container:

   ```
   $ podman run -it --rm --network host -v /var/occne/cluster/$
   {OCCNE_CLUSTER}:/host winterfell:5000/occne/provision:$
   {OCCNE_VERSION} /bin/bash
   ```

5. Validate the MTU value of the interface on the controller nodes and worker nodes:
   - For BareMetal, run the following command to validate the MTU value:

     ```
     $ ansible -i /host/hosts.ini k8s-cluster -m shell -a 'ip link show
     vxlan.calico'
     ```

   - For vCNE (OpenStack or VMware), run the following command to validate the MTU value:

     ```
     $ ansible -i /host/hosts k8s-cluster -m shell -a 'ip link show
     vxlan.calico'
     ```

> **Note**
>
> It takes some time for all the nodes to change to the new MTU. If the MTU value isn't updated, run the command several times to see the changes in the values.

Changing MTU on Calico Interfaces (cali*) for vCNE or BareMetal

1. Run the following command from the Bastion Host to edit `configmap calico-config`:

   ```
   $ kubectl edit configmap calico-config -n kube-system "mtu": 1500,    →
   "mtu": <MTU value>,
   ```

2. Run the following command to restart daemonset:

   ```
   $ kubectl rollout restart daemonset calico-node -n kube-system
   ```

3. The change in Calico interface MTU takes effect when a new pod on the node is started. The following codeblock provides an example to restart `occne-kube-prom-stack-grafana` deployment. Verify that the deployment is READY 1/1 before you delete and reapply:

   ```
   $ kubectl rollout restart deployment occne-kube-prom-stack-grafana -n
   occne-infra
   ```

4. Run the following commands to verify the MTU change on worker nodes:
   - Verify which node has the new pod:

     ```
     $ kubectl get pod -A -o wide | grep occne-kube-prom-stack-grafana
     ```

     Sample output:

     ```
      occne-infra     occne-kube-prom-stack-grafana-79f9b5b488-
     cl76b                    3/3     Running     0               60s
     10.233.120.22   k8s-node-2     <none>           <none>
     ```

   - Use SSH to log in to the node and check the calico interface change. Only the last interface MTU changes due to new pod for the services. Other Calico interface MTU changes when other services are changed.

     ```
     $ ssh k8s-node-2

     $ ip link
     ```

     Sample output:

     ```
     ...
     35: calia44682149a1@if4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1480 qdisc
     noqueue state UP mode DEFAULT group default
     link/ether ee:ee:ee:ee:ee:ee brd ff:ff:ff:ff:ff:ff link-netns cni-7f1a8116-5acf-
     b7df-5d6a-eb4f56330cf1
     115: calif0adcd64a1c@if4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu <MTU value>
     qdisc noqueue state UP mode DEFAULT group default
     link/ether ee:ee:ee:ee:ee:ee brd ff:ff:ff:ff:ff:ff link-netns
     cni-7b99dc36-3b3b-75c6-e27c-9045eeb8242d
     ```

5. Reboot all worker nodes if possible. In this case, all pods get restarted and all cali* interfaces have the new MTU:

   ```
   $ ssh <worker node>$ sudo reboot
   ```

7.2.3 Changing Metrics Storage Allocation

The following procedure describes how to increase the amount of persistent storage allocated to Prometheus for metrics storage.

Prerequisites

The revised amount of persistent storage required by metrics must be calculated. Rerun the metrics storage calculations as provided in the "Preinstallation Tasks" section of *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*, and record the calculated *total_metrics_storage* value.

> **Note**
>
> When you increase the storage size for Prometheus, the retention size must also be increased to maintain the purging cycle of Prometheus. The default retention is set to 6.8 GB. If the storage is increased to a higher value and retention remains at 6.8 GB, the amount of data that is stored inside the storage is still 6.8 GB. Therefore, follow the Changing Retention Size of Prometheus procedure to calculate the retention size and update the retention size in Prometheus. These steps are applied while performing Step 3.

Procedure

1. A Prometheus resource is used to configure all Prometheus instances running in CNE. Run the following command to identify the Prometheus resource:

   ```
   $ kubectl get prometheus -n occne-infra
   ```

   Sample output:

   ```
    NAME                                    VERSION   DESIRED   READY
   RECONCILED   AVAILABLE   AGE
   occne-kube-prom-stack-kube-prometheus   v2.44.0   2         2
   True         True        20h
   ```

2. Run the following command to edit the Prometheus resource:

   ```
   $ kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n occne-
   infra
   ```

> **Note**
>
> You are placed in a *vi* editor session that contains all of the configuration for the CNE Prometheus instances.
> Scroll down to the line that contains the "storage" key(line-91), then change the value to <desired pv size>. Also scroll down to the line that contains the "replicas" key(line-54), then change the value to 0. This scales down both the pods. The file must look similar to the following example.

Sample output:

```
53       release: occne-kube-prom-stack
    54   replicas: 2
    55   resources:
    56     limits:
    57       cpu: 2000m
    58       memory: 4Gi
    59     requests:
    60       cpu: 2000m
    61       memory: 4Gi
    62   retention: 14d
    63   retentionSize: 6.8GB
    64   routePrefix: /occne4-utpalkant-kumar/prometheus
    65   ruleNamespaceSelector: {}
    66   ruleSelector:
    67     matchLabels:
    68       role: cnc-alerting-rules
    69   scrapeInterval: 1m
    70   scrapeTimeout: 30s
    71   secrets:
    72   - etcd-occne4-utpalkant-kumar-k8s-ctrl-1
    73   - etcd-occne4-utpalkant-kumar-k8s-ctrl-2
    74   - etcd-occne4-utpalkant-kumar-k8s-ctrl-3
    75   securityContext:
    76     fsGroup: 2000
    77     runAsGroup: 2000
    78     runAsNonRoot: true
    79     runAsUser: 1000
    80   serviceAccountName: occne-kube-prom-stack-kube-prometheus
    81   serviceMonitorNamespaceSelector: {}
    82   serviceMonitorSelector: {}
    83   shards: 1
    84   storage:
    85     volumeClaimTemplate:
    86       spec:
    87         accessModes:
    88         - ReadWriteOnce
    89         resources:
    90           requests:
    91             storage: 10Gi
    92         storageClassName: occne-metrics-sc
```

> **Note**
>
> Type ":wq" to exit the editor session and save the changes. Verify that Prometheus instances are scaled down.

3. To change the pvc size of Prometheus pods, run the following command:

   ```
   $ kubectl edit pvc prometheus-occne-kube-prom-stack-kube-prometheus-db-prometheus-occne-kube-prom-stack-kube-prometheus-0 -n occne-infra
   ```

   > **Note**
   >
   > You will be placed in a *vi* editor session that contains all of the configuration for the CNE Prometheus pvc. Scroll down to the line that contains the "spec.resources.requests.storage" key, then update the value to the <desired pv size>. The file must look similar to the following example:
   >
   > ```
   > spec:
   >   accessModes:
   >   - ReadWriteOnce
   >   resources:
   >     requests:
   >       storage: 10Gi
   >   storageClassName: occne-metrics-sc
   >   volumeMode: Filesystem
   > ```
   >
   > Type "`:wq`" to exit the editor session and save the changes.

4. To verify if the pvc size change is applied, run the following command:

   ```
   $ kubectl get pv |grep kube-prom-stack-kube-prometheus-0
   ```

   Sample output:

   ```
   pvc-3c595b70-4265-42e8-a0ca-623b28ce4221  10Gi  RWO  Delete  Bound  occne-infra/prometheus-occne-kube-prom-stack-kube-prometheus-db-prometheus-occne-kube-prom-stack-kube-prometheus-0   occne-metrics-sc
   ```

   > **Note**
   >
   > Wait until the new desired size "10Gi" gets reflected. Repeat step 3 and step 4 for "kube-prom-stack-kube-prometheus-1" pvc.

5. Once both the pv sizes are updated to the new desired size, run the following command to scale up the Prometheus pods:

   ```
   $ kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n occne-infra
   ```

> **Note**
>
> You will be placed in a *vi* editor session that contains all of the configuration for the CNE Prometheus instances. Scroll down to the line that contains the "replicas" key, then change the value back to 2. This scale backs up both the pods. The file must look similar to the following example:
>
> ```
> 53       release: occne-kube-prom-stack
> 54   replicas: 2
> 55   resources:
> 56     limits:
> 57       cpu: 2000m
> 58       memory: 4Gi
> 59     requests:
> 60       cpu: 2000m
> 61       memory: 4Gi
> 62   retention: 14d
> ```

6. To verify that the Prometheus pods are up and running, run the following command:

   ```
   $ kubectl get pods -n occne-infra | grep kube-prom-stack-kube-prometheus
   ```

   Example output:

   ```
   prometheus-occne-kube-prom-stack-kube-prometheus-0 2/2 Running 1 40s
   prometheus-occne-kube-prom-stack-kube-prometheus-1 2/2 Running 1 29s
   ```

7.2.4 Changing OpenSearch Storage Allocation

This section describes the procedure to increase the amount of persistent storage allocated to OpenSearch for data storage.

Prerequisites

- Calculate the revised amount of persistent storage required by OpenSearch. Rerun the OpenSearch storage calculations as provided in the "Preinstallation Taks" section of *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*, and record the calculated `log_trace_active_storage` and `log_trace_inactive_storage` values.

Procedure

This procedure uses the value of `log_trace_active_storage` for opensearch-data PV size and `log_trace_inactive_storage` for opensearch-master PV size. The following table displays the sample PV sizes considered in this procedure:

OpenSearch Component	Current PV Size	Desired PV Size
occne-opensearch-master	500Mi	500Mi
occne-opensearch-data	10Gi	200Gi (log_trace_active_storage)
opensearch-data-replicas-count	5	7

Expanding PV size for opensearch-master nodes

1. Store the output of the current configuration values for the `os-master-helm-values.yaml` file.

   ```
   $ helm -n occne-infra get values occne-opensearch-master > os-master-helm-values.yaml
   ```

2. Update the PVC size block in the `os-master-helm-values.yaml` file. The PVC size must be updated to the newly required PVC size (in this case, 50Gi as per the sample value considered). The `os-master-helm-values.yaml` file is required in Step 8 to recreate `occne-opensearch-master` Statefulset.

   ```
   $ vi os-master-helm-values.yaml
   persistence:
     enabled: true
     image: occne-repo-host:5000/docker.io/busybox
     imageTag: 1.31.0
     size: <desired size>Gi
     storageClass: occne-esmaster-sc
   ```

3. Delete the statefulset of `occne-opensearch-cluster-master` by running the following command:

   ```
   $ kubectl -n occne-infra delete sts --cascade=orphan occne-opensearch-cluster-master
   ```

4. Delete the `occne-opensearch-cluster-master-2` pod by running the following command:

   ```
   $ kubectl -n occne-infra delete pod occne-opensearch-cluster-master-2
   ```

5. Update the PVC storage size in the PVC of `occne-opensearch-cluster-master-2` by running the following command:

   ```
   $ kubectl -n occne-infra patch -p '{ "spec": { "resources": { "requests": { "storage": "40Gi" }}}}' pvc occne-opensearch-cluster-master-occne-opensearch-cluster-master-2
   ```

6. Get the PV volume ID from the PVC of `opensearch-master-2`:

   ```
   $ kubectl get pvc -n occne-infra | grep master-2
   ```

   Sample output:

   ```
   occne-opensearch-cluster-master-occne-opensearch-cluster-master-2   Bound    pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72   30Gi       RWO            occne-esmaster-sc   17h
   ```

   In this case, the PV volume ID in the sample output is *pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72*.

7. Hold on to the PV attached to `occne-opensearch-cluster-master-2` PVC using the volume ID until the newly updated size gets reflected. Verify the updated PVC value by running the following command:

   ```
   $ kubectl get pv -w | grep pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72
   ```

   Sample output:

   ```
   pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72   30Gi       RWO
   Delete           Bound    occne-infra/occne-opensearch-cluster-master-
   occne-opensearch-cluster-master-2    occne-esmaster-sc            17h
   pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72   40Gi       RWO
   Delete           Bound    occne-infra/occne-opensearch-cluster-master-
   occne-opensearch-cluster-master-2    occne-esmaster-sc            17h
   ```

8. Run Helm upgrade to recreate the `occne-opensearch-master` statefulset:

   ```
   $ helm upgrade -f os-master-helm-values.yaml occne-opensearch-master
   opensearch-project/opensearch -n occne-infra
   ```

9. Once the deleted pod (master-2) and its statefulset are up and running, check the pod's PVC status and verify if it reflects the updated size.

   ```
   $ kubectl get pvc -n occne-infra | grep master-2
   ```

   Sample output:

   ```
   occne-opensearch-cluster-master-occne-opensearch-cluster-master-2
   Bound    pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72  40Gi
   RWO            occne-esmaster-sc   17h
   e.g id: pvc-9d9897c1-b7b9-43a3-bf78-f03b91ea4d72
   ```

10. Repeat steps 3 through 9 for each of the remaining pods, one after the other (in order master-1, master-0).

Expanding PV size for opensearch-data nodes

1. Store the output of the current configuration values for `os-master-helm-values.yaml` file.

   ```
   $ helm -n occne-infra get values occne-opensearch-data > os-data-helm-
   values.yaml
   ```

2. Update the PVC size block in the `os-master-helm-values.yaml` file. The PVC size must be updated to the newly required PVC size (in this case, 200Gi as per the sample value considered). The `os-master-helm-values.yaml` file is required in Step 8 of this procedure to recreate the `occne-opensearch-data` statefulset.

   ```
   $ vi os-data-helm-values.yaml
   ```

   Sample output:

   ```
   persistence:
     enabled: true
     image: occne-repo-host:5000/docker.io/busybox
     imageTag: 1.31.0
   ```

```
  size: <desired size>Gi
  storageClass: occne-esdata-sc
```

3. Delete the statefulset of `occne-opensearch-opensearch-data` by the running the following command:

   ```
   $ kubectl -n occne-infra delete sts --cascade=orphan occne-opensearch-
   cluster-data
   ```

4. Delete the `occne-opensearch-cluster-data-2`.

   ```
   $ kubectl -n occne-infra delete pod occne-opensearch-cluster-data-2
   ```

5. Update the PVC storage size in the PVC of `occne-opensearch-cluster-data-2`.

   ```
   $ kubectl -n occne-infra patch -p '{ "spec": { "resources": { "requests":
   { "storage": "20Gi" }}}}' pvc occne-opensearch-cluster-data-occne-
   opensearch-cluster-data-2
   ```

6. Get the PV volume ID from the PVC of `opensearch-data-2`.

   ```
   $ kubectl get pvc -n occne-infra | grep data-2
   ```

   Sample output:

   ```
   occne-opensearch-cluster-data-occne-opensearch-cluster-data-2   Bound
   pvc-80a56d73-d7b7-417f-a7a7-c8484bc8171d   10Gi       RWO            occne-
   esdata-sc   17h
   ```

7. Hold on to the PV attached to opensearch-data-2 PVC using the volume ID until the newly updated size gets reflected. Verify the updated PVC value by running the following command:

   ```
   $ kubectl get pv -w | grep pvc-80a56d73-d7b7-417f-a7a7-c8484bc8171d
   ```

   Sample output:

   ```
   pvc-80a56d73-d7b7-417f-a7a7-c8484bc8171d   10Gi       RWO
   Delete           Bound    occne-infra/occne-opensearch-cluster-data-occne-
   opensearch-cluster-data-2    occne-esdata-sc            17h
   pvc-80a56d73-d7b7-417f-a7a7-c8484bc8171d   20Gi       RWO
   Delete           Bound    occne-infra/occne-opensearch-cluster-data-occne-
   opensearch-cluster-data-2    occne-esdata-sc            17h
   ```

8. Run helm upgrade to recreate the `occne-opensearch-data` statefulset

   ```
   $ helm upgrade -f os-data-helm-values.yaml occne-opensearch-data
   opensearch-project/opensearch -n occne-infra
   ```

9. Once the deleted pod (data-2) and its statefulset are up and running, check the pod's PVC status and verify if it reflects the updated size.

   ```
   $ kubectl get pvc -n occne-infra | grep data-2
   ```

Sample output:

```
occne-opensearch-cluster-data-occne-opensearch-cluster-data-2   Bound
pvc-80a56d73-d7b7-417f-a7a7-c8484bc8171d  20Gi       RWO            occne-
esdata-sc   17h
```

10. Repeat steps 3 through 9 for each of the remaining pods, one after the other (in the order, data-1, data-0,..).

7.2.5 Changing the RAM and CPU Resources for Common Services

This section describes the procedure to change the RAM and CPU resources for CNE common services.

Prerequisites

Before changing the RAM, CPU, or both the resources for CNE common services, make sure that the following prerequisites are met:

- The cluster must be in a healthy state. This can verified by checking if all the common services are up and running.

> **Note**
>
> – When changing the CPU and RAM resources for any component, the limit value must always be greater than or equal to the requested value.
>
> – Run all the commands in this section from the Bastion Host.

7.2.5.1 Changing the Resources for Prometheus

This section describes the procedure to change the RAM or CPU resources for Prometheus.

Procedure

1. Run the following command to edit the Prometheus resource:

   ```
   kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n occne-
   infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE Prometheus instances.

2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for both the prometheus pods.
   For example:

   ```
   resources:
       limits:
         cpu: 2000m
         memory: 4Gi
       requests:
         cpu: 2000m
         memory: 4Gi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if both the Prometheus pods are restarted:

   ```
   kubectl get pods -n occne-infra |grep kube-prom-stack-kube-prometheus
   ```

   Sample output:

   ```
   prometheus-occne-kube-prom-stack-kube-prometheus-0             2/2     Running
   0             85s
   prometheus-occne-kube-prom-stack-kube-prometheus-1             2/2     Running
   0             104s
   ```

7.2.5.2 Changing the Resources for Alertmanager

This section describes the procedure to change the RAM or CPU resources for Alertmanager.

Procedure

1. Run the following command to edit the Alertmanager resource:

   ```
   kubectl edit alertmanager occne-kube-prom-stack-kube-alertmanager -n occne-
   infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE Alertmanager instances.
2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the Alertmanager pods.
   For example:

   ```
   resources:
       limits:
         cpu: 20m
         memory: 64Mi
       requests:
         cpu: 20m
         memory: 64Mi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the Alertmanager pods are restarted:

   ```
   kubectl get pods -n occne-infra |grep alertmanager
   ```

   Sample output:

   ```
   alertmanager-occne-kube-prom-stack-kube-alertmanager-0         2/2     Running
   0             16s
   alertmanager-occne-kube-prom-stack-kube-alertmanager-1         2/2     Running
   0             35s
   ```

7.2.5.3 Changing the Resources for Grafana

This section describes the procedure to change the RAM or CPU resources for Grafana.

Procedure

1. Run the following command to edit the Grafana resource:

   ```
   kubectl edit deploy occne-kube-prom-stack-grafana -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE Grafana instances.
2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the Grafana pod.
   For example:

   ```
   resources:
       limits:
         cpu: 100m
         memory: 128Mi
       requests:
         cpu: 100m
         memory: 128Mi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the Grafana pod is restarted:

   ```
   kubectl get pods -n occne-infra |grep grafana
   ```

   Sample output:

   ```
   occne-kube-prom-stack-grafana-84898d89b4-nzkr4                3/3     Running
   0             54s
   ```

7.2.5.4 Changing the Resources for Kube State Metrics

This section describes the procedure to change the RAM or CPU resources for kube-state-metrics.

Procedure

1. Run the following command to edit the kube-state-metrics resource:

   ```
   kubectl edit deploy occne-kube-prom-stack-kube-state-metrics -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE kube-state-metrics instances.
2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the kube-state-metrics pod.

For example:

```
resources:
    limits:
      cpu: 20m
      memory: 100Mi
    requests:
      cpu: 20m
      memory: 32Mi
```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the kube-state-metrics pod is restarted:

   ```
   kubectl get pods -n occne-infra |grep kube-state-metrics
   ```

   Sample output:

   ```
   occne-kube-prom-stack-kube-state-metrics-cff54c76c-t5k7p        1/1     Running
   0             20s
   ```

7.2.5.5 Changing the Resources for OpenSearch

This section describes the procedure to change the RAM or CPU resources for OpenSearch.

Procedure

1. Run the following command to edit the opensearch-master resource:

   ```
   kubectl edit sts occne-opensearch-cluster-master -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE opensearch-master instances.
2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the opensearch-master pod.
   For example:

   ```
   resources:
       limits:
         cpu: "1"
         memory: 2Gi
       requests:
         cpu: "1"
         memory: 2Gi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the opensearch-master pods are restarted:

   ```
   kubectl get pods -n occne-infra |grep opensearch-cluster-master
   ```

   Sample output:

   ```
   occne-opensearch-cluster-master-0                          1/1     Running
   0             3m34s
   occne-opensearch-cluster-master-1                          1/1     Running
   ```

```
0             4m8s
occne-opensearch-cluster-master-2                          1/1     Running
0             4m19s
```

> **Note**
>
> Repeat this procedure for opensearch-data and opensearch-client pods if required.

7.2.5.6 Changing the Resources for OpenSearch Dashboard

This section describes the procedure to change the RAM or CPU resources for OpenSearch Dashboard.

Procedure

1. Run the following command to edit the opensearch-dashboard resource:

   ```
   kubectl edit deploy occne-opensearch-dashboards -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE opensearch-dashboard instances.
2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the opensearch-dashboard pod.
   For example:

   ```
   resources:
       limits:
         cpu: 100m
         memory: 512Mi
       requests:
         cpu: 100m
         memory: 512Mi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the opensearch-dashboard pod is restarted:

   ```
   kubectl get pods -n occne-infra |grep dashboard
   ```

   Sample output:

   ```
   occne-opensearch-dashboards-7b7749c5f7-jcs7d               1/1     Running
   0             20s
   ```

7.2.5.7 Changing the Resources for Fluentd OpenSearch

This section describes the procedure to change the RAM or CPU resources for Fluentd OpenSearch.

Procedure

1. Run the following command to edit the `occne-fluentd-opensearch` resource:

   ```
   kubectl edit ds occne-fluentd-opensearch -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE Fluentd OpenSearch instances.
2. Scroll to the resources section and change the CPU and memory resources to the desired values. This updates the resources for the Fluentd OpenSearch pods.
   For example:

   ```
   resources:
       limits:
         cpu: 100m
         memory: 128Mi
       requests:
         cpu: 100m
         memory: 128Mi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the Fluentd OpenSearch pods are restarted:

   ```
   kubectl get pods -n occne-infra |grep fluentd-opensearch
   ```

   Sample output:

   ```
   occne-fluentd-opensearch-kcx87                                    1/1
   Running   0             19s
   occne-fluentd-opensearch-m9zhz                                    1/1
   Running   0             9s
   occne-fluentd-opensearch-pbbrw                                    1/1
   Running   0             14s
   occne-fluentd-opensearch-rstqf                                    1/1
   Running   0             4s
   ```

7.2.5.8 Changing the Resources for Jaeger Agent

This section describes the procedure to change the RAM or CPU resources for Jaeger Agent.

Procedure

1. Run the following command to edit the jaeger-agent resource:

   ```
   kubectl edit ds occne-tracer-jaeger-agent -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE jaeger-agent instances.

2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the jaeger-agent pods.
   For example:

   ```
   resources:
       limits:
         cpu: 500m
         memory: 512Mi
       requests:
         cpu: 256m
         memory: 128Mi
   ```

3. Type `:wq` to exit the editor session and save the changes.
4. Verify if the jaeger-agent pods are restarted:

   ```
   kubectl get pods -n occne-infra |grep jaeger-agent
   ```

   Sample output:

   ```
   occne-tracer-jaeger-agent-dpn4v                                  1/1     Running
   0             58s
   occne-tracer-jaeger-agent-dvpnv                                  1/1     Running
   0             62s
   occne-tracer-jaeger-agent-h4t67                                  1/1     Running
   0             55s
   occne-tracer-jaeger-agent-q92ld                                  1/1     Running
   0             51s
   ```

7.2.5.9 Changing the Resources for Jaeger Query

This section describes the procedure to change the RAM or CPU resources for Jaeger Query.

Procedure

1. Run the following command to edit the jaeger-query resource:

   ```
   kubectl edit deploy occne-tracer-jaeger-query -n occne-infra
   ```

   The system opens a `vi` editor session that contains all the configuration for the CNE jaeger-query instances.
2. Scroll to the resources section and change the CPU and Memory resources to the desired values. This updates the resources for the jaeger-query pod.
   For example:

   ```
   resources:
       limits:
         cpu: 500m
         memory: 512Mi
       requests:
         cpu: 256m
         memory: 128Mi
   ```

3. Type `:wq` to exit the editor session and save the changes.

4. Verify if the jaeger-query pod is restarted:

   ```
   kubectl get pods -n occne-infra |grep jaeger-query
   ```

   Sample output:

   ```
   occne-tracer-jaeger-query-67bdd85fcb-hw67q                    2/2     Running
   0             19s
   ```

> **Note**
>
> Repeat this procedure for the jaeger-collector pod if required.

7.2.6 Activating and Configuring Local DNS

This section provides information about activating and configuring local DNS.

7.2.6.1 Activating Local DNS

Local DNS allows CNE clusters to perform domain name lookups within Kubernetes clusters. This section provides the procedure to activate the local DNS feature on a CNE cluster.

> **Note**
>
> Before activating Local DNS, ensure that you are aware about the following conditions:
>
> - Local DNS does not handle backups of any added record.
> - You must run this procedure to activate local DNS only after installing or upgrading to release 25.1.20x.
> - Once you activate Local DNS, you cannot rollback or deactivate the feature.

7.2.6.1.1 Prerequisites

Before activating local DNS, ensure that the following prerequisites are met:

- Ensure that the cluster is running in a healthy state.
- Ensure that the CNE cluster is running with version 25.1.20x. You can validate the CNE version by echoing the `OCCNE_VERSION` environment variable on Bastion Host:

  ```
  echo $OCCNE_VERSION
  ```

- Ensure that the cluster is running with the Bastion DNS configuration.

7.2.6.1.2 Preactivation Checks

This section provides information about the checks that are performed before activating local DNS.

Determining the Active Bastion Host

1. Log in to the Active Bastion Host (for example, Bastion 1). Verify if the current Bastion is active:

   ```
   $ is_active_bastion
   ```

   The system displays the following output if the Bastion Host is active:

   ```
   IS active-bastion
   ```

2. If the current Bastion is not active, then log in to the mate Bastion Host and verify if it is active:

   ```
   $ is_active_bastion
   ```

   The system displays the following output if the Bastion Host is active:

   ```
   IS active-bastion
   ```

Determining the current state of the bastion_http_server service API

> **Note**
>
> By default, after the post-installation procedure the `bastion_http_server` service is disabled and shut down.

1. Verify the current status of the `bastion_http_server` API by running the following command:

   ```
   $ systemctl status bastion_http_server.service
   ```

   The following sample output displays the service as inactive and disabled:

   ```
   bastion_http_server.service - Bastion http server
        Loaded: loaded (/etc/systemd/system/bastion_http_server.service;
   disabled; preset: disabled)
        Active: inactive (dead)

   May 06 23:01:39 occne-test-bastion-1.novalocal systemd[1]: Stopping
   Bastion http server...
   May 06 23:01:40 occne-test-bastion-1.novalocal gunicorn[82034]:
   [2025-05-06 23:01:39 +0000] [82034] [INFO] Handling signal: term
   May 06 23:01:40 occne-test-bastion-1.novalocal gunicorn[82057]:
   [2025-05-06 23:01:39 +0000] [82057] [INFO] Worker exiting (pid: 82057)
   May 06 23:01:40 occne-test-bastion-1.novalocal gunicorn[82056]:
   [2025-05-06 23:01:39 +0000] [82056] [INFO] Worker exiting (pid: 82056)
   May 06 23:01:40 occne-test-bastion-1.novalocal gunicorn[82055]:
   [2025-05-06 23:01:39 +0000] [82055] [INFO] Worker exiting (pid: 82055)
   May 06 23:01:41 occne-test-bastion-1.novalocal gunicorn[82034]:
   [2025-05-06 23:01:41 +0000] [82034] [INFO] Shutting down: Master
   May 06 23:01:42 occne-test-bastion-1.novalocal systemd[1]:
   bastion_http_server.service: Deactivated successfully.
   ```

```
May 06 23:01:42 occne-test-bastion-1.novalocal systemd[1]: Stopped Bastion
http server.
May 06 23:01:42 occne-test-bastion-1.novalocal systemd[1]:
bastion_http_server.service: Consumed 3min 37.802s CPU time.
```

Verifying if Local DNS is Already Activated

1. Navigate to the cluster directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}
   ```

2. Open the `occne.ini` file (for vCNE) or `hosts.ini` file (for Bare Metal) and verify if the `local_dns_enabled` variable under the `occne:vars` header is set to *False*.
   Example for vCNE:

   ```
   $ cat occne.ini
   ```

   Sample output:

   ```
   [occne:vars]
   .
   local_dns_enabled=False
   .
   ```

   Example for Bare Metal:

   ```
   $ cat hosts.ini
   ```

   Sample output:

   ```
   [occne:vars]
   .
   local_dns_enabled=False
   .
   ```

   If `local_dns_enabled` is set to *True*, then it indicates that local DNS feature is already enabled in the CNE cluster. If the variable is present, it should be included under the `occne:vars` header. If the variable setting is otherwise, then Local DNS is disabled.

   > **Note**
   >
   > Ensure that the first character of the variable value (*True* or *False*) is capitalized and there is no space before and after the equal to sign.

7.2.6.1.3 Enabling Local DNS

This section provides the procedure to enable Local DNS in a CNE cluster.

1. Log in to the active Bastion Host and run the following command to navigate to the cluster directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}
   ```

2. Open the `occne.ini` file (for vCNE) or `hosts.ini` file (for Bare metal) in edit mode:

Example for vCNE:

```
$ vi occne.ini
```

Example for Bare Metal:

```
$ vi hosts.ini
```

3. Set the `local_dns_enabled` variable under the `occne:vars` header to *True*. If the `local_dns_enabled` variable is not present under the `occne:vars` header, then add the variable.

> **Note**
>
> Ensure that the first character of the variable value (*True* or *False*) is capitalized and there is no space before and after the equal to sign.

For example,

```
[occne:vars]
.
local_dns_enabled=True
.
```

4. For vCNE (OpenStack or VMware) deployments, additionally add the `provider_domain_name` and `provider_ip_address` variables under the `occne:vars` section of the `occne.ini` file. You can obtain the provider domain name and IP address from the provider administrator and set the variable values accordingly.
The following block shows the sample `occne.ini` file with the additional variables:

```
[occne:vars]
.
local_dns_enabled=True
provider_domain_name=<cloud provider domain name>
provider_ip_address=<cloud provider IP address>
.
```

5. Run the following commands on Bastion Host to enable and start the `bastion_http_server` service:

```
$ sudo systemctl enable bastion_http_server.service
$ sudo systemctl start bastion_http_server.service
```

6. Update the cluster with the new settings in the ini file:

```
$ OCCNE_CONTAINERS=(K8S) OCCNE_STAGES=(DEPLOY) OCCNE_ARGS='--tags=coredns'
pipeline.sh
```

7.2.6.1.4 Validating Local DNS

This section provides the steps to validate if you have successfully enabled local DNS.

Local DNS provides the `validateLocalDns.py` script to validate if you have successfully enabled Local DNS. The `validateLocalDns.py` script is located in the `/var/occne/cluster/${OCCNE_CLUSTER}/artifacts/maintenance/validateLocalDns.py` folder. This automated script validates Local DNS by performing the following actions:

1. Creating a test record
2. Reloading local DNS
3. Querying the test record from within a pod
4. Getting the response (Success status)
5. Deleting the test record

To run the `validateLocalDns.py` script:

1. Log in to the active Bastion Host and navigate to the cluster directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}
   ```

2. Run the `validateLocalDns.py` script:

   ```
   $ ./artifacts/maintenance/validateLocalDns.py
   ```

   Sample output:

   ```
   Beginning local DNS validation
    - Validating local DNS configuration in occne.ini
    - Adding DNS A record.
    - Adding DNS SRV record.
    - Reloading local coredns.
    - Verifying local DNS A record.
      - DNS A entry has not been propagated, retrying in 10 seconds (retry 1/5)
    - Verifying local DNS SRV record.
    - Deleting DNS SRV record.
    - Deleting DNS A record.
    - Reloading local coredns.
   Validation successful
   ```

   > **Note**
   >
   > If the script encounters an error, it returns an error message indicating which part of the process failed. For more information about troubleshooting local DNS errors, see Troubleshooting Local DNS.

3. Once you successfully enable Local DNS, add the external hostname records using the Local DNS API to resolve external domain names using CoreDNS. For more information, see Adding and Removing DNS Records.

7.2.6.2 Deactivating Local DNS

This section provides the procedure to deactivate Local DNS in a CNE cluster.

1. Log in to Bastion Host (for example, Bastion 1) and determine if that Bastion Host is active or not. If the current Bastion is not active, then log in to the mate Bastion and verify if the mate Bastion is active or not.
   Run the following command to check if Bastion Host is active or not:

   ```
   $ is_active_bastion
   IS active-bastion
   ```

2. Deactivating local DNS:

a. On the active Bastion Host, change to the cluster directory from the existing directory.

```
$ cd /var/occne/cluster/${OCCNE_CLUSTER}
```

b. Edit the `occne.ini` (vCNE) or `hosts.ini` (Bare metal) file.
Example for vCNE:

```
$ vi occne.ini
```

Example for Bare Metal:

```
$ vi hosts.ini
```

c. Set the `local_dns_enabled` variable under the `occne:vars` header to False. If the `local_dns_enabled` variable is not present under the `occne:vars` header, then add the variable.

> **Note**
>
> Ensure that the first character of the variable value (True or False) is capitalized and there is no space before and after the equal to sign.

For example,

```
[occne:vars]
.
local_dns_enabled=False
.
```

d. Delete the CoreDNS configmap using the following command:

> **Note**
>
> Running the following command will delete all the records added using the API as part of Local DNS.

```
$ kubectl delete cm coredns -n kube-system
```

e. Run the following commands on the bastion host to stop and disable the bastion_http_server service:

```
$ sudo systemctl stop bastion_http_server.service
$ sudo systemctl disable bastion_http_server.service
```

f. Update the cluster with the new settings in the ini file:

```
$ OCCNE_CONTAINERS=(K8S) OCCNE_STAGES=(DEPLOY) OCCNE_ARGS='--
tags=coredns' pipeline.sh
```

7.2.6.3 Adding and Removing DNS Records

This section provides the procedures to add and remove DNS records ("A" records and SRV records) using Local DNS API to the core DNS configuration.

Each Bastion Host runs a version of the Local DNS API as a service on port 8000. The system doesn't require any authentication from inside a Bastion Host and runs the API requests locally.

7.2.6.3.1 Prerequisites

Before adding or removing DNS records, ensure that the following prerequisites are met:

- The Local DNS feature must be enabled on the cluster. For more information about enabling Local DNS, see Activating Local DNS.
- The CNE cluster version must be 23.2.x or above.

7.2.6.3.2 Adding an A Record

This section provides information on how to use the Local DNS API to create or add an A record in the CNE cluster.

The system creates zones to group records with similar domain names together. When an API call is made to the Local DNS API, the request payload (request body) is used to create the zones automatically. The system creates a new zone when it identifies a domain name for the first time. Henceforth, it stores each request coming with the same domain name within the same zone.

> **Note**
>
> - You cannot create and maintain identical A records.
> - You cannot create two A records with the same name.

The following table provides details on how to use the Local DNS API to add an "A" record:

Table 7-1 Adding an A Record

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response

`http://localhost:8000/occne/dns/a`	POST	application/json	`{ "name": "string", "ttl": "integer", "ip-address": "string" }`
			
			Note: Define each field in the request body within double quotes (" ").
			Sample request:
			
			`curl -X POST http://localhost:8000/occne/dns/a \ -H 'Content-Type: application/json' \ -d '{"name":"occne.lab.oracle.com","ttl":"3600","ip-address":"175.80.200.20"}'`
				• 200: Record Added Successfully.
				• 400: Already exists, request payload/ parameters incomplete or not valid.
				• 503: Could not be added, internal error.
					`200: DNS A record added in coredns file for occne.lab.oracle.com 175.80.200.20 3600, msg SUCCESS: Zone info and A record updated for domain name`

The following table provides details about the request body parameters:

Table 7-2 Request Body Parameters

Parameter	Required or Optional	Type	Description
name	Required	string	Fully-Qualified Domain Name (FQDN) to be include in the core DNS. This parameter can contain multiple subdomains where each subdomain can range between 1 and 63 characters and contain the following characters: `[a-zA-Z0-9_-]`. This parameter cannot start or end with `-` or `_`. The last segment of this parameter is taken as the domain name to create zones. For example, `sample.oracle.com`
ip-address	Required	string	The IP address to locate a service. For example, `xxx.xxx.xxx.xxx`. The API supports IPv4 protocol only.
ttl	Required	integer	The Time To Live (TTL) in seconds. This is the amount of time the record is allowed to be cached by a resolver. The minimum and the maximum value that can be set are 300 and 3600 respectively.

7.2.6.3.3 Deleting an A Record

This section provides information on how to use the Local DNS API to delete an A record in the CNE cluster.

> **Note**
>
> - When the last A record in a zone is deleted, the system deletes the zone as well.
> - You cannot delete an A record that is linked to an existing SRV record. You much first delete the linked SRV record to delete the A record.

The following table provides details on how to use the Local DNS API to delete an "A" record:

Table 7-3 Deleting an A Record

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response

`http://localhost:8000/occne/dns/a`	DELETE	application/json	`{ "name": "string", "ip-address": "string" }`
			
			Note: Define each field in the request body within double quotes (" ").
			Sample request:
			
			`curl -X DELETE http://localhost:8000/occne/dns/a \ -H 'Content-Type: application/json' \ -d '{"name":"occne.lab.oracle.com","ip-address":"175.80.200.20"}'`
				• 200: Record Deleted Successfully.
				• 400: Record does not exist, or request payload/ parameters are incomplete or not valid.
				• 503: Could not be deleted, internal error.
					200: `DNS A record added in coredns file for occne.lab.oracle.com 175.80.200.203600, msg SUCCESS: Zone info and A record updated for domain name`

The following table provides details about the request body parameters:

Table 7-4 Request Body Parameters

Parameter	Required or Optional	Type	Description
name	Required	string	Fully-Qualified Domain Name (FQDN). This parameter can contain multiple subdomains where each subdomain can range between 1 and 63 characters and contain the following characters: `[a-zA-Z0-9_-]`. This parameter cannot start or end with `-` or `_`. For example, `sample.oracle.com`
ip-address	Required	string	The IP address to locate a service. For example, `xxx.xxx.xxx.xxx`.

7.2.6.3.4 Adding an SRV Record

This section provides information on how to use the Local DNS API to create or add an SRV record in the CNE cluster.

SRV records are linked to A records. To add a new SRV record, you must already have an A record in the system. Adding an SRV record creates a dependency between the A record and the SRV record. Therefore, to delete an A record, you must first delete the SRV record pointing to the A record. When you are adding an SRV record, the system adds the SRV record to the designated zone, matching the domain name and the related A record.

> **Note**
>
> - You cannot create and maintain identical SRV records. However, you can have a different protocol for the same combo service and target A record.
> - Currently, there is no provision to edit an existing SRV record. If you want to edit an SRV record, then delete the existing SRV record and then re-add the record with the updated parameters (weight, priority, or TTL).

The following table provides details on how to use the Local DNS API to create an SRV record:

Table 7-5 Adding an SRV Record

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response

`https://localhost:8000/occne/dns/srv`	POST	application/json	`{ "service": "string", "protocol": "string", "dn": "string", "ttl": "integer" "priority": "integer", "weight": "integer", "port": "integer", "server": "string", "a_record": "string" }`
			
			Note: Define each field in the request body within double quotes (" ").
			Sample request:
			
			`curl -X POST http://localhost:8000/occne/dns/srv \ -H 'Content-Type: application/json' \ -d '{"service":"sip","protocol":"tcp","dn":"lab.oracle.com","ttl":"3600","weight":"100","port":"35061","server":"occne","priority":"10","a_`
				• 200: Record Added Successfully.
				• 400: Request payload/ parameters incomplete or not valid.
				• 409: Already exists.
				• 503: Could not be added, internal error.
					200: `SUCCESS: SRV record successfully added to config map coredns.`

Table 7-5 (Cont.) Adding an SRV Record

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response
			`record":"occne.lab.oracle.com"}'`		

The following table provides details about the request body parameters:

Table 7-6 Request Body Parameters

Parameter	Required or Optional	Type	Description
service	Required	string	The symbolic name for the service, such as "sip", and "my_sql". The value of this parameter can range between 1 and 63 characters and contain the following characters: [a-zA-Z0-9_-]. The parameter cannot start or end with - or _.
protocol	Required	string	The protocol supported by the service. The allowed values are: • tcp • tcp

Table 7-6 (Cont.) Request Body Parameters

Parameter	Required or Optional	Type	Description
dn	Required	string	The domain name that the SRV record is applicable to. This parameter can contain multiple subdomains where each subdomain can range between 1 and 63 characters and contain the following characters: `[a-zA-Z0-9_-]`. For example: `lab.oracle.com`. If the SRV record is applicable to the entire domain, then provide only the domain name without subdomains. For example, `oracle.com` The length of the Top Level Domains (TLD) must be between 1 and 6 characters and must only contain the following characters: `[a-z]`. For example: .com, .net, and .uk.
ttl	Required	integer	The Time To Live (TTL) in seconds. This is the amount of time the record is allowed to be cached by a resolver. This value can range between 300 and 3600.
priority	Required	integer	The priority of the current SRV record in comparison to the other SRV records. The values can range from 0 to n.
weight	Required	integer	The weight of the current SRV record in comparison to the other SRV records with the same priority. The values can range from 0 to n.
port	Required	integer	The port on which the target service is found. The values can range from 1 to 65535.

Table 7-6 (Cont.) Request Body Parameters

Parameter	Required or Optional	Type	Description
server	Required	string	The name of the machine providing the service without including the domain name (value provided in the `dn` field). The value can range between 1 and 63 characters and contain the following characters: `[a-zA-Z0-9_-]`. The parameter cannot start or end with `-` or `_`. For example: `occne-node1`.
a_record	Required	string	The "A" record name to which the SRV is added. The "A" record mentioned here must be already added. Otherwise the request fails.

7.2.6.3.5 Deleting an SRV Record

This section provides information on how to use the Local DNS API to delete an SRV record in the CNE cluster.

> **Note**
>
> To delete an SRV record, the details in the request payload must exactly match the details, such as weight, priority, and ttl, of an existing SRV record.

The following table provides details on how to use the Local DNS API to delete an SRV record:

Table 7-7 Deleting an SRV Record

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response

`https://localhost:8000/occne/dns/srv`	DELETE	application/json	`{ "service": "string", "protocol": "string", "dn": "string", "ttl": "integer" "priority": "integer", "weight": "integer", "port": "integer", "server": "string" "a_record": "string" }`
			
			Note: Define each field in the request body within double quotes (" ").
			Sample request:
			
			`curl -X DELETE http://localhost:8000/occne/dns/srv \ -H 'Content-Type: application/json' \ -d '{"service":"sip","protocol":"tcp","dn":"lab.oracle.com","ttl":"3600","weight":"100","port":"35061","server":"occne","priority":"10","a_`
				• 200: Record Deleted Successfully.
				• 400: Record does not exist, or request payload/ parameters incomplete or not valid.
				• 503: Could not be deleted, internal error.
					200: `SUCCESS: SRV record successfully deleted from config map coredns`

Table 7-7 (Cont.) Deleting an SRV Record

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response
			`record":"occne.lab.oracle.com"}'`		

The following table provides details about the request body parameters:

Table 7-8 Request Body Parameters

Parameter	Required or Optional	Type	Description
service	Required	string	The symbolic name for the service, such as "sip", and "my_sql". The value of this parameter can range between 1 and 63 characters and contain the following characters: [a-zA-Z0-9_-]. The parameter cannot start or end with - or _.
protocol	Required	string	The protocol supported by the service. The allowed values are: • tcp • tcp
dn	Required	string	The domain name that the SRV record is applicable to. This parameter can contain multiple subdomains where each subdomain can range between 1 and 63 characters and contain the following characters: `[a-zA-Z0-9_-]`. The length of the Top Level Domains (TLD) must be between 1 and 6 characters and must only contain the following characters: `[a-z]`. For example: .com, .net, and .uk.

Table 7-8 (Cont.) Request Body Parameters

Parameter	Required or Optional	Type	Description
ttl	Required	integer	The Time To Live (TTL) in seconds. This is the amount of time the record is allowed to be cached by a resolver. This value can range between 300 and 3600.
priority	Required	integer	The priority of the current SRV record in comparison to the other SRV records. The values can range from 0 to n.
weight	Required	integer	The weight of the current SRV record in comparison to the other SRV records with the same priority. The values can range from 0 to n.
port	Required	integer	The port on which the target service is found. The values can range from 1 to 65535.
server	Required	string	The name of the machine providing the service minus the domain name (the value in the dn field). The value can range from 1 and 63 characters and contain the following characters: `[a-zA-Z0-9_-]`. The parameter cannot start or end with `-` or _.
a_record	Required	string	The "A" record name from which the SRV is deleted. The "A" record mentioned here must be already added. Otherwise the request fails.

7.2.6.4 Adding and Removing Forwarding Nameservers

The forward section added in the coreDNS forwards the queries to the nameservers if they are not resolved by coreDNS. This section provides information about adding or removing forwarding nameservers using the `forward` endpoint provided by Local DNS API.

7.2.6.4.1 Adding Forwarding Nameservers

This section provides information about adding forward section in coreDNS using the `forward` endpoint provided by Local DNS API.

> **Note**
>
> - Add forward section in coreDNS by using the payload data.
> - Ensure that the forward section is not added already.

The following table provides details on how to use the Local DNS API endpoint to add forward section:

Table 7-9 Adding Forwarding Nameserver

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response

`https://localhost:8000/occne/dns/forward`	POST	application/json	`{ "ip-address": "string", }`
			
			Note: Define each field in the request body within double quotes (" ").
			Sample request to add forward section:
			
			`curl -X POST http://localhost:8000/occne/dns/forward \ -H 'Content-Type: application/json' \ -d '{"ip-address":"192.168.100.25,10.75.100.5"}'`
				• 200: Forward successfully configured.
				• 400: Request payload/ parameters incomplete or not valid.
				• 503: Could not configure, internal error.
					200: `SUCCESS: Forwarding nameserver list added to coredns successfully`

The following table provides details about the request body parameters:

Table 7-10 Request Body Parameters

Parameter	Required or Optional	Type	Description
ip-address	Required	string	The IP addresses to forward the requests. You can define up to 15 IP addresses. The IP addresses must be valid IPv4 addresses and they must be defined as a comma separated list without extra space.

7.2.6.4.2 Removing Forwarding Nameservers

This section provides information about deleting forward section in coreDNS using the `forward` endpoint provided by Local DNS API.

> **Note**
>
> - CNE doesn't support updating the forward section. If you want to update the forward nameservers, then remove the existing forward section and add a new one with the updated data.
> - Before removing the forward section, ensure that there is already a forward section to delete.

The following table provides details on how to use the Local DNS API endpoint to remove forward section:

Table 7-11 Removing Forwarding Nameserver

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response
`https://localhost:8000/occne/dns/forward`	DELETE	NA	Sample request to delete forward section: `curl -X DELETE http://localhost:8000/occne/dns/forward`	• 200: Forward configuration successfully removed. • 400: Request payload/ parameters incomplete or not valid. Not configured, unable to remove. • 503: Could not configure, internal error.	200: `SUCCESS: Forwarding nameserver list deleted from coredns successfully`

7.2.6.5 Reloading Local or Core DNS Configurations

This section provides information about reloading core DNS configuration using the `reload` endpoint provided by Local DNS API.

> **Note**
>
> You must reload the core DNS configuration to commit the last configuration update, whenever you:
>
> - add or remove multiple records in the same zone
> - update a single or multiple DNS records

The following table provides details on how to use the Local DNS API endpoint to reload the core DNS configuration:

Table 7-12 Reloading Local or Core DNS Configurations

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response

`http://localhost:8000/occne/coredns/reload`	POST	application/json	`{ "deployment-name": "string", "namespace": "string" }`
			
			Note:
			• Define each field in the request body within double quotes (" ").
			• Currently, the system always uses the default values for the `"deployment-name"` and `"namespace"` parameters and doesn't consider any modification done to them. This will be address in the future releases.
			
			Sample request to reload the core DNS without payload (using the default values):
			
			`curl -X POST http://localhost:8000/occne/coredns/reload`
			
			Sample request to reload the core DNS using the payload:
			
			`curl -X POST http://localhost:8000/occne/coredns/reload \ -H 'Content-`
				• 200: Local DNS or Core DNS Reloaded Successfully.
				• 400: Request payload/ parameters incomplete or not valid.
				• 503: Could not be reloaded, internal error.
					200: `Deployment reloaded, msg SUCCESS: Reloaded coredns deployment in ns kube-system`

Table 7-12 (Cont.) Reloading Local or Core DNS Configurations

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response
			`Type: application/ json' \ -d '{"deployment-name":"coredns","namespace":"kube-system"}'`		

The following table provides details about the request body parameters:

Table 7-13 Request Body Parameters

Parameter	Required or Optional	Type	Description
deployment-name	Required	string	The deployment Name to be reloaded. The value must be a valid Kubernetes deployment name. The default value is *coredns*.
namespace	Required	string	The namespace where the deployment exists. The value must be a valid Kubernetes namespace name. The default value is *kube-system*.

7.2.6.6 Other Local DNS API Endpoints

This section provides information about the additional endpoints provided by Local DNS API.

Get Data

The Local DNS API provides an endpoint to get the current configuration, zones and records of local DNS or core DNS.

The following table provides details on how to use the Local DNS API endpoint to get the Local DNS or core DNS configuration details:

Table 7-14 Get Local DNS or Core DNS Configurations

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response
`http://localhost:8000/occne/dns/data`	GET	NA	Sample request: `curl -X GET http://localhost:8000/occne/dns/data`	• 200: Returns core DNS configmap data, including zones and records. • 503: Could not get data, internal error.	200: `[True, {'api_version': 'v1', 'binary_data': None, 'data': {'Corefile': '.:53 {\n' ... # Output Omitted ... 'db.oracle.com': ';oracle.com db file\n' 'oracle.com. 300 ' 'IN SOA ns1.oracle.com andrei.oracle.com ' '201307231 3600 10800 86400 3600\n' 'occne1.us.oracle.com. ' '3600 IN A ' '10.65.200.182\n' '_sip._tcp.lab.o`

Table 7-14 (Cont.) Get Local DNS or Core DNS Configurations

Request URL	HTTP Method	Content Type	Request Body	Response Code	Sample Response
					racle.com 30 IN SRV 10 102 32061 ' 'occne.lab.oracle.com.\n' 'occne.lab.oracle.com. ' '3600 IN A ' '175.80.200.20\n', ... # Output Omitted ...

7.2.6.7 Troubleshooting Local DNS

This section describes the issues that you may encounter while configuring Local DNS and their troubleshooting guidelines.

By design, the Local DNS functionality is built on top of the core DNS (CoreDNS). Therefore, all the troubleshooting, logging, and configuration management are performed directly on the core DNS. Each cluster runs a CoreDNS deployment (2 pods), with the rolling update strategy. Therefore, any change in the configuration is applied to both the pods one by one. This process can take some time (approximately, 30 to 60 seconds to reload both pods).

A NodeLocalDNS daemonset is a cache implementation of core DNS. The NodeLocalDNS runs as a pod on each node and is used for quick DNS resolution. When a pod requires a certain domain name resolution, it first checks its NodeLocalDNS pod, the one running in the same node, for resolution. If the pod doesn't get the required resolution, then it forwards the request to the core DNS.

All local DNS records are stored inside the core DNS configmap grouped by zones.

> **Note**
>
> Use the active Bastion to run all the troubleshooting procedures in this section.

7.2.6.7.1 Troubleshooting Local DNS API

This section provides the troubleshooting guidelines for the common scenarios that you may encounter while using Local DNS API.

Validating Local DNS API

Local DNS API, that is used to add or remove DNS records, runs as a service ("bastion_http_server") in all Bastion servers. To validate if the API is up and running, run the following command from a Bastion server:

```
$ systemctl status bastion_http_server
```

Sample output:

```
● bastion_http_server.service - Bastion http server
Loaded: loaded (/etc/systemd/system/bastion_http_server.service; enabled; vendor preset:
disabled)
Active: active (running) since Wed 2023-04-12 00:12:51 UTC; 1 day 19h ago
Main PID: 283470 (gunicorn)
Tasks: 4 (limit: 23553)
Memory: 102.6M
CGroup: /system.slice/bastion_http_server.service
├──283470 /usr/bin/python3.6 /usr/local/bin/gunicorn --workers=3 --bind 0.0.0.0:8000 --
chdir /bin/bastion_http_setup wsgi:app --max-requests 0 --timeout 5 --keep>
├──283474 /usr/bin/python3.6 /usr/local/bin/gunicorn --workers=3 --bind 0.0.0.0:8000 --
chdir /bin/bastion_http_setup wsgi:app --max-requests 0 --timeout 5 --keep>
├──283476 /usr/bin/python3.6 /usr/local/bin/gunicorn --workers=3 --bind 0.0.0.0:8000 --
chdir /bin/bastion_http_setup wsgi:app --max-requests 0 --timeout 5 --keep>
└──641094 /usr/bin/python3.6 /usr/local/bin/gunicorn --workers=3 --bind 0.0.0.0:8000 --
chdir /bin/bastion_http_setup wsgi:app --max-requests 0 --timeout 5 --keep>
```

The sample output shows the status of the `Bastion http server` service as *active (running)* and *enabled*. All Bastion servers have their own independent version of this service. Therefore, it is recommended to check the status of all Bastion servers.

Starting or Restarting Local DNS API

If Local DNS API is not running, run the following command to start or restart it:

Command to start Local DNS API:

```
$ sudo systemctl start bastion_http_server
```

Command to restart Local DNS API:

```
$ sudo systemctl restart bastion_http_server
```

The start and restart commands don't display any output on completion. To check the status of Local DNS API, perform the Validating Local DNS API procedure.

If bastion_http_server doesn't run even after starting or restarting it, refer to the following section to check its log.

Generating and Checking Local DNS Logs

This section provides details about generating and checking Local DNS logs.

Generating Local DNS Logs

You can use `journalctl` to get the logs of Local DNS API that runs as a service (`bastion_http_server`) on each bastion server.

Run the following command to get the logs of Local DNS API:

```
$ journalctl -u bastion_http_server
```

Run the following command to print only the latest 20 logs of Local DNS API:

```
journalctl -u bastion_http_server --no-pager -n 20
```

> **Note**
>
> In the interactive mode, you can use the keyboard shortcuts to scroll through the logs. The system displays the latest logs at the end.

Sample output:

```
-- Logs begin at Tue 2023-04-11 22:36:02 UTC. --
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,357
BHHTTP:INFO: Request payload: Record name occne.lab.oracle.com record ip 175.80.200.20
[/bin/bastion_http_setup/bastionApp.py:125]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,357
BHHTTP:INFO: Domain name oracle.com db name db.oracle.com for record entry [/bin/
bastion_http_setup/coreDnsData.py:362]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,369
BHHTTP:INFO: SUCCESS:  Validate coredns common config msg data oracle.com [/bin/
bastion_http_setup/commons.py:36]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,380
BHHTTP:INFO: SUCCESS:  A Record deleted msg data occne.lab.oracle.com [/bin/
bastion_http_setup/commons.py:36]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,380
BHHTTP:INFO: SUCCESS:  A Record deleted msg data occne.lab.oracle.com [/bin/
bastion_http_setup/commons.py:36]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,380
BHHTTP:INFO: Domain name oracle.com db name db.oracle.com for record entry [/bin/
bastion_http_setup/coreDnsData.py:362]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,388
BHHTTP:INFO: SUCCESS:  Validate coredns common config msg data oracle.com [/bin/
bastion_http_setup/commons.py:36]
Apr 12 16:33:27 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:33:27,388
BHHTTP:INFO: DNS A record deleted in coredns file for occne.lab.oracle.com
175.80.200.20,  msg SUCCESS:  SUCCESS:  A Record deleted [/bin/bastion_http_setup/
commons.py:47]
Apr 12 16:34:13 test-bastion-1.novalocal gunicorn[283474]: 2023-04-12 16:34:13,487
BHHTTP:INFO: Deployment reloaded,  msg SUCCESS:  Reloaded coredns deployment in ns kube-
system [/bin/bastion_http_setup/commons.py:47]
```

Checking Local DNS Logs

Local DNS logs contain information, errors, and debug messages about all the activities in Local DNS. The following table lists some of the sample messages and their description:

Table 7-15 Local DNS Log Messages

Message	Type/ Level	Description
Deployment reloaded, msg SUCCESS: Reloaded coredns deployment in ns kube-system	INFO	Success message indicating that the core DNS deployment reloaded successfully.
Validate coredns common config msg data oracle.com	INFO	Indicates that the module was able to process core DNS configuration data for a specific domain name.
Request payload incomplete. Request requires name and ip-address, error missing param 'ip-address'	ERROR	Indicates an invalid payload. The API sends this type of messages when the payload used for a given record is not valid or not complete.
FAILED: A record occne.lab.oracle.com does not exists in Zone db.oracle.com	ERROR	This message is used by an API module to trigger a creation of a new zone. This error message does not require any intervention.
Already exists: DNS A record in coredns file for occne.lab.oracle.com 175.80.200.20 3600, msg SUCCESS: A record occne.lab.oracle.com already exists in Zone db.oracle.com, msg: Record occne.lab.oracle.com cannot be duplicated.	ERROR	Same domain name error. Records in the same zone cannot have the same name. This message is displayed if either of these conditions is true.
DNS A record deleted in coredns file for occne.lab.oracle.com 175.80.200.20, msg SUCCESS: A Record deleted	INFO	Success message indicating that an A record was deleted successfully.
DNS A record added in coredns file for occne.lab.oracle.com 175.80.200.20 3600, msg SUCCESS: Zone info and A record updated for domain name	INFO	Success message indicating that the API has successfully added a new A record and updated the zone information.
ERROR in app: Exception on /occne/dns/a [POST] ... Traceback Omitted	ERROR	Fatal error indicating that an exception has occurred while processing a request. You can get more information by performing a traceback. This type of error is not common and must be reported as a bug.
Zone already present with domain name oracle.com	DEBUG	This type of debug messages are not enabled by default. They are usually used to print a high amount of information while troubleshooting.
FAILED: Unable to add SRV record: _sip._tcp.lab.oracle.com. 3600 IN SRV 10 100 35061 occne.lab.oracle.com. - record already exists - data: ... Data Omitted	ERROR	Error message indicating that the record already exists and cannot be duplicated.

7.2.6.7.2 Troubleshooting Core DNS

This section provides information about troubleshooting Core DNS using the core DNS logs.

Local DNS records are added to CoreDNS configuration. Therefore, the logs are generated and reported by the core DNS pods. As per the default configuration, CoreDNS reports information logs only on start up (for example, after a reload) and on running into an error.

- Run the following command to print all logs from both core DNS pods to the terminal, separated by name:

  ```
  $ for pod in $(kubectl -n kube-system get pods | grep coredns | awk
  '{print $1}'); do echo "----- $pod -----"; kubectl -n kube-system
  logs $pod; done
  ```

  Sample output:

  ```
  ----- coredns-8ddb9dc5d-5nvrv -----
  [INFO] plugin/ready: Still waiting on: "kubernetes"
  [INFO] plugin/auto: Inserting zone `occne.lab.oracle.com.' from: /etc/
  coredns/..2023_04_12_16_34_13.510777403/db.occne.lab.oracle.com
  .:53
  [INFO] plugin/reload: Running configuration SHA512 =
  2bc9e13e66182e6e829fe1a954359de92746468f433b8748589dfe16e1afd0e790e1ff75415ad40ad1771
  1abfc7a8348fdda2770af99962db01247526afbe24a
  CoreDNS-1.9.3
  linux/amd64, go1.18.2, 45b0a11
  ----- coredns-8ddb9dc5d-6lf5s -----
  [INFO] plugin/auto: Inserting zone `occne.lab.oracle.com.' from: /etc/
  coredns/..2023_04_12_16_34_15.930764941/db.occne.lab.oracle.com
  .:53
  [INFO] plugin/reload: Running configuration SHA512 =
  2bc9e13e66182e6e829fe1a954359de92746468f433b8748589dfe16e1afd0e790e1ff75415ad40ad1771
  1abfc7a8348fdda2770af99962db01247526afbe24a
  CoreDNS-1.9.3
  linux/amd64, go1.18.2, 45b0a11
  ```

- Additionally, you can pipe the above command to a file for better readability and sharing:

  ```
  $ for pod in $(kubectl -n kube-system get pods | grep coredns | awk
  '{print $1}'); do echo "----- $pod -----"; kubectl -n kube-system
  logs $pod; done > coredns.logs
  $ vi coredns.logs
  ```

- Run the following command to get the latest logs from any of the CoreDNS pods:

  ```
  $ kubectl -n kube-system --tail 20 logs $(kubectl -n kube-system get pods
  | grep coredns | awk  '{print $1 }' | head -n 1)
  ```

  This command prints the latest 20 log entries. You can modify the `--tail` value as per your requirement.

  Sample output:

  ```
  [INFO] plugin/auto: Inserting zone `occne.lab.oracle.com.' from: /etc/
  coredns/..2023_04_13_19_29_29.1646737834/db.occne.lab.oracle.com
  .:53
  [INFO] plugin/reload: Running configuration SHA512 =
  ```

```
2bc9e13e66182e6e829fe1a954359de92746468f433b8748589dfe16e1afd0e790e1ff75415ad40ad1771
1abfc7a8348fdda2770af99962db01247526afbe24a
CoreDNS-1.9.3
linux/amd64, go1.18.2, 45b0a11
```

7.2.6.7.3 Troubleshooting DNS Records

This section provides information about validating, and querying internal and external records.

> **Note**
>
> Use the internal cluster network to resolve the records added to core DNS through local DNS API. The system does not respond if you query for a DNS record from outside the cluster (for example, querying from a Bastion server).

Validating Records

You can use any pod to access and query a DNS record in core DNS. However, most of the pods do not have the network utilities to directly query a record. In such cases, you can include the network utilities, such as bind-utils, bundled with the pods to allow them to access and query records.

You can also use the MetalLB controller pod, which is already bundled with bind-utils, to query the DNS records:

- Run the following command from a Bastion server to query an A record:

  ```
  $ kubectl -n occne-infra exec -i -t $(kubectl -n occne-infra get pod |
  grep metallb-cont | awk '{print $1}') -- nslookup occne.lab.oracle.com
  ```

  Sample output:

  ```
  .oracle.com
  Server: 169.254.25.10
  Address: 169.254.25.10:53


  Name: occne.lab.oracle.com
  Address: 175.80.200.20
  ```

- Run the following command from a Bastion server to query an SRV record:

  ```
  $ kubectl -n occne-infra exec -i -t $(kubectl -n occne-infra get pod |
  grep metallb-cont | awk '{print $1}') -- nslookup -type=srv
  _sip._tcp.lab.oracle.com
  ```

  Sample output:

  ```
  Server:         169.254.25.10
  Address:        169.254.25.10:53

  _sip._tcp.lab.oracle.com        service = 10 100 35061 occne.lab.oracle.com
  ```

> **Note**
>
> Reload the core DNS configuration after adding multiple records to ensure that your changes are applied.

The following code block provides the command to query a DNS record using a pod that is created on a different namespace. By default, this pod is not bundled with the CNE cluster:

> **Note**
>
> This example considers that an A record is already loaded to occne1.us.oracle.com using the API.

```
$ kubectl -n occne-demo exec -it test-app -- nslookup occne1.us.oracle.com
```

Sample output:

```
.oracle.com
Server: 169.254.25.10
Address: 169.254.25.10:53


Name: occne1.us.oracle.com
Address: 10.65.200.182
```

Querying Non Existing or External Records

You cannot access or query an external record or a record that is not added using the API. The system terminates such queries with an error code.

For example:

- the following codeblock shows a case where a non existing A record is queried:

  ```
  $ kubectl -n occne-infra exec -i -t $(kubectl -n occne-infra get pod |
  grep metallb-cont | awk '{print $1}') -- nslookup not-in.oracle.com
  ```

  Sample output:

  ```
  Server:         169.254.25.10
  Address:        169.254.25.10:53

  ** server can't find not-in.oracle.com: NXDOMAIN

  ** server can't find not-in.oracle.com: NXDOMAIN

  command terminated with exit code 1
  ```

- the following codeblock shows a case where a non existing SRV record is queried:

  ```
  $ kubectl -n occne-infra exec -i -t $(kubectl -n occne-infra get pod |
  grep metallb-cont | awk '{print $1}') -- nslookup not-in.oracle.com
  ```

Sample output:

```
Server:         169.254.25.10
Address:        169.254.25.10:53

** server can't find not-in.oracle.com: NXDOMAIN

** server can't find not-in.oracle.com: NXDOMAIN

command terminated with exit code 1
```

Querying Internal Services

Core DNS is configured to resolve internal services by default. Therefore, you can query any internal Kubernetes services as usual.

For example,

- the following codeblock shows a case where an A record is queried from an internal Kubernetes service:

  ```
  $ kubectl -n occne-infra exec -i -t $(kubectl -n occne-infra get pod |
  grep metallb-cont | awk '{print $1}') -- nslookup kubernetes
  ```

  Sample output:

  ```
  Server:         169.254.25.10
  Address:        169.254.25.10:53


  Name:   kubernetes.default.svc.test
  Address: 10.233.0.1

  ** server can't find kubernetes.svc.test: NXDOMAIN
  ** server can't find kubernetes.svc.test: NXDOMAIN
  ** server can't find kubernetes.test: NXDOMAIN
  ** server can't find kubernetes.test: NXDOMAIN
  ** server can't find kubernetes.occne-infra.svc.test: NXDOMAIN
  ** server can't find kubernetes.occne-infra.svc.test: NXDOMAIN
  ```

  The sample output displays the response from default.svc.test as "Kubernetes", as a service, exists only in the default namespace.

- the following codeblock shows a case where an SRV record is queried from an internal Kubernetes service:

  ```
  $ kubectl -n occne-infra exec -i -t $(kubectl -n occne-infra get pod |
  grep metallb-cont | awk '{print $1}') -- nslookup -type=srv
  kubernetes.default.svc.test
  ```

  Sample output:

  ```
  Server:         169.254.25.10
  Address:        169.254.25.10:53

  kubernetes.default.svc.occne3-toby-edwards      service = 0 100 443
  kubernetes.default.svc.test

  ** server can't find kubernetes.svc.test: NXDOMAIN
  ** server can't find kubernetes.occne-infra.svc.test: NXDOMAIN
  ** server can't find kubernetes.test: NXDOMAIN
  ```

The sample output displays the response from default.svc.test as "Kubernetes", as a service, exists only in the default namespace.

7.2.6.7.4 Accessing Configuration Files

This section provides information about accessing configuration files for troubleshooting.

Local DNS does not have any configuration file of its own; it relies entirely on CoreDNS config files. CoreDNS and nodelocaldns (CoreDNS cache daemon) have their configuration files as configmaps on the kube-system namespace.

> **Note**
>
> Local DNS API takes care of configurations and modifications by default. Therefore, it is not recommended to access or update the configmaps as manual intervention to these files can potentially break the entire CoreDNS functionality.

If there is absolute necessity to access configmap for troubleshooting, then use the data endpoint to access records of all zones along with the CoreDNS configuration.

Sample configuration:

```
# The following line, starting with "db.DOMAIN-NAME" represents a Zone file
'db.oracle.com': ';oracle.com db file\n'
                 'oracle.com.                  300                  ' # All zone files
contain a default SOA entry auto generated
                 'IN      SOA     ns1.oracle.com  andrei.oracle.com '
                 '201307231 3600 10800 86400 3600\n'
                 'occne.lab.oracle.com.                   ' # User added A record
                 '3600                  IN      A       175.80.200.20\n'
                 '_sip._tcp.lab.oracle.com 30 IN SRV 10 102 32061 ' # User added SRV record
                 'occne.lab.oracle.com.\n'
                 'occne1.us.oracle.com.                   ' # User added A record
                 '3600                  IN      A       '
                 '10.65.200.182\n'},
```

7.2.6.7.5 Troubleshooting Validation Script Errors

The local DNS feature provides the `validateLocalDns.py` script to validate if the Local DNS feature is activated successfully. This section provides information about troubleshooting some of the common issues that occur while using the `validateLocalDns.py` script.

Local DNS variable is not set properly

You can encounter the following or a similar error message while running the validation script if the local DNS variable is not set properly:

```
Beginning local DNS validation
 - Getting the occne-metallb-controller pod's name.
 - Validating occne.ini.
Unable to continue - err: Cannot continue - local_dns_enabled variable is set to False,
which is not valid to continue..
```

In such cases, ensure that:

- the `local_dns_enabled` variable is set to *True*: `local_dns_enabled=True`
- there are no black spaces before and after the "=" sign

- the variable is typed correctly as it is case sensitive

> **Note**
>
> To successfully enable Local DNS, you must follow the entire activation procedure. Otherwise, the system doesn't enable the feature successfully even after you set the `ocal_dns_enabled` variable to the correct value.

Unable to access the test pod

The validation script uses the `occne-metallb-controller` pod to validate the test record. This is because the DNS records can be accessed from inside the cluster only, and the MetalLB pod contains the necessary utility tools to access the records by default. You can encounter the following error while running the validation script if the MetalLB pod is not accessible:

```
Beginning local DNS validation
 - Getting the occne-metallb-controller pod's name.
  - Error while trying to get occne-metallb-controller pod's name, error: ...
```

In such cases, ensure that the `occne-metallb-controller` is accessible.

Unable to add a test record

While performing a validation, the validation script creates and removes a test record using the API to check if the Local DNS feature is working properly. You can encounter the following error when the script is unable to create a test record:

```
Beginning local DNS validation
 - Getting the occne-metallb-controller pod's name.
 - Validating occne.ini.
 - Adding DNS A record.
Unable to continue - err: Failed to add DNS entry.
```

The following table lists some of the common issues why the script can fail to add a test record, along with the resolutions:

Table 7-16 Validation Script Errors and Resolutions

Issue	Error Message	Resolution
The script is previously run and interrupted before it finished. The script possibly created a test record the previous time it was run unsuccessfully. When the script is run again, it tries to create a duplicate test record and fails.	Cannot add a duplicate record. Test record: *name:occne.dns.local.com, ip-address: 10.0.0.3*	Delete the existing test record from the system and rerun the validation script.
A record similar to the test record is added manually.	Cannot add a duplicate record. Test record: *name:occne.dns.local.com, ip-address: 10.0.0.3*	Delete the existing test record from the system and rerun the validation script.
Local DNS API is not available.	The Local DNS API is not running or is in an error state	Validate if the Local DNS feature is enabled properly. For more information, see Troubleshooting Local DNS API.

Table 7-16 (Cont.) Validation Script Errors and Resolutions

Issue	Error Message	Resolution
Local DNS API returns 50X status code.	Kubernetes Admin Configmap missing or misconfigured	Check if Kubernetes admin.conf is properly set to allow the API to interact with Kubernetes.

> **Note**
>
> The name and ip-address of the test record are managed by the script. Use these details for validation purpose only.

Unable to reload configuration

You can encounter the following error if the validation script fails to reload the core DNS configuration:

```
Beginning local DNS validation
 - Getting the occne-metallb-controller pod's name.
 - Validating occne.ini.
 - Adding DNS A record.
 - Adding DNS SRV record.
 - Reloading local coredns.
  - Error while trying to reload the local coredns, error: .... # Reason Omitted
```

In such cases, analyze the cause of the issue using the Local DNS logs. For more information, see Troubleshooting Local DNS API.

Other miscellaneous errors

If you are encountering other miscellaneous errors (such as, "unable to remove record"), follow the steps in the Troubleshooting Local DNS API section to generate logs and analyze the issue.

7.3 Managing the Kubernetes Cluster

This section provides instructions on how to manage the Kubernetes Cluster.

7.3.1 Creating CNE Cluster Backup

This section describes the procedure to create a backup of CNE cluster data using the `createClusterBackup.py` script.

Critical CNE data can be damaged or lost during a fault recovery scenario. Therefore, it is advised to take a backup of your CNE cluster data regularly. These backups can be used to restore your CNE cluster when the cluster data is lost or damaged.

Backing up a CNE cluster data involves the following steps:

1. Backing up Bastion Host data
2. Backing up Kubernetes data using Velero

The `createClusterBackup.py` script is used to backup both the bastion host data and Kubernetes data.

Prerequisites

Before creating CNE cluster backup, ensure that the following prerequisites are met:

- Velero must be activated successfully. For Velero installation procedure, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.
- Velero v1.10.0 server must be installed and running.
- Velero CLI for v1.10.0 must be installed and running.
- boto3 python module must be installed. For more information, see the "Configuring PIP Repository" section in the *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.
- The S3 Compatible Object Storage Provider must be configured and ready to be used.
- The following S3 related credentials must be available:
  - Endpoint Url
  - Access Key Id
  - Secret Access Key
  - Region Name
  - Bucket Name
- An external S3 compatible data store to store backup data must have been configured while installing CNE.
- The backup will only create an CNE Cluster backup that contains Bastion Host data, including Kubernetes.
- Cluster must be in a good state, that is all content included in the following namespaces must be up and running:
  - occne-infra
  - cert-manager
  - kube-system
  - rook-ceph (for Bare Metal)
  - istio-system
- All bastion-controller and lb-controller PVCs must be in "Bound" status.

> **Note**
>
> - This procedure creates only a CNE cluster backup that contains Bastion Host data, including Kubernetes.
> - For Kubernetes, this procedure creates the backup content included in the following namespaces only:
>   - occne-infra
>   - cert-manager
>   - kube-system
>   - rook-ceph (for Bare Metal)
>   - istio-system
> - You must take the Bastion backup in the ACTIVE Bastion only.

7.3.1.1 Creating a Backup of Bastion Host and Kubernetes Data

This section describes the procedure to back up the Bastion Host and Kubernetes data using the `createClusterBackup.py` script.

> **Note**
>
> Before creating a backup, Velero must be enabled.

Cluster backup procedure consists of the following two main stages:

1. Bastion Backup
2. Velero Kubernetes Backup

Both are created in order when the `createClusterBackup.py` initializes.

Procedure

1. Access the active Bastion using `ssh`.
2. Run the following command to verify if you are currently on an active Bastion. If you are not, log in to an active Bastion and continue this procedure.

   ```
   $ is_active_bastion
   ```

   Sample output:

   ```
   IS active-bastion
   ```

   > **Note**
   >
   > If the active Bastion is not being used, log in to the other Bastion, and continue this procedure.

3. Use the following commands to run the `createClusterBackup.py` script:

> **Note**
>
> The `boto3` library is required for the backup procedure. This is only required for CNE versions 23.3 and higher.

```
$ cd /var/occne/cluster/${OCCNE_CLUSTER}/
$ ./scripts/backup/createClusterBackup.py
```

Sample output:

```
Initializing cluster backup occne-example-20250310-145503

Creating bastion backup: 'occne-example-20250310-145503'

Successfully created bastion backup

GENERATED LOG FILE AT: /var/occne/cluster/occne-example/logs/velero/backup/
createBastionBackup-20250310-145503.log

Creating velero backup: 'occne-example-20250310-145503'

Successfully created velero backup

Successfully created cluster backup
GENERATED LOG FILE AT: /var/occne/cluster/occne-example/logs/velero/backup/
createBastionBackup-20250310-145503.log
```

4. Verify that the backup tar file was generated at `/home/${USER}`.

```
$ ls ~
```

Sample output:

```
createBastionBackup-20250310-144552.log  occne4-
example-20250310-145503.tar       OCCNE_PIPELINE_2025-03-06_234008.log
createBastionBackup-20250310-145503.log
OCCNE_PIPELINE_2025-03-06_200544.log
OCCNE_PIPELINE_2025-03-08_010753.log
createClusterBackup-20250310-144552.log
OCCNE_PIPELINE_2025-03-06_222802.log
createClusterBackup-20250310-145503.log
OCCNE_PIPELINE_2025-03-06_233319.log
```

7.3.1.2 Verifying Backup in S3 Bucket

This section describes the procedure to verify the CNE cluster data backup in S3 bucket.

Log in into the S3 cloud storage that was used to save the backup for verifying that the Bastion backup was successfully uploaded.

S3 bucket contains two folders:

- `bastion-data-backups`: for storing Bastion backup

- `velero-backup`: for storing Velero backup

1. Verify if the Bastion Host data is stored as a `.tar` file in the `{BUCKET_NAME}/bastion-data-backups/{CLUSTER-NAME}/{BACKUP_NAME}` folder. Where, `{CLUSTER-NAME}` is the name of the cluster and`{BACKUP_NAME}` is the name of the backup.
2. Verify if the Velero Kubernetes backup is stored in the `{BUCKET_NAME}/velero-backup/{BACKUP_NAME}/` folder. Where, `{BACKUP_NAME}` is the name of the backup.

> **⚠ Caution**
>
> The `velero-backup` folder must not be modified manually as this folder is managed by Velero. Modifying the folder can corrupt the structure or files.

For information about restoring CNE cluster from a backup, see "Restoring CNE from Backup" in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.

7.3.2 Renewing Kubernetes Certificates

Some of the Kubernetes certificates in your cluster are valid for a period of one year. These certificates include various important files that secure the communication within your cluster, such as the API server certificate, the etcd certificate, and the controller manager certificate. To maintain the security and operation of your CNE Kubernetes cluster, it is important to keep these certificates updated. The certificates are renewed automatically during the CNE upgrade. If you have not performed an CNE upgrade in the last year, you must run this procedure to renew your certificates for the continued operation of the CNE Kubernetes cluster.

Introduction

Kubernetes uses many different TLS certificates to secure access to internal services. There certificates are automatically renewed during upgrade. However, if upgrade is not performed regularly, these certificates may expire and cause the Kubernetes cluster to fail. To avoid this situation follow the procedure below to renew all certificates used by Kubernetes. This procedure can also be used to renew expired certificates and restore access to the Kubernetes cluster.

List of K8s internal certificates

The following table lists the Kubernetes (K8s) internal certificates and their validity.

Table 7-17 Kubernetes Internal Certificates and Validity Period

Node Type	Componet Name	.crt File Path	Validity (in years)	.pem File Path	Validity (in years)
Kubernetes Controller	etcd	/etc/pki/ca-trust/source/anchors/etcd-ca.crt	100	/etc/ssl/etcd/ssl/admin-<node_name>.pem	100
Kubernetes Controller	etcd	NA	NA	/etc/ssl/etcd/ssl/ca.pem	100
Kubernetes Controller	etcd	NA	NA	/etc/ssl/etcd/ssl/member-<node_name>.pem	100

Table 7-17 (Cont.) Kubernetes Internal Certificates and Validity Period

Node Type	Componet Name	.crt File Path	Validity (in years)	.pem File Path	Validity (in years)
Kubernetes Controller	etcd	NA	NA	/etc/ssl/etcd/ssl/member-<node_name>.pem	100
Kubernetes Controller	Kubernetes	/etc/kubernetes/ssl/ca.crt	10	NA	NA
Kubernetes Controller	Kubernetes	/etc/kubernetes/ssl/apiserver.crt	1	NA	NA
Kubernetes Controller	Kubernetes	/etc/kubernetes/ssl/apiserver-kubelet-client.crt	1	NA	NA
Kubernetes Controller	Kubernetes	/etc/kubernetes/ssl/front-proxy-ca.crt	10	NA	NA
Kubernetes Controller	Kubernetes	/etc/kubernetes/ssl/front-proxy-client.crt	1	NA	NA
Kubernetes Node	Kubernetes	/etc/kubernetes/ssl/ca.crt	10	NA	NA

You can use the above table to keep a record of the Kubernetes certificates and their validity details. Fill the Validity column in the table with your certificates' validity.

> ⚠ **Caution**
>
> Run this procedure on each controller node and verify that the certificates are renewed successfully to avoid cluster failures. The controller nodes are the orchestrator and maintainers of the metadata of all objects and components of the cluster. If you do not run this procedure on all the controller nodes and the certificates expire, the integrity of the cluster and the applications that are deployed on the cluster are staged at risk. This causes the communication within the internal components to be lost resulting in a total cluster failure. In such a case, you must recover each controller node or in the worst case scenario, recover the complete cluster.

Prerequisites

Checking Certificate Expiry

Log in to any Kubernetes controller node and run the following commands to verify the expiration date for the Kubernetes certificates:

```
$ sudo su
# export PATH=$PATH:/usr/local/bin
# kubeadm certs check-expiration
```

Sample output:

```
[check-expiration] Reading configuration from the cluster...
[check-expiration] FYI: You can look at this config file with 'kubectl -n kube-system
get cm kubeadm-config -o yaml'
W0214 13:39:25.870724   84036 utils.go:69] The recommended value for "clusterDNS" in
"KubeletConfiguration" is: [10.233.0.10]; the provided value is: [169.254.25.10]

CERTIFICATE                EXPIRES                  RESIDUAL TIME   CERTIFICATE
AUTHORITY   EXTERNALLY MANAGED
admin.conf                 Feb 14, 2026 17:42 UTC   364d
ca                      no
apiserver                  Feb 14, 2026 17:42 UTC   364d
ca                      no
apiserver-kubelet-client   Feb 14, 2026 17:42 UTC   364d
ca                      no
controller-manager.conf    Feb 14, 2026 17:42 UTC   364d
ca                      no
front-proxy-client         Feb 14, 2026 17:42 UTC   364d            front-proxy-
ca          no
scheduler.conf             Feb 14, 2026 17:42 UTC   364d
ca                      no
super-admin.conf           Feb 14, 2026 17:42 UTC   364d
ca                      no

CERTIFICATE AUTHORITY   EXPIRES                  RESIDUAL TIME   EXTERNALLY MANAGED
ca                      Feb 12, 2035 17:42 UTC   9y              no
front-proxy-ca          Feb 12, 2035 17:42 UTC   9y              no
```

Procedure

1. Use SSH to log in to the active Bastion Host.
2. Run the following command to verify if the Bastion Host is the active Bastion Host:

   ```
   $ is_active_bastion
   ```

   The system displays the following output if the Bastion Host is the active Bastion Host:

   ```
   IS active-bastion
   ```

   If the Bastion Host is not the active Bastion Host, try a different Bastion Host.

   > **Note**
   >
   > If the certificates are expired, the `is_active_bastion` command doesn't work as it depends on `kubectl`. In this case, skip this step and move to the next step.

3. Perform the following steps to log in to a controller node as a root user and back up the SSL directory:
   a. Use SSH to log in to Kubernetes controller node as a root user:

      ```
      $ ssh <k8s-ctrl-node>
      $ sudo su
      # export PATH=$PATH:/usr/local/bin
      ```

b. Take a backup of the `ssl` directory:

```
# cp -r /etc/kubernetes/ssl /etc/kubernetes/ssl_backup
```

4. Renew all `kubeadm` certificates:

```
# kubeadm certs renew all
```

Sample output:

```
[renew] Reading configuration from the cluster...
[renew] FYI: You can look at this config file with 'kubectl -n kube-system get cm
kubeadm-config -o yaml'
W0212 18:04:43.840444 3620859 utils.go:69] The recommended value for "clusterDNS" in
"KubeletConfiguration" is: [10.233.0.10]; the provided value is: [169.254.25.10]

certificate embedded in the kubeconfig file for the admin to use and for kubeadm
itself renewed
certificate for serving the Kubernetes API renewed
certificate for the API server to connect to kubelet renewed
certificate embedded in the kubeconfig file for the controller manager to use renewed
certificate for the front proxy client renewed
certificate embedded in the kubeconfig file for the scheduler manager to use renewed
certificate embedded in the kubeconfig file for the super-admin renewed

Done renewing certificates. You must restart the kube-apiserver, kube-controller-
manager, kube-scheduler and etcd, so that they can use the new certificates.
```

5. Perform the following steps to remove the manifest files in the `/etc/kubernetes/manifests/` directory and restart the static pods:

> **Note**
>
> This step requires removing (moving the file to `tmp` folder) the manifest files in the `/etc/kubernetes/manifests/` directory and copying back the file to the same directory to restart the `kube-apiserver` pod. Each time you remove and copy the manifest files, the system waits for a period configured in `fileCheckFrequency`. `fileCheckFrequency` is a Kubelet configuration and the default value is *20* seconds.

a. Perform the following steps to restart the API server pod:

i. Remove the `kube-apiserver` pod:

```
# mv /etc/kubernetes/manifests/kube-apiserver.yaml /tmp
```

ii. Run the watch command until the `kube-apiserver` pod is removed. When the pod is removed, use `Ctrl+C` to exit the watch command:

```
# watch -n 1 "sudo /usr/local/bin/crictl -r unix:///run/containerd/
containerd.sock ps | grep -e api -e kube-controller-manager -e
scheduler"
```

Sample output:

```
Every 1.0s: sudo /usr/local/bin/crictl -r unix:///run/containerd/
contain...  occne-example-k8s-ctrl-1: Fri Feb 14 13:52:26 2025

ff79b19fdffd7       9aa1fad941575       27 seconds ago
Running             kube-scheduler                    2
  ab0da7c51b413       kube-scheduler-occne-example-k8s-ctrl-1
64059f7efadc5       175ffd71cce3d       27 seconds ago
Running             kube-controller-manager           3
  9591cd755dae4       kube-controller-manager-occne-example-k8s-
ctrl-1
```

iii. Restore the `kube-apiserver` pod to the `/etc/kubernetes/manifests/` directory:

```
# mv /tmp/kube-apiserver.yaml /etc/kubernetes/manifests
```

iv. Run the watch command until the `kube-apiserver` pod appears in the output. When the pod appears, use `Ctrl+C` to exit the watch command:

```
# watch -n 1 "sudo /usr/local/bin/crictl -r unix:///run/containerd/
containerd.sock ps | grep -e api -e kube-controller-manager -e
scheduler"
```

Sample output:

```
Every 1.0s: sudo /usr/local/bin/crictl -r unix:///run/containerd/
contain...  occne-example-k8s-ctrl-1: Fri Feb 14 13:53:28 2025

67c8d5c42645f       6bab7719df100       10 seconds ago
Running             kube-apiserver                    0
   3bb9f31dad8c6       kube-apiserver-occne-example-k8s-ctrl-1
ff79b19fdffd7       9aa1fad941575       About a minute ago
Running             kube-scheduler                    2
   ab0da7c51b413       kube-scheduler-occne-example-k8s-ctrl-1
64059f7efadc5       175ffd71cce3d       About a minute ago
Running             kube-controller-manager           3
   9591cd755dae4       kube-controller-manager-occne-example-k8s-
ctrl-1
```

b. Perform the following steps to restart the controller manager pod:

i. Remove the `kube-controller-manager` pod:

```
# mv /etc/kubernetes/manifests/kube-controller-manager.yaml /tmp
```

ii. Run the watch command until the `kube-controller-manager` pod is removed. When the pod is removed, use `Ctrl+C` to exit the watch command:

```
# watch -n 1 "sudo /usr/local/bin/crictl -r unix:///run/containerd/
containerd.sock ps | grep -e api -e kube-controller-manager -e
scheduler"
```

Sample output:

```
Every 1.0s: sudo /usr/local/bin/crictl -r unix:///run/containerd/
contain...  occne-example-k8s-ctrl-1: Fri Feb 14 13:55:48 2025

67c8d5c42645f       6bab7719df100       2 minutes ago
Running             kube-apiserver                    0
  3bb9f31dad8c6       kube-apiserver-occne-example-k8s-ctrl-1
ff79b19fdffd7       9aa1fad941575       3 minutes ago
Running             kube-scheduler                    2
  ab0da7c51b413       kube-scheduler-occne-example-k8s-ctrl-1
```

iii. Restore the `kube-controller-manager` pod to the `/etc/kubernetes/manifests/` directory:

```
# mv /tmp/kube-controller-manager.yaml /etc/kubernetes/manifests
```

iv. Run the watch command until the `kube-controller-manager` pod appears in the output. When the pod appears, use `Ctrl+C` to exit the watch command:

```
# watch -n 1 "sudo /usr/local/bin/crictl -r unix:///run/containerd/
containerd.sock ps | grep -e api -e kube-controller-manager -e
scheduler"
```

Sample output:

```
Every 1.0s: sudo /usr/local/bin/crictl -r unix:///run/containerd/
contain...  occne-example-k8s-ctrl-1: Fri Feb 14 13:57:11 2025

fa16530da2e04       175ffd71cce3d       15 seconds ago
Runningeconds ago   kube-controller-manager           0
  9b6c69c940bfa       kube-controller-manager-occne-example-k8s-
ctrl-1
67c8d5c42645f       6bab7719df100       3 minutes ago
Running             kube-apiserver                    0
  3bb9f31dad8c6       kube-apiserver-occne-example-k8s-ctrl-1
ff79b19fdffd7       9aa1fad941575       5 minutes ago
Running             kube-scheduler                    2
  ab0da7c51b413       kube-scheduler-occne-example-k8s-ctrl-1
```

c. Perform the following steps to restart the scheduler pod:

i. Remove the `kube-scheduler` pod:

```
# mv /etc/kubernetes/manifests/kube-scheduler.yaml /tmp
```

ii. Run the watch command until the `kube-scheduler` pod is removed. When the pod is removed, use `Ctrl+C` to exit the watch command:

```
# watch -n 1 "sudo /usr/local/bin/crictl -r unix:///run/containerd/
containerd.sock ps | grep -e api -e kube-scheduler -e scheduler"
```

Sample output:

```
Every 1.0s: sudo /usr/local/bin/crictl -r unix:///run/containerd/
contain...  occne-example-k8s-ctrl-1: Thu Feb 13 13:16:06 2025

fa16530da2e04       175ffd71cce3d       19 minutes ago
Running             kube-controller-manager            0
  9b6c69c940bfa       kube-controller-manager-occne-example-k8s-
ctrl-1
67c8d5c42645f       6bab7719df100       23 minutes ago
Running             kube-apiserver                     0
  3bb9f31dad8c6       kube-apiserver-occne-example-k8s-ctrl-1
```

iii. Restore the `kube-scheduler` pod to the `/etc/kubernetes/manifests/` directory:

```
# mv /tmp/kube-scheduler.yaml /etc/kubernetes/manifests
```

iv. Run the watch command until the `kube-scheduler` pod appears in the output. When the pod appears, use `Ctrl+C` to exit the watch command:

```
# watch -n 1 "sudo /usr/local/bin/crictl -r unix:///run/containerd/
containerd.sock ps | grep -e api -e kube-scheduler -e scheduler"
```

Sample output:

```
Every 1.0s: sudo /usr/local/bin/crictl -r unix:///run/containerd/
contain...  occne-example-k8s-ctrl-1: Fri Feb 14 14:16:35 2025

8c4500f3d61d7       9aa1fad941575       16 seconds ago
Running             kube-scheduler                     0
  7c175d8106f0c       kube-scheduler-occne-example-k8s-ctrl-1
fa16530da2e04       175ffd71cce3d       19 minutes ago
Running             kube-controller-manager            0
  9b6c69c940bfa       kube-controller-manager-occne-example-k8s-
ctrl-1
67c8d5c42645f       6bab7719df100       23 minutes ago
Running             kube-apiserver                     0
  3bb9f31dad8c6       kube-apiserver-occne-example-k8s-ctrl-1
```

6. Renew the `admin.conf` file and update the contents of `$HOME/.kube/config`. Type *yes* when prompted.

```
# cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
cp: overwrite '/root/.kube/config'? yes

# chown $(id -u):$(id -g) $HOME/.kube/config
```

7. Run the following command to validate if the certificates are renewed:

```
# kubeadm certs check-expiration
```

Sample output:

```
[check-expiration] Reading configuration from the cluster...
[check-expiration] FYI: You can look at this config file with 'kubectl -n
kube-system get cm kubeadm-config -o yaml'
W0214 14:21:49.907835  143445 utils.go:69] The recommended value for
"clusterDNS" in "KubeletConfiguration" is: [10.233.0.10]; the provided
value is: [169.254.25.10]

CERTIFICATE                EXPIRES                  RESIDUAL TIME
CERTIFICATE AUTHORITY   EXTERNALLY MANAGED
admin.conf                 Feb 14, 2026 18:51 UTC   364d
ca                      no
apiserver                  Feb 14, 2026 18:51 UTC   364d
ca                      no
apiserver-kubelet-client   Feb 14, 2026 18:51 UTC   364d
ca                      no
controller-manager.conf    Feb 14, 2026 18:51 UTC   364d
ca                      no
front-proxy-client         Feb 14, 2026 18:51 UTC   364d            front-
proxy-ca          no
scheduler.conf             Feb 14, 2026 18:51 UTC   364d
ca                      no
super-admin.conf           Feb 14, 2026 18:51 UTC   364d
ca                      no

CERTIFICATE AUTHORITY   EXPIRES                  RESIDUAL TIME
EXTERNALLY MANAGED
ca                      Feb 12, 2035 17:42 UTC   9y              no
front-proxy-ca          Feb 12, 2035 17:42 UTC   9y              no
```

8. Perform steps 3 through 7 on the remaining controller nodes.
9. Exit from the root user privilege:

   ```
   # exit
   ```

10. Copy the `/etc/kubernetes/admin.conf` file from the controller node to the artifacts directory of the active Bastion.

> **Note**
>
> - Replace `<OCCNE_ACTIVE_BASTION>` and `<OCCNE_CLUSTER>` with the values corresponding to your system. Refer to Step 2 for the value of `<OCCNE_ACTIVE_BASTION>` (For example, `occne-example-bastion-1`).
> - Type *yes* and enter your password if prompted.

```
$ sudo scp /etc/kubernetes/admin.conf ${USER}@<OCCNE_ACTIVE_BASTION>:/var/
occne/cluster/<OCCNE_CLUSTER>/artifacts
```

11. Log in to the active Bastion Host and update the server address in the `admin.conf` file to https://lb-apiserver.kubernetes.local:6443:

```
$ ssh <active-bastion>
$ sed -i 's#https://127.0.0.1:6443#https://lb-
apiserver.kubernetes.local:6443#' /var/occne/cluster/${OCCNE_CLUSTER}/
artifacts/admin.conf
```

12. Recreate the secrets that contains the `admin.config`:
    a. **CNLB only**:
        i. Delete the existing `cnlb-man-admin-config` secret and recreate a new one from the new `admin.conf` file.
        Run the following command to delete the existing cnlb-man-admin-config secret:

        ```
        kubectl -n occne-infra delete secret cnlb-man-admin-config
        ```

        Run the following command to recreate a new `cnlb-man-admin-config` secret from the new `admin.conf` file.

        ```
        kubectl -n occne-infra create secret generic cnlb-man-admin-config
        --from-file=/var/occne/cluster/${OCCNE_CLUSTER}/artifacts/admin.conf
        ```

        ii. Patch the `cnlb-man-admin-config` secret and restart the cnlb-manager pod and cnlb-app pods:

        ```
        $ kubectl -n occne-infra patch --type=merge secret cnlb-man-admin-
        config --patch '{"data":{"admin.conf":"'"$(kubectl -n occne-infra
        get secret cnlb-man-admin-config -o jsonpath='{.data.admin\.conf}'
        | base64 -d | sed 's/https:\/\/lb-apiserver.kubernetes.local:6443/
        https:\/\/kubernetes.default:443/g' | base64 -w0)"'"}}'
        ```

        Run the following command to obtain the number of replicas of the cnlb app pods:

        ```
        $ kco get deploy | grep cnlb
        ```

        Run the following command to remove the cnlb manager and app pods:

        ```
        $ kco scale deploy cnlb-manager --replicas=0
        $ kco scale deploy cnlb-app --replicas=0
        ```

        Run the watch command until the occne-lb-controller-server pod has been removed.

        Exit the watch command by using Ctrl+C.

        ```
        $ watch -n 1 "kubectl -n occne-infra get pods | grep cnlb"
        ```

Restore the cnlb manager and app pods:

```
$ kco scale deploy cnlb-manager --replicas=1
$ kco scale deploy cnlb-app --replicas=<Number of replicas obtained
previously>
```

Run the watch command until the occne-lb-controller-server pod has appered. Exit the watch command by using Ctrl+C.

```
$ watch -n 1 "kubectl -n occne-infra get pods | grep cnlb"
```

b. **LBVM Only**
Delete the existing lb-controller-admin-config secret and recreate a new one from the new admin.conf file.

i. Run the following command to patch the lb-controller-admin-config secret.

```
echo -n "$(kubectl get secret lb-controller-admin-config -n occne-
infra -o jsonpath='{.data.admin\.conf}' | base64 -d | sed
's#https://lb-apiserver.kubernetes.local:6443#https://
kubernetes.default:443#g')" | base64 -w0 | xargs -I{} kubectl -n
occne-infra patch secret lb-controller-admin-config --patch
'{"data":{"admin.conf":"{}"}}
```

ii. Run the following command to remove the lb-controller-server pod.

```
kubectl scale deployment/occne-lb-controller-server -n occne-infra
--replicas=0
```

iii. Run the watch command until the occne-lb-controller-server pod has been removed. Exit the watch command by using Ctrl+C.

```
watch -n 1 "kubectl -n occne-infra get pods | grep lb-controller"
```

iv. Run the following command to restore the lb-controller-server pod:

```
$ kubectl scale deployment/occne-lb-controller-server -n occne-
infra --replicas=1
```

v. Run the watch command until the occne-lb-controller-server pod has appered. Exit the watch command by using Ctrl+C.

```
watch -n 1 "kubectl -n occne-infra get pods | grep lb-controller"
```

13. If you are using a Load Balancer VM (LBVM), perform the following steps to delete the existing `lb-controller-admin` secret and create a new one:

a. Run the following command to delete the existing `lb-controller-admin` secret:

```
$ kubectl -n occne-infra delete secret lb-controller-admin-config
```

b. Run the following command to create a new `lb-controller-admin` secret from the updated `admin.conf` file:

```
$ kubectl -n occne-infra create secret generic lb-controller-admin-config --from-file=/var/occne/cluster/${OCCNE_CLUSTER}/artifacts/admin.conf
```

14. If you are using a Load Balancer VM (LBVM), perform the following steps to patch the `lb-controller-admin-config` secret and restart the `lb-controller-server` pod:

a. Patch the `lb-controller-admin-config` secret:

```
$ echo -n "$(kubectl get secret lb-controller-admin-config -n occne-infra -o jsonpath='{.data.admin\.conf}' | base64 -d | sed 's#https://lb-apiserver.kubernetes.local:6443#https://kubernetes.default:443#g')" | base64 -w0 | xargs -I{} kubectl -n occne-infra patch secret lb-controller-admin-config --patch '{"data":{"admin.conf":"{}"}}'
```

b. Remove the `lb-controller-server` pod:

```
$ kubectl scale deployment/occne-lb-controller-server -n occne-infra --replicas=0
```

c. Run the watch command until the `occne-lb-controller-server` pod is removed. When the pod is removed, use `Ctrl+C` to exit the watch command:

```
$ watch -n 1 "kubectl -n occne-infra get pods | grep lb-controller"
```

d. Restore the `lb-controller-server` pod:

```
$ kubectl scale deployment/occne-lb-controller-server -n occne-infra --replicas=1
```

e. Run the watch command until the `occne-lb-controller-server` pod appears in the output. When the pod appears, use `Ctrl+C` to exit the watch command:

```
$ watch -n 1 "kubectl -n occne-infra get pods | grep lb-controller"
```

7.3.2.1 Renewing Kyverno Certificates

Kyverno 1.9.0 doesn't support automatic certificate renewal. Therefore, if you are using Kyverno 1.9.0, you must renew the certificates manually. This section provides the procedure to renew Kyverno certificates.

1. Renew the Kyverno certificates by deleting the secrets from the `kyverno` namespace:

```
$ kubectl delete secret occne-kyverno-svc.kyverno.svc.kyverno-tls-ca -n kyverno
```

Sample output:

```
secret "occne-kyverno-svc.kyverno.svc.kyverno-tls-ca" deleted
```

```
$ kubectl delete secret occne-kyverno-svc.kyverno.svc.kyverno-tls-pair -n
kyverno
```

Sample output:

```
secret "occne-kyverno-svc.kyverno.svc.kyverno-tls-pair" deleted
```

2. Perform the following steps to verify if the secrets are recreated and the certificates are renewed:
   a. Run the following command to verify the Kyverno secrets:

      ```
      $ kubectl get secrets -n kyverno
      ```

      Sample output:

      ```
      NAME                                                TYPE
      DATA   AGE
      occne-kyverno-svc.kyverno.svc.kyverno-tls-ca     kubernetes.io/tls
      2      21s
      occne-kyverno-svc.kyverno.svc.kyverno-tls-pair   kubernetes.io/tls
      2      11s
      sh.helm.release.v1.occne-kyverno-policies.v1     helm.sh/release.v1
      1      26h
      sh.helm.release.v1.occne-kyverno.v1              helm.sh/release.v1
      1      26h
      ```

   b. Run the following commands to review the expiry dates of Kyverno certificates:

      ```
      $ for secret in $(kubectl -n kyverno get secrets --no-headers | grep
      kubernetes.io/tls | awk {'print $1'}); do currdate=$(date +'%s');
      echo $secret; expires=$(kubectl -n kyverno get secrets $secret -o
      jsonpath="{.data['tls\.crt']}" | base64 -d | openssl x509 -enddate -
      noout | awk -F"=" {'print $2'} | xargs -d '\n' -I {} date -d '{}'
      +'%s'); if [ $expires -le $currdate ]; then echo "Certificate invalid,
      expired: $(date -d @${expires})"; echo "Need to renew certificate
      using:"; echo "kubectl -n kyverno delete secret $secret"; else echo
      "Certificate valid, expires: $(date -d @${expires})"; fi done
      ```

      Sample output:

      ```
      occne-kyverno-svc.kyverno.svc.kyverno-tls-ca
      Certificate valid, expires: Wed Feb 25 05:35:03 PM EST 2026
      occne-kyverno-svc.kyverno.svc.kyverno-tls-pair
      Certificate valid, expires: Fri Jul 25 06:35:12 PM EDT 2025
      ```

7.3.2.2 Renewing Kubelet Server Certificates

This section provides the procedure to renew Kubelet server certificate using the `renew-kubelet-server-cert.sh` script.

The certificate rotation configuration of the Kubelet server renews the Kubelet client certificates automatically, as this configuration is enabled by default. The `renew-kubelet-server-cert.sh` script sets the `--rotate-server-certificates` flag to *true*, which enables the `serverTLSBootstrap` variable in the Kubelet configuration.

> **Note**
>
> Perform this procedure from the active Bastion.

1. Use SSH to log in to the active Bastion Host.
2. Run the following command to verify if the Bastion Host is the active Bastion Host:

   ```
   $ is_active_bastion
   ```

   The system displays the following output if the Bastion Host the active Bastion Host:

   ```
   IS active-bastion
   ```

   If the Bastion Host is not the active Bastion Host, try a different Bastion Host.

   > **Note**
   >
   > If the certificates are expired, the `is_active_bastion` command doesn't work as it depends on `kubectl`. In this case, skip this step and move to the next step.

3. Navigate to the `/var/occne/cluster/${OCCNE_CLUSTER}/artifacts/` directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}/artifacts/
   ```

4. Run the `renew-kubelet-server-cert.sh` script:

   ```
   $ ./renew-kubelet-server-cert.sh
   ```

   Sample output:

   ```
   ============ Checking if all nodes are accessible via ssh ============
   occne3-k8s-ctrl-1
   occne3-k8s-ctrl-2
   occne3-k8s-ctrl-3
   occne3-k8s-node-1
   occne3-k8s-node-2
   occne3-k8s-node-3
   occne3-k8s-node-4
   All nodes are healthy and accessible using ssh, Starting kubelet server
   ```

```
certificate renewal procedure now...
--------------------------------------------------------------------------
------------------
Starting renewal of K8s kubelet server certificate for occne3-k8s-ctrl-1.
Adding the line --rotate-server-certificates=true --tls-cipher-
suites=TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 to kubelet environment file.
Restarting Kubelet to trigger Certificate signing request...
Kubelet is successfully restarted!
A signing request has been raised, Verifying it now....
A Certificate signing request csr-lfsq9 has been found, Approving it now!
certificatesigningrequest.certificates.k8s.io/csr-lfsq9 approved
The CSR has been approved for the node occne3-k8s-ctrl-1.
Checking if the new K8s kubelet server certificate has been generated...
New K8s kubelet server certificate has been successfully generated for the
node occne3-k8s-ctrl-1 as shown below.
lrwxrwxrwx. 1 root root 59 Jul 24 08:05 kubelet-server-current.pem -
> /var/lib/kubelet/pki/kubelet-server-2024-07-24-08-05-40.pem
Marked occne3-k8s-ctrl-1 as RENEWED.
Kubelet server certificate creation was successful for the node occne3-k8s-
ctrl-1.
```

7.3.3 Renewing the Kubernetes Secrets Encryption Key

This section describes the procedure to renew the key that is used to encrypt the Kubernetes Secrets stored in the CNE Kubernetes cluster.

Procedure

> **Note**
>
> Secret encryption is enabled by default during CNE installation or upgrade.

The key that is used to encrypt Kubernetes Secrets does not expire. However, it is recommended to change the encryption key periodically to ensure the security of your Kubernetes Secrets. If you think that your key is compromised, you must change the encryption key immediately.

To renew a Kubernetes Secrets encryption key, perform the following steps:

1. From bastion host, run the following commands:

   ```
   $ NEW_KEY=$(head -c 32 /dev/urandom | base64)
   $ KEY_NAME=$(cat /dev/random | tr -dc '[:alnum:]' | head -c 10)
   $ kubectl get nodes | awk '/control-plane/ {print $1}' | xargs -I{} ssh {}
   " sudo sed -i '/keys:$/a\        - name: key_$KEY_NAME\n\
   secret: $NEW_KEY' /etc/kubernetes/ssl/secrets_encryption.yaml; sudo
   cat /etc/kubernetes/ssl/secrets_encryption.yaml"
   ```

   This creates a random encryption key with a random key name, and adds it to the `/etc/kubernetes/ssl/secrets_encryption.yaml` file within each controller node. The output shows the new encryption key, the key name, and the contents of the `/etc/kubernetes/ssl/secrets_encryption.yaml` file.

Sample Output:

```
This site is for the exclusive use of Oracle and its authorized customers
and partners. Use of this site by customers and partners is subject to the
Terms of Use and Privacy Policy for this site, as well as your contract
with Oracle. Use of this site by Oracle employees is subject to company
policies, including the Code of Conduct. Unauthorized access or breach of
these terms may result in termination of your authorization to use this
site and/or civil and criminal penalties.
kind: EncryptionConfig
apiVersion: v1
resources:
  - resources:
    - secrets

    providers:
    - secretbox:
        keys:
        - name: key_ZOJ1Hf5OCx
          secret: l+CaDTmMkC85LwJRiWJ0LQPYVtOyZ0TdtNZ2ij+kuGA=
        - name: key
          secret: ZXJ1Ulk2U0xSbWkwejdreTlJWkFrZmpJZjhBRzg4U00=
    - identity: {}
```

2. Restart the API server by running the following command. This ensures that all the secrets get encrypted with the new key while encrypting the secrets in the next step:

```
kubectl get nodes | awk '/control-plane/ {print $1}' | xargs -I{} ssh {} "
sudo mv /etc/kubernetes/manifests/kube-apiserver.yaml ~; sleep 2; sudo mv
~/kube-apiserver.yaml /etc/kubernetes/manifests"
```

3. To encrypt all the existing secrets with a new key, run the following command:

```
kubectl get secrets --all-namespaces -o json | kubectl replace -f
```

Sample output:

```
-secret/occne-cert-manager-webhook-ca replaced
secret/sh.helm.release.v1.occne-cert-manager.v1 replaced
secret/istio-ca-secret replaced
secret/cloud-config replaced
secret/external-openstack-cloud-config replaced
secret/occne-kyverno-svc.kyverno.svc.kyverno-tls-ca replaced
secret/occne-kyverno-svc.kyverno.svc.kyverno-tls-pair replaced
secret/sh.helm.release.v1.occne-kyverno-policies.v1 replaced
secret/sh.helm.release.v1.occne-kyverno.v1 replaced
secret/alertmanager-occne-kube-prom-stack-kube-alertmanager replaced
secret/etcd-occne6-j-jorge-l-lopez-k8s-ctrl-1 replaced
secret/etcd-occne6-j-jorge-l-lopez-k8s-ctrl-2 replaced
secret/etcd-occne6-j-jorge-l-lopez-k8s-ctrl-3 replaced
secret/lb-controller-user replaced
secret/occne-alertmanager-snmp-notifier replaced
secret/occne-kube-prom-stack-grafana replaced
secret/occne-kube-prom-stack-kube-admission replaced
secret/occne-kube-prom-stack-kube-prometheus-scrape-confg replaced
```

```
secret/occne-metallb-memberlist replaced
secret/occne-tracer-jaeger-elasticsearch replaced
secret/prometheus-occne-kube-prom-stack-kube-prometheus replaced
secret/prometheus-occne-kube-prom-stack-kube-prometheus-tls-assets-0
replaced
secret/prometheus-occne-kube-prom-stack-kube-prometheus-web-config replaced
secret/sh.helm.release.v1.occne-alertmanager-snmp-notifier.v1 replaced
secret/sh.helm.release.v1.occne-bastion-controller.v1 replaced
secret/sh.helm.release.v1.occne-fluentd-opensearch.v1 replaced
secret/sh.helm.release.v1.occne-kube-prom-stack.v1 replaced
secret/sh.helm.release.v1.occne-lb-controller.v1 replaced
secret/sh.helm.release.v1.occne-metallb.v1 replaced
secret/sh.helm.release.v1.occne-metrics-server.v1 replaced
secret/sh.helm.release.v1.occne-opensearch-client.v1 replaced
secret/sh.helm.release.v1.occne-opensearch-dashboards.v1 replaced
secret/sh.helm.release.v1.occne-opensearch-data.v1 replaced
secret/sh.helm.release.v1.occne-opensearch-master.v1 replaced
secret/sh.helm.release.v1.occne-promxy.v1 replaced
secret/sh.helm.release.v1.occne-tracer.v1 replaced
secret/webhook-server-cert replaced
Error from server (Conflict): error when replacing "STDIN": Operation
cannot be fulfilled on secrets "alertmanager-occne-kube-prom-stack-kube-
alertmanager-generated": the object has been modified; please apply your
changes to the latest version and try again
Error from server (Conflict): error when replacing "STDIN": Operation
cannot be fulfilled on secrets "alertmanager-occne-kube-prom-stack-kube-
alertmanager-tls-assets-0": the object has been modified; please apply
your changes to the latest version and try again
Error from server (Conflict): error when replacing "STDIN": Operation
cannot be fulfilled on secrets "alertmanager-occne-kube-prom-stack-kube-
alertmanager-web-config": the object has been modified; please apply your
changes to the latest version and try again
```

> **Note**
>
> You may encounter some errors on the output depending on how the secret is created. You can ignore these errors and verify that the encrypted secret's key is replaced with a new one using the following steps.

4. Run the following command from a controller node with any `cert pem` and `key pem` pair files to show all existing secrets:

   ```
   sudo ETCDCTL_API=3 /usr/local/bin/etcdctl --cert /etc/ssl/etcd/ssl/<cert-
   pem-file> --key /etc/ssl/etcd/ssl/<key-pem-file> get --keys-only=true --
   prefix /registry/secrets
   ```

   Select any secret path you want to verify from the output.

5. To verify that the secret is using the newly generated key, run the following command from a controller node. Replace `<cert pem file>`, `<key pem file>` and `<secret-path>` in the following command with the corresponding values.

   ```
   sudo ETCDCTL_API=3 /usr/local/bin/etcdctl --cert /etc/ssl/etcd/ssl/<cert-
   pem-file> --key /etc/ssl/etcd/ssl/<key-pem-file> get <secret-path> -w
   fields | grep Value
   ```

   Example:

   ```
   [cloud-user@occne3-user-k8s-ctrl-3 ~]$ sudo ETCDCTL_API=3 /usr/local/bin/
   etcdctl --cert /etc/ssl/etcd/ssl/node-occne3-user-k8s-ctrl-1.pem --
   key /etc/ssl/etcd/ssl/node-occne3-user-k8s-ctrl-1-key.pem get /registry/
   secrets/default/secret1 -w fields | grep Value
   "Value" :
   "k8s:enc:secretbox:v1:key_ZOJ1Hf5OCx:&9\x90\u007f'*6\x0e\xf8]\x98\xd7t1\xa9
   |\x90\x93\x88\xebc\xa9\xfe\x82<\xeb\xaa\x17$
   \xa4\x14%m\xb7<\x1d\xf7N\b\xa7\xbaZ\xb0\xd4#\xbev)
   \x1bv9\x19\xdel\xab\x89@\xe7\xaf$L\xb8)\xc9\x1bl\x13\xc1V\x1b\xf7\bX\x88\xe
   7\ue131\x1dG\xe2_\x04\xa2\xf1n\xf5\x1dP\
   \4\xe7)^\x81go\x99\x98b\xbb\x0e\xc0R;>
   j\xeeV54\xac\x06\t\x1b9\xd5N\xa77\xd9\x03 \x05\xfb%\xa1\x81\xd5\x0e
   \xcax\xc4\x1cz6\xf3\xd8\xf9?Щ\x9a%
   \x9b\xe5\xa7й\xcd!,\xb8\x8b\xc2\xcf\xe2\xf2|
   \x8f\x90\xa9\x05y\xc5\xfc\xf7\x87\xf9\x13\x0e4[i\x12\xcc\xfaR\xdf3]\xa2V\x1
   b\xbb\xeba6\x1c\xba\v\xb0p}\xa5;\x16\xab\x8e\xd5Ol\xb7\x87BW\tY;寄
   \xca\x87Y;\n;/
   \xf2\x89\xa1\xcc\xc3\xc9\xe3\xc5\v\x1b\x88\x84
   \xc6\x00\xb4\xed\xa5\xe2\xfa\xa9\xff \xd9k\xf2\x04\x8f\x81,l"
   ```

   This example shows a new key, `key_ZOJ1Hf5OCx`, being used to encrypt `secret1` secret.

7.3.4 Adding a Kubernetes Worker Node

This section describes how to add a Kubernetes node (formally called a "worker" node) to an existing CNE Kubernetes cluster. The procedure is applicable to both CNLB and non-CNLB clusters. However, certain steps may differ depending on that.

> **Note**
>
> - For a BareMetal installation, ensure that you are familiar with the inventory file preparation procedure. For more information about this procedure, see "*Inventory File Preparation*" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.
> - Run this procedure from the active Bastion Host only.

Points to note

- **vCNE LVBM deployment**: Only one node can be added at a time. It will be added in sequence at the next available numeric index.

- **vCNE CNLB deployment**: Only one node can be added at a time. Node names consist of a list of string identifiers of up to 4 characters (defined in cluster.tfvars; by default, it uses a single character enclosed in quotation marks).
- **BareMetal Metallb and CNLB deployment**: Only one node can be added at a time. Nodes are defined by the `hosts.ini`, no sequence is required other than no duplicate items allowed.
- Ensure that the cluster is in a healthy state (no nodes should be in not-ready state), before running this procedure. Remove any unreachable nodes before you begin.

Adding a Kubernetes Worker Node on BareMetal

1. Log in to Bastion Host and verify if it's an active Bastion Host. If the Bastion Host isn't an active Bastion Host, then log in to another.
   Run the following command to check if the Bastion Host is an active Bastion Host:

   ```
   is_active_bastion
   ```

   The system displays the following output if the Bastion Host is an active Bastion Host:
   `IS active-bastion`

   The system displays the following output if the Bastion Host isn't an active Bastion Host:

   ```
   NOT active-bastion
   ```

2. Run the following command to navigate to the cluster directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}/
   ```

3. Ensure the `secrets.ini` file is present and properly populated.
4. Ensure the correct Oracle Linux ISO image is available.
   a. Verify that the Oracle Linux ISO image exists and that it corresponds to the desired version for the new node.
   b. Verify its permissions and ownership so that Ansible can read it.

      ```
      $ ls -l /var/occne/os
      ```

      Sample output:

      ```
      total 12305408
      -rw------- 1 admusr admusr 12600737792 Mar 21 22:34 OracleLinux-R9-U5-
      x86_64-dvd.iso
      ```

   c. If the ISO is missing, download it from the central repository before proceeding.
5. Verify that the cluster is healthy.

   > **Note**
   >
   > vCNE CNLB script includes this pre-test.

   ```
   $ OCCNE_STAGES=(TEST) pipeline.sh
   ```

Adding a Kubernetes Worker Node on vCNE (OpenStack and VMware)

This section provides procedures to add Kubernetes worker nodes on vCNE CNLB and vCNE LBVM deployments.

Pre-procedure:

1. Log in to Bastion Host and verify if it's an active Bastion Host. If the Bastion Host isn't an active Bastion Host, then log in to another.
   Run the following command to check if the Bastion Host is an active Bastion Host:

   ```
   is_active_bastion
   ```

   The system displays the following output if the Bastion Host is an active Bastion Host:
   `IS active-bastion`

   The system displays the following output if the Bastion Host isn't an active Bastion Host:

   `NOT active-bastion`
2. Run the following command to navigate to the cluster directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}/
   ```
3. Ensure the `secrets.ini` file is present and properly populated.

Perform the following steps to add a Kubernetes node for vCNE CNLB deployments

> **Note**
>
> - The procedure and script are applicable to “CNLB nodes”.
> - If this feature was previously enabled (only during installation), the script can be used to add a new Kubernetes node or a CNLB node to the cluster.
> - If the feature is disabled, this script can be used to add a standard Kubernetes node.

1. Run the following command to open the `$OCCNE_CLUSTER/cluster.tfvars` file.
   Modify only one of the fields at a time, and add a new "name" to the lists of node names. The items in a given list cannot be repeated within the same list, and each item must have a maximum of 4 characters (lowercase). OpenTofu sorts each list alphabetically, turning it into a set, a new node can be added regardless of being first, second or last in the set.

Table 7-18 Node Names

Field	Example: Old value	Example: New value	Valid only if
occne_node_names	["1", "2", "3"]	["1", "2", "3", "4"] or ["0", "1", "2", "3"]	All types of vCNE CNLB deployments
cnlb_node_names	["1", "2", "3", "4", "5"]	["1", "2", "3", "4", "5", "6"] or ["1", "2", "a", "3", "4", "5"]	CNLB Nodes feature is enabled: `cnlb_node_label = True`

Edit the `cluster.tfvars` file.

```
$ vi $OCCNE_CLUSTER/cluster.tfvars
```

Sample output:

```
Adding a new node name at the end of the list
...
# K8s nodes
#
occne_node_names = ["1", "2", "3", "4"]
...


Adding a new node name at the end of the list
...
# CNLB nodes
#
cnlb_node_names = ["0", "1", "2", "3", "4", "5"]
```

2. Run the `addK8sNode.py` script.

> **Note**
>
> - **Log file location**: Information will be displayed on screen and logged to a log file. This file is located at the path, `/var/occne/cluster/${OCCNE_CLUSTER}/logs/maintenance/add_cnlb_k8s_node_<yyyy-mm-dd_hhmmss>.log`.
> Long-running processes (such as cluster tests or the node provison) will not appear in the file until they have finished. The process must complete before its entry is recorded.
>
> The standard output (stdout) and standard error output (stderr) commands will be logged to the file, each on a separate line.
>
> - **Backup file location**: The script creates a backup of the `cluster.tfvars`, `terraform.tfstate` files and saves them to the `/var/occne/cluster/${OCCNE_CLUSTER}/backup_config/add_cnlb_k8s_node_<yyyy-mm-dd_hhmmss>/` location.
> By default, each run of the script creates a dedicated directory and copy of the files.
>
> The `terraform.tfstate` file is renamed to `terraform.tfstate.ORIG` to prevent it from being used by the inventory.

3. **For OpenStack**, perform this step to source the `openrc.sh` file. The `openrc.sh` file sets the necessary environment variables for OpenStack. For VMware, skip this step and move to the next step.
   a. Source the `openrc.sh` file.

      ```
      $ source openrc.sh
      ```

   b. Enter the OpenStack username and password when prompted.

The following block shows the username and password prompt displayed by the system:

```
Please enter your OpenStack Username:
 Please enter your OpenStack Password as <username>:
```

4. Run the `addK8sNode.py` script. Adding any type of node will produce similar outputs, regardless of whether it is a CNLB node or a regular Kubernetes node.

   ```
   $ ./scripts/addK8sNode.py
   ```

   Sample output for both OpenStack and VMware:

   ```
   - Initializing Add K8s Node(s) Process

    - Backing up configuration files...
      Backup files location: /var/occne/cluster/test-cluster/backup_config/
   add_cnlb_k8s_node_2025-09-05_162745

    - Log file location: /var/occne/cluster/test-cluster/logs/maintenance/
   add_cnlb_k8s_node_2025-09-05_162745.log, long-running processes will write
   to it as they finish.

    - Initializing tofu...
      Tofu successfully initialized.

    - Update tfstate (tofu plan)...
      Tofu successfully planned.

    - List of new or affected nodes: test-cluster-k8s-node-4

    - Testing cluster health...
      Test pipeline completed successfully.

    - Setting maintenance banner...
      Maintenance banner set successfully.

    - Updating infrastructure (tofu apply)...
      Tofu successfully applied.

    - Updating /etc/hosts files...
      Successfully updated file: /etc/hosts on all servers.

    - Running provision container (pipeline.sh) - may take considerable time
   to complete...
      Provision pipeline completed successfully.

    - Running Cluster Test: Provision...
      Test pipeline completed successfully.

    - Running k8s_install container (pipeline.sh) - may take considerable
   time to complete...
      K8s pipeline completed successfully.

    - Running Cluster Test: Kubernetes...
      Test pipeline completed successfully.
   ```

```
 - Running Cluster Test: Common Services...
   Test pipeline completed successfully.

 - Restoring default banner...
   Successfully restored default banner.

 - Add K8s Node(s) successfully completed - Check the log file for
details: /var/occne/cluster/test-cluster/logs/maintenance/
add_cnlb_k8s_node_2025-09-05_162745.log
```

Perform the following steps to add a Kubernetes node for vCNE LBVM (Openstack and VMWare) deployments

1. Edit the `$OCCNE_CLUSTER/cluster.tfvars` file. Modify the `number_of_k8s_nodes` field and increase its value by 1.

   ```
   $ vi $OCCNE_CLUSTER/cluster.tfvars
   ```

   Sample output:

   ```
    Increase the number of nodes from 5 to 6
   ...
   # K8s nodes
   #
   number_of_k8s_nodes = 6
   ...
   ```

2. Run the `addWorkerNode.py` script.

   > **Note**
   >
   > - **Log file location**: Information will be displayed on screen and logs are stored in a file. This file is located at the path, `/var/occne/cluster/${OCCNE_CLUSTER}/addWrkNodeCapture-<mmddyyyy_hhmmss>.log`. Long-running processes (such as node provison) will not appear in the file until they have finished. The process must complete before its entry is recorded.
   > - **Backup file location**: The script creates a backup of the `lbCtrlData.json`, `/etc/hosts`, `cluster.tfvars`, and `terraform.tfstate` files and saves them to the `/var/occne/cluster/${OCCNE_CLUSTER}/backUpConfig/` location.
   >   By default, each time the script runs, it overwrites the previous backup; it does not create additional copies. Make sure to move the files to a new location before running the script again. Create a manual copy of these backups in a different location.
   >
   >   The `terraform.tfstate` file will be renamed to `terraform.tfstate.ORIG` to prevent it from being read by the inventory.

3. Run the `addWorkerNode.py` script:

   ```
   $ ./scripts/addWorkerNode.py
   ```

Sample output for OpenStack:

```
Starting addWorkerNode instance for the last worker node.

 - Backing up configuration files...

 - Checking if cluster.tfvars matches with the terraform state...
   Succesfully checked the number_of_k8s_nodes parameter in the
cluster.tfvars file.

 - Running terraform apply to update its state...
   Successfully applied Openstack terraform apply - check /var/occne/
cluster/occne-test/addWkrNodeCapture-11262024_220914.log for details

 - Get name for the new worker node...
   Successfully retrieved the name of the new worker node.

 - Update /etc/hosts files on all previous servers...
   Successfully updated file: /etc/hosts on all servers - check /var/occne/
cluster/occne-test/addWkrNodeCapture-11262024_220914.log for details.

 - Setting maintenance banner...
   Successfully set maintenance banner - check /var/occne/cluster/occne-
test/addWkrNodeCapture-11262024_220914.log for details.

 - Running pipeline.sh for provision - can take considerable time to
complete...
   Successfully run Provisioning pipeline - check /var/occne/cluster/occne-
test/addWkrNodeCapture-11262024_220914.log for details.

 - Running pipeline.sh for k8s_install - can take considerable time to
complete...
   Successfully run K8s pipeline - check /var/occne/cluster/occne-test/
addWkrNodeCapture-11262024_220914.log for details.

 - Get IP address for the new worker node...
   Successfully retrieved IP address of the new worker node occne-test-k8s-
node-5.

 - Update lbCtrlData.json file...
   Successfully updated file: /var/occne/cluster/occne-test/lbvm/
lbCtrlData.json.

 - Update lb-controller-ctrl-data and lb-controller-master-ip configmap...
   Successfully created configmap lb-controller-ctrl-data.
   Successfully created configmap lb-controller-master-ip.

 - Restarting LB Controller POD to bind in configmaps...
   Successfully restarted deployment occne-lb-controller-server.
   Waiting for occne-lb-controller-server deployment to return to Running
status.
   Deployment "occne-lb-controller-server" successfully rolled out

 - Update servers from new occne-lb-controller pod...
   Successfully updated server list for each service in haproxy.cfg on
LBVMs with new node: occne-test-k8s-node-5.
```

```
 - Restoring default banner...
   Successfully restored default banner - check /var/occne/cluster/occne-
test/addWkrNodeCapture-11262024_220914.log for details.

Worker node successfully added to cluster: occne-test
```

Sample output for VMware:

```
Starting addWorkerNode instance for the last worker node.

 - Backing up configuration files...

 - Checking if cluster.tfvars matches with the terraform state...
   Succesfully checked the number_of_k8s_nodes parameter in the
cluster.tfvars file.

 - Running terraform apply to update its state...
   VmWare terraform apply -refresh-only successful - check /var/occne/
cluster/vmw-test/addWkrNodeCapture-11282023_115313.log for details.
   VmWare terraform apply successful - node - check /var/occne/cluster/vmw-
test/addWkrNodeCapture-11282023_115313.log for details.

 - Get name for the new worker node...
   Successfully retrieved the name of the new worker node.

 - Update /etc/hosts files on all previous servers...
   Successfully updated file: /etc/hosts on all servers - check /var/occne/
cluster/vmw-test/addWkrNodeCapture-11282023_115313.log for details.

 - Setting maintenance banner...
   Successfully set maintenance banner - check /var/occne/cluster/vmw-test/
addWkrNodeCapture-11282023_115313.log for details.

 - Running pipeline.sh for provision - can take considerable time to
complete...
   Successfully run Provisioning pipeline - check /var/occne/cluster/vmw-
test/addWkrNodeCapture-11282023_115313.log for details.

 - Running pipeline.sh for k8s_install - can take considerable time to
complete...
   Successfully run K8s pipeline - check /var/occne/cluster/vmw-test/
addWkrNodeCapture-11282023_115313.log for details.

 - Get IP address for the new worker node...
   Successfully retrieved IP address of the new worker node vmw-test-k8s-
node-4.

 - Update lbCtrlData.json file...
   Successfully updated file: /var/occne/cluster/vmw-test/lbvm/
lbCtrlData.json.

 - Update lb-controller-ctrl-data and lb-controller-master-ip configmap...
   Successfully created configmap lb-controller-ctrl-data.
   Successfully created configmap lb-controller-master-ip.
```

```
 - Restarting LB Controller POD to bind in configmaps...
   Successfully restarted deployment occne-lb-controller-server.
   Waiting for occne-lb-controller-server deployment to return to Running
status.
   Deployment "occne-lb-controller-server" successfully rolled out

 - Update servers from new occne-lb-controller pod...
   Successfully updated server list for each service in haproxy.cfg on
LBVMs with new node: vmw-test-k8s-node-4.

 - Restoring default banner...
   Successfully restored default banner - check /var/occne/cluster/vmw-
test/addWkrNodeCapture-11282023_115313.log for details.

Worker node successfully added to cluster: vmw-test
```

4. Run the following command to verify that the new node was added:

   ```
   kubectl get nodes
   ```

   Sample output for vCNE OpenStack CNLB (CNLB Nodes enabled):

   ```
   NAME                                STATUS   ROLES           AGE   VERSION
   test-cluster-k8s-ctrl-1        Ready    control-plane   45h   v1.33.1
   test-cluster-k8s-ctrl-2        Ready    control-plane   45h   v1.33.1
   test-cluster-k8s-ctrl-3        Ready    control-plane   45h   v1.33.1
   test-cluster-k8s-node-1        Ready    <none>          45h   v1.33.1
   test-cluster-k8s-node-2        Ready    <none>          45h   v1.33.1
   test-cluster-k8s-node-a        Ready    <none>          9m    v1.33.1
   # <------ Example: New node
   test-cluster-k8s-node-cnlb-1   Ready    <none>          45h   v1.33.1
   test-cluster-k8s-node-cnlb-2   Ready    <none>          45h   v1.33.1
   test-cluster-k8s-node-cnlb-3   Ready    <none>          45h   v1.33.1
   test-cluster-k8s-node-cnlb-4   Ready    <none>          45h   v1.33.1
   test-cluster-k8s-node-cnlb-5   Ready    <none>          45h   v1.33.1
   ```

5. The vCNE LBVM script (`addWorkerNode.py`) does not allow resuming a process that has previously failed. The script assumes that the new node does not yet exist; that is, it should not be present in the tfstate file, in the Kubernetes cluster, or in the `/etc/hosts` file.
   To restart the process after a previous failure, manual intervention is required:

   a. Restore the original configuration files. Note that subsequent runs of the script will overwrite previous backup files, and the current backup might not be useful anymore, use the manually created backup files instead.

      ```
      $ cp /var/occne/cluster/${OCCNE_CLUSTER}/cluster.tfvars $
      {OCCNE_CLUSTER}/cluster.tfvars
      $ cp /var/occne/cluster/${OCCNE_CLUSTER}/backupConfig/lbCtrlData.json
      lbvm/lbCtrlData.json
      # sudo cp /var/occne/cluster/${OCCNE_CLUSTER}/backupConfig/hosts /etc/
      hosts
      ```

b. In some cases, after a failed run, the node may already be part of the Kubernetes cluster; in that case, it will be necessary to drain it and remove it from the cluster.

```
$ kubectl drain --ignore-daemonsets --delete-emptydir-data --force --
disable-eviction <FAILED_NODE>
$ kubectl delete node <FAILED_NODE>
```

c. Manually delete the node that was previusly tried to be added. Go to OpenStack Dashboard or VCD GUI and delete it from there.

d. Update the terraform.tfstate file using the `-refresh-only` option. This will update the tfstate file without creating or deleting any resources.

```
$ terraform apply -var-file ${OCCNE_CLUSTER}/cluster.tfvars -refresh-
only
```

> **Warning**
>
> If the previous command indicates that several changes will be made to the infrastructure (not related to the node), then stop the process and contact My Oracle Support.

At this point, the addition process can start again from the beginning.

7.3.5 Removing a Kubernetes Worker Node

This section describes how to remove a Kubernetes node (formally called a "worker" node) to an existing CNE Kubernetes cluster. The procedure is applicable to both CNLB and non-CNLB clusters. However, certain steps may differ depending on that.

Prerequisites

- For a BareMetal installation, ensure that you are familiar with the inventory file preparation procedure. For more information about this procedure, see "*Inventory File Preparation*" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*.
- Run this procedure from the active Bastion Host only.

Points to note

- **vCNE LVBM deployment**: Only one node can be removed at a time. The procedure can only be used to remove the last node in the sequence due to limitations in Terraform.
- **vCNE CNLB deployment**: Only one node can be removed at a time.
- **BareMetal Metallb and CNLB deployment**: Only one node can be removed at a time.
- **All platforms**: It is possible to run this procedure multiple times in a row to remove varius nodes from the cluster, however there must be a minimum number/set of nodes available for the cluster to function correctly. See the prerequisites section for more information.
- CNE does not support standard recovery procedures when more than one node enters the **NotReady** state. In such cases, the cluster is considered **impaired**, and the customer must raise a support ticket for further assistance.

Pre-procedure:

1. Log in to Bastion Host and verify if it's an active Bastion Host. If the Bastion Host isn't an active Bastion Host, then log in to another.
   Run the following command to check if the Bastion Host is an active Bastion Host:

   ```
   is_active_bastion
   ```

   The system displays the following output if the Bastion Host is an active Bastion Host:
   `IS active-bastion`

   The system displays the following output if the Bastion Host isn't an active Bastion Host:

   `NOT active-bastion`
2. Run the following command to navigate to the cluster directory:

   ```
   cd /var/occne/cluster/${OCCNE_CLUSTER}/
   ```
3. Ensure the `secrets.ini` file is present and properly populated.

Perform the following steps to remove a Kubernetes node for vCNE CNLB deployments (Openstack and VMware)

> **Note**
>
> - The procedure and script are applicable to “CNLB nodes”.
> - If this feature was previously enabled (only during installation), the script can be used to remove either a new Kubernetes node or a CNLB node to the cluster.
> - If the feature is disabled, this script can be used to remove a standard Kubernetes node.

1. Run the following command to open the `$OCCNE_CLUSTER/cluster.tfvars` file.
   Modify only one of the fields at a time, and add a new "name" to the lists of node names. The items in a given list cannot be repeated within the same list, and each item must have a maximum of 4 characters (lowercase). OpenTofu sorts each list alphabetically, turning it into a set, a new node can be added regardless of being first, second or last in the set.

Table 7-19 Node Names

Field	Example: Old value	Example: New value	Valid only if
occne_node_names	["1", "2", "3"]	["1", "2", "3", "4"] or ["0", "1", "2", "3"]	All types of vCNE CNLB deployments
cnlb_node_names	["1", "2", "3", "4", "5"]	["1", "2", "3", "4", "5", "6"] or ["1", "2", "a", "3", "4", "5"]	CNLB Nodes feature is enabled: `cnlb_node_label = True`

Edit the `cluster.tfvars` file.

```
$ vi $OCCNE_CLUSTER/cluster.tfvars
```

Sample output: Removing a node name at the end of the list

```
...
# K8s nodes
#
occne_node_names = ["1", "2", "3", "4"]
...
```

Sample output: Removing a node name at the beginning of the list

```
...
# CNLB nodes
#
cnlb_node_names = ["2", "3", "4", "5"]
```

2. Run the `removeK8sNode.py` script.

> **Note**
>
> - **Log file location**: Information will be displayed on screen and logged to a log file. This file is located at the path, `/var/occne/cluster/${OCCNE_CLUSTER}/logs/maintenance/remove_cnlb_k8s_node_<yyyy-mm-dd_hhmmss>.log`.
> Long-running processes (such as cluster tests or the node provison) will not appear in the file until they have finished. The process must complete before its entry is recorded.
>
> The standard output (stdout) and standard error output (stderr) commands will be logged to the file, each on a separate line.
>
> - **Backup file location**: The script creates a backup of the `cluster.tfvars`, `terraform.tfstate` files and saves them to the `/var/occne/cluster/${OCCNE_CLUSTER}/backup_config/remove_cnlb_k8s_node_<yyyy-mm-dd_hhmmss>/` location.
> By default, each run of the script creates a dedicated directory and copy of the files.
>
> The `terraform.tfstate` file is renamed to `terraform.tfstate.ORIG` to prevent it from being used by the inventory.

3. **For OpenStack**, perform this step to source the `openrc.sh` file. The `openrc.sh` file sets the necessary environment variables for OpenStack. For VMware, skip this step and move to the next step.
   a. Source the `openrc.sh` file.

      ```
      $ source openrc.sh
      ```

   b. Enter the OpenStack username and password when prompted.
      The following block shows the username and password prompt displayed by the system:

      ```
      Please enter your OpenStack Username:
       Please enter your OpenStack Password as <username>:
      ```

> **Note**
>
> It is assumed that the provided credentials and the `openrc.sh` file are current, valid, and have the necessary permissions.

4. Verify that the cluster is healthy.

   > **Note**
   >
   > As mentioned in the introduction, while it is possible to run this procedure even if the node to be removed is considered unhealthy, it is recommended to perform this step to check the cluster health. The vCNE CNLB script includes this health pre-check by default.

   ```
   $ OCCNE_STAGES=(TEST) pipeline.sh
   ```

5. Run the `removeK8sNode.py` script. removing any type of node will produce similar outputs, regardless of whether it is a CNLB node or a regular Kubernetes node.
   Run the following script to remove a Kubernetes node:

   ```
   ./scripts/removeK8sNode.py
   ```

   Sample output for both OpenStack and VMware:

   ```
   Initializing Remove K8s Node(s) Process

    - Backing up configuration files...
      Backup files location: /var/occne/cluster/test-cluster/backup_config/
   remove_cnlb_k8s_node_2025-09-10_003841/

    - Log file location: /var/occne/cluster/test-cluster/logs/maintenance/
   remove_cnlb_k8s_node_2025-09-10_003841.log, long-running processes will
   write to it as they finish.

    - Initializing tofu...
      Tofu successfully initialized.

    - Update tfstate (tofu plan)...
      Tofu successfully planned.

    - List of nodes to be removed: cluster-test-k8s-node-cnlb-2

    - PRE: Testing cluster health...
      Test pipeline completed successfully.

    - Setting maintenance banner...
      Maintenance banner set successfully.

    - Cordoning node(s)...
      Node(s) successfully cordoned.

    - Draining node(s) - can take considerable time to complete...
   ```

```
  Node(s) successfully drained.

- Removing node(s) from Kubernetes cluster...
  Node(s) removed successfully from Kubernetes.

- Updating infrastructure (tofu apply)...
  Tofu successfully applied.

- Update /etc/hosts files on all remaining servers...
  Update /etc/host successful.

- POST: Testing cluster health...
  Test pipeline completed successfully.

- Restoring default banner...
  Successfully restored default banner.

 - Remove K8s Node(s) successfully completed - Check the log file for
details: /var/occne/cluster/test-cluster/logs/maintenance/
remove_cnlb_k8s_node_2025-09-10_003841.log
```

Perform the following steps to remove a Kubernetes node for vCNE LBVM deployments (Openstack and VMware)

1. Edit the `$OCCNE_CLUSTER/cluster.tfvars` file. Modify the `number_of_k8s_nodes` field and decrease its value by 1.

   ```
   $ vi $OCCNE_CLUSTER/cluster.tfvars
   ```

   Sample output:

   ```
    Decrease the number of nodes from 6 to 5
   ...
   # K8s nodes
   #
   number_of_k8s_nodes = 5
   ...
   ```

2. Run the `removeWorkerNode.py` script.

> **Note**
>
> - **Log file location**: Information will be displayed on screen and logs are stored in a file. This file is located at the path, `/var/occne/cluster/${OCCNE_CLUSTER}/removeWrkNodeCapture-<mmddyyyy_hhmmss>.log`.
>   Long-running processes (such as node provison) will not appear in the file until they have finished. The process must complete before its entry is recorded.
> - **Backup file location**: The script creates a backup of the `lbCtrlData.json`, `/etc/hosts`, `cluster.tfvars`, and `terraform.tfstate` files and saves them to the `/var/occne/cluster/${OCCNE_CLUSTER}/backUpConfig/` location.
>   By default, each time the script runs, it overwrites the previous backup; it does not create additional copies. Make sure to move the files to a new location before running the script again. Create a manual copy of these backups in a different location.
>
>   The `terraform.tfstate` file will be renamed to `terraform.tfstate.ORIG` to prevent it from being read by the inventory.

3. Run the `removeWorkerNode.py` script:

   ```
   ./scripts/removeWorkerNode.py
   ```

   Sample output for OpenStack:

   ```
   Starting removeWorkerNode instance for the last worker node.

    - Backing up configuration files...

    - Checking if cluster.tfvars matches with the terraform state...
      Successfully checked the number_of_k8s_nodes parameter in the
   cluster.tfvars file.

    - Getting the IP address for the worker node to be deleted...
      Successfully gathered occne-test-k8s-node-4's ip: 192.168.200.105.

    - Draining  node - can take considerable time to complete...
      Successfully drained occne-test-k8s-node-4 node.

    - Removing  node from the cluster...
      Successfully removed occne-test-k8s-node-4 from the cluster.

    - Running terraform apply to update its state...
      Successfully applied Openstack terraform apply - check /var/occne/
   cluster/occne-test/removeWkrNodeCapture-11282023_090320.log for details

    - Updating /etc/hosts on all servers...
      Successfully updated file: /etc/hosts on all servers - check /var/occne/
   cluster/occne-test/removeWkrNodeCapture-11282023_090320.log for details.

    - Updating lbCtrlData.json file...
      Successfully updated file: /var/occne/cluster/occne-test/lbvm/
   ```

```
lbCtrlData.json.

 - Updating lb-controller-ctrl-data and lb-controller-master-ip
configmap...
   Successfully created configmap lb-controller-ctrl-data.
   Successfully created configmap lb-controller-master-ip.

 - Deleting LB Controller POD: occne-lb-controller-server-fc869755-lm4hd
to bind in configmaps...
   Successfully restarted deployment occne-lb-controller-server.
   Waiting for occne-lb-controller-server deployment to return to Running
status.
   Deployment "occne-lb-controller-server" successfully rolled out

 - Update servers from new occne-lb-controller pod...
   Successfully removed the node: occne-test-k8s-node-4 from server list
for each service in haproxy.cfg on LBVMs.

Worker node successfully removed from cluster: occne-test
```

Sample output for VMware:

```
$ ./scripts/removeWorkerNode.py
Starting removeWorkerNode instance for the last worker node.
   Successfully obtained index 5 from node occne-test-k8s-node-6.

 - Backing up configuration files...

 - Checking if cluster.tfvars matches with the terraform state...
   Successfully checked the number_of_k8s_nodes parameter in the
cluster.tfvars file.

 - Getting the IP address for the worker node to be deleted...
   Successfully gathered occne-test-k8s-node-6's ip: 192.168.200.105.

 - Draining  node - can take considerable time to complete...
   Successfully drained occne-test-k8s-node-6 node.

 - Removing  node from the cluster...
   Successfully removed occne-test-k8s-node-6 from the cluster.

 - Running terraform apply to update its state...
   Successfully applied VMware terraform apply - check /var/occne/cluster/
occne-test/removeWkrNodeCapture-11282023_090320.log for details

 - Updating /etc/hosts on all servers...
   Successfully updated file: /etc/hosts on all servers - check /var/occne/
cluster/occne-test/removeWkrNodeCapture-11282023_090320.log for details.

 - Updating lbCtrlData.json file...
   Successfully updated file: /var/occne/cluster/occne-test/lbvm/
lbCtrlData.json.

 - Updating lb-controller-ctrl-data and lb-controller-master-ip
```

```
configmap...
   Successfully created configmap lb-controller-ctrl-data.
   Successfully created configmap lb-controller-master-ip.

 - Deleting LB Controller POD: occne-lb-controller-server-fc869755-lm4hd
to bind in configmaps...
   Successfully restarted deployment occne-lb-controller-server.
   Waiting for occne-lb-controller-server deployment to return to Running
status.
   Deployment "occne-lb-controller-server" successfully rolled out

 - Update servers from new occne-lb-controller pod...
   Successfully removed the node: occne-test-k8s-node-6 from server list
for each service in haproxy.cfg on LBVMs.

Worker node successfully removed from cluster: occne-test
```

Remove a Kubernetes Worker Node in BareMetal Deployment (MetalLB and CNLB)

> **Note**
>
> For any failure or successful run, the system maintains all pipeline outputs in the `/var/occne/cluster/${OCCNE_CLUSTER}/removeWrkNodeCapture-<mmddyyyy_hhmmss>.log` file. The system displays other outputs, messages, or errors directly on the terminal during the runtime of the script.

1. Log in to Bastion Host and verify if it's an active Bastion Host. If the Bastion Host isn't an active Bastion Host, then log in to another.

   Use the following command to check if the Bastion Host is an active Bastion Host:

   ```
   $ is_active_bastion
   ```

   The system displays the following output if the Bastion Host is an active Bastion Host:
   `IS active-bastion`

   The system displays the following output if the Bastion Host isn't an active Bastion Host:

   `NOT active-bastion`

2. Navigate to the `/var/occne/cluster/${OCCNE_CLUSTER}/scripts/maintenance` directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}/scripts/maintenance
   ```

3. Run the following command to remove the targeted worker node:

> **Note**
>
> - **Log file location**: Information will be displayed on screen and logged to a log file. This file is located at the path, `/var/occne/cluster/${OCCNE_CLUSTER}/removeBmWkrNodeCapture-<mmddyyyy_hhmmss>.log`.
>   Long-running processes (such as node provisioning) will not appear in the file until they have finished. The process must complete before its entry is recorded.
> - **Backup file location**: The script creates a backup of the `lbCtrlData.json`, `/etc/hosts`, `registries.conf`, and `hosts.ini` files and saves them to the `/var/occne/cluster/${OCCNE_CLUSTER}/backUpConfig/` location.

```
$ artifacts/maintenance/removeBmWorkerNode.py -nn <NODE_FULL_NAME>
```

where, `<NODE_FULL_NAME>` is the name of the node that you want to remove (in this case, `k8s-3.test.us.oracle.com`).
For example:

```
$ artifacts/maintenance/removeBmWorkerNode.py -nn k8s-3.test.us.oracle.com
```

Sample output:

```
Beginning remove worker node: k8s-3.test.us.oracle.com
 - Backing up configuration files.
    - Backup folder: /var/occne/cluster/delta/backupConfig
 - Removing BM worker node, could take considerable amount of time.
    - k8s-3.test.us.oracle.com is not reachable
       - Performing node cleanup.
          - k8s-3.test.us.oracle.com pods are scheduled for deletion.
             - Node cleanup completed.
       - Removing... Please Wait. Do not cancel.
       - Removed. Check /var/occne/cluster/delta/
removeBmWkrNodeCapture-05312024_215105.log for details.
 - Checking if the rook-ceph toolbox deployment already exists.
    - rook-ceph toolbox deployment does not exist.
    - Creating the rook-ceph toolbox deployment.
       - rook-ceph toolbox created.
 - Waiting for Toolbox pod to be Running.
    - Waiting for toolbox pod in namespace rook-ceph to be in Running
state, current state:
    - ToolBox pod in namespace rook-ceph is now in Running state.
 - Getting the OSD Id.
    - Found OSD ID: 1, for worker node: k8s-3.test.us.oracle.com
 - Scaling down the rook-ceph-operator deployment.
    - rook-ceph-operator deployment scaled down.
 - Scaling down the OSD deployment.
    - rook-ceph-osd-1 deployment scaled down.
 - Purging OSD Id.
    - OSD.1 purged.
```

```
    - OSD host k8s-3.test.us.oracle.com removed.
    - OSD auth key osd.1 removed.
 - Deleting OSD deployment.
    - rook-ceph-osd-1 deleted.
 - Scaling up the rook-ceph-operator deployment.
    - rook-ceph-operator deployment scaled up.
 - Checking if the rook-ceph toolbox deployment exists.
    - Removing the rook-ceph toolbox deployment.
       - rook-ceph toolbox removed.
 - Cleanup leftover rook-ceph-mon replicasets
    - Found pod rook-ceph-mon-c-74f5d4d498-tw4d6, getting replica set...
       - Found deployment rook-ceph-mon-c, deleting...
    - rook-ceph-mon cleanup completed.
Worker node: k8s-3.test.us.oracle.com removed Successfully
```

4. Edit the `hosts.ini` file, remove the lines that contain <NODE_FULL_NAME>, must be the same node used the previous step.

   Run the following command to open the `hosts.ini` file:

   ```
   $ vi hosts.ini
   ```

   For the following sample output, `<NODE_FULL_NAME>` is `k8s-node-3.test.us.oracle.com`

   ```
   [host_hp_gen_X]/[host_netra_X] # Host header may vary depending on your
   hardware
   k8s-host-1.test.us.oracle.com ansible_host=179.1.5.2 hp_ilo=172.16.9.44
   mac=a2-27-3d-d3-b4-00 oam_host=10.75.216.13
   k8s-host-2.test.us.oracle.com ansible_host=179.1.5.3 hp_ilo=172.16.9.45
   mac=4d-d9-1a-e2-7e-e8 oam_host=10.75.216.14
   k8s-host-3.test.us.oracle.com ansible_host=179.1.5.4 hp_ilo=172.16.9.46
   mac=e1-15-b4-1d-32-10

   k8s-node-1.test.us.oracle.com ansible_host=179.1.5.5 hp_ilo=172.16.9.47
   mac=3b-d2-2d-f6-1e-20
   k8s-node-2.test.us.oracle.com ansible_host=179.1.5.6 hp_ilo=172.16.9.48
   mac=a8-1a-37-b1-c0-dc
   k8s-node-3.test.us.oracle.com ansible_host=179.1.5.7 hp_ilo=172.16.9.49
   mac=a4-be-2d-3f-21-f0 # <------ Remove this whole line
   k8s-node-4.test.us.oracle.com ansible_host=179.1.5.8 hp_ilo=172.16.9.35
   mac=3a-d9-2c-e6-35-18
   .
   .
   .
   [kube-node]
   k8s-node-1.test.us.oracle.com
   k8s-node-2.test.us.oracle.com
   k8s-node-3.test.us.oracle.com # <------ Remove this whole line
   k8s-node-4.test.us.oracle.com
   ```

   Save and exit.

Post verification

This procedure provides steps to verify if the node is removed successfully.

Perform the following steps to verify the node is no longer part of Kubernetes cluster:

```
$ kubectl get nodes
```

Before performing the procedure, the node `k8s-node-4.test.us.oracle.com` was part of the cluster. The following sample output for BareMetal shows that the node is removed:

```
NAME                                STATUS   ROLES           AGE     VERSION
k8s-master-1.test.us.oracle.com   Ready    control-plane   8d10h   v1.33.1
k8s-master-2.test.us.oracle.com   Ready    control-plane   8d10h   v1.33.1
k8s-master-3.test.us.oracle.com   Ready    control-plane   8d10h   v1.33.1
k8s-node-1.test.us.oracle.com     Ready    <none>          8d10h   v1.33.1
k8s-node-2.test.us.oracle.com     Ready    <none>          8d10h   v1.33.1
k8s-node-3.test.us.oracle.com     Ready    <none>          8d10h   v1.33.1
k8s-node-5.test.us.oracle.com     Ready    <none>          8d10h   v1.33.1
k8s-node-6.test.us.oracle.com     Ready    <none>          8d10h   v1.33.1
```

Before performing the procedure, the node `test-cluster-k8s-node-6` was part of the cluster. The following sample output for vCNE OpenStack LBVM shows that the node is removed:

```
NAME                                STATUS   ROLES           AGE   VERSION
test-cluster-k8s-ctrl-1        Ready    control-plane   45h   v1.33.1
test-cluster-k8s-ctrl-2        Ready    control-plane   45h   v1.33.1
test-cluster-k8s-ctrl-3        Ready    control-plane   45h   v1.33.1
test-cluster-k8s-node-1        Ready    <none>          45h   v1.33.1
test-cluster-k8s-node-2        Ready    <none>          45h   v1.33.1
test-cluster-k8s-node-3        Ready    <none>          45h   v1.33.1
test-cluster-k8s-node-4        Ready    <none>          45h   v1.33.1
test-cluster-k8s-node-5        Ready    <none>          45h   v1.33.1
```

Run the following command to check the node is no longer part of the `/etc/hosts` file:

```
$ cat /etc/hosts
```

Before performing the procedure, the node `test-cluster-k8s-node-6` was part of the cluster. The following sample output for vCNE shows that the node is removed:

```
127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4
::1         localhost localhost.localdomain localhost6 localhost6.localdomain6

10.1.1.3 centralrepo
192.168.202.3   test-cluster-bastion-2.novalocal  test-cluster-bastion-2
192.168.202.4   test-cluster-k8s-node-1.novalocal  test-cluster-k8s-node-1
192.168.202.5   test-cluster-k8s-node-2.novalocal  test-cluster-k8s-node-2
192.168.200.6   test-cluster-k8s-node-3.novalocal  test-cluster-k8s-node-3
192.168.203.7   test-cluster-k8s-node-4.novalocal  test-cluster-k8s-node-4
192.168.201.8   test-cluster-k8s-node-5.novalocal  test-cluster-k8s-node-5
192.168.201.9   test-cluster-k8s-ctrl-1.novalocal  test-cluster-k8s-ctrl-1
```

```
192.168.201.10  test-cluster-k8s-ctrl-2.novalocal  test-cluster-k8s-ctrl-2
192.168.201.11  test-cluster-k8s-ctrl-3.novalocal  test-cluster-k8s-ctrl-3
127.0.0.1  occne-repo-host  test-cluster-bastion-1
192.168.201.9  lb-apiserver.kubernetes.local
192.168.201.10 lb-apiserver.kubernetes.local
192.168.201.11 lb-apiserver.kubernetes.local
```

Run the following command to check the node is no longer part of the dynamic inventory (hosts script) file:

```
$ ./hosts --hostfile
```

Before performing the procedure, the node `cluster-test-k8s-node-3` was part of the cluster. The following sample output for vCNE (CNLB Nodes) shows that the node is removed:

```
## begin hosts generated by terraform.py ##
10.123.154.116      cluster-test-bastion-1
10.123.154.60       cluster-test-bastion-2
192.168.202.217     cluster-test-k8s-node-cnlb-1
192.168.202.33      cluster-test-k8s-node-cnlb-2
192.168.200.219     cluster-test-k8s-node-cnlb-3
192.168.203.179     cluster-test-k8s-node-cnlb-4
192.168.201.229     cluster-test-k8s-node-cnlb-5
192.168.201.204     cluster-test-k8s-ctrl-1
192.168.201.130     cluster-test-k8s-ctrl-2
192.168.201.206     cluster-test-k8s-ctrl-3
192.168.203.205     cluster-test-k8s-node-1
192.168.203.205     cluster-test-k8s-node-2
192.168.203.205     cluster-test-k8s-node-4
## end hosts generated by terraform.py ##
```

Verify that the cluster is healthy. The following are simple examples.

Run the following command to retrieve all node from all namespaces and verify that they are all up and running:

```
$ kubectl get pods -A
```

For LBVM and MetalLB deployments, verify that all services are assigned and accessible.

```
$ kubectl get svc -A
```

Troubleshooting

Resuming after a previous failure (vCNE LBVM)

> **Note**
>
> If an issue occurs while removing a node, it is strongly recommended to contact the My Oracle Support.

The vCNE LBVM script (`removeWorkerNode.py`) does not allow resuming a process that has previously failed. The script requieres a very specirfc state of the terraform tfstate and Kubernetes cluster to perform its procedure.

Restarting or rerunning the script is not supported. Manual intervention is required to finish removing the node in case of a failure.

1. If the node is still part of the Kubernetes cluster:

   ```
   $ kubectl get nodes
   ```

   In this case, it might be possible to rerun the script to restart the process. The script relies on the Kubernetes cluster to determine whether a node can be deleted. Start over from the beginning of this procedure.

2. If re-running the script does not resolve the issue and the node is still part of the Kubernetes cluster, another option is to remove it manually from Kubernetes:

   ```
   $ kubectl drain --ignore-daemonsets --delete-emptydir-data --force --
   disable-eviction <FAILED_NODE>
   $ kubectl delete node <FAILED_NODE>
   ```

3. If the script removed the node from Kubernetes, but it still exists in Terraform, go to OpenStack Dashboard or VCD user interface and delete the node from there. Update the terraform.tfstate file using the `-refresh-only` option. This will update the tfstate file without creating or deleting any resources.

   ```
   $ terraform apply -var-file ${OCCNE_CLUSTER}/cluster.tfvars -refresh-only
   ```

   > **Note**
   >
   > If the previous command indicates that several changes will be made to the infrastructure (not related to the node), then stop the process and open a support ticket.

4. Manually clean the `/etc/hosts` file, starting with the hosts file on the active Bastion:

   ```
   $ vi /etc/hosts
   ```

5. Remove all entries related to the deleted node from the file. Editing this file may require administrator privileges. Repeat this step for each VM in the cluster by connecting to each VM using SSH and manually editing the file.

   ```
   $ ssh <NODE/BASTION/LBVM/CONTROL_PLANE_VM>
   $ vi /etc/hosts
   $ exit
   ```

Advanced options (vCNE CNLB)

The vCNE CNLB script (`removeK8sNode.py`) can accept additional arguments that are useful for troubleshooting common issues or for resuming a node deletion process if it failed previously.

```
$ scripts/removeK8sNode.py -h
```

> **Note**
>
> Use the script's `help` option for more information about each argument.

Sample output:

```
usage: removeK8sNode.py [-h] [-d] [-nb] [-i] [-iq] [-s {PRE,POST}
[{PRE,POST} ...]] [-R] [-D]

Remove one or more K8s nodes or CNLB K8s nodes (control plane nodes are not
supported) from an OCCNE cluster.

Optional arguments:
  -d, --debug           Debug mode.
  -nb, --no-backup      Do not create backup.
  -i, --ignore-disruption
                        Ignores pod disruption budget while draining a node.
This could lead to service disruption use with caution or manually shift load
around before attempting to
                        remove a node.
  -iq, --ignore-quota   Allows the script to remove a node even if the number
of nodes would be too low to execute its load. Use it only to replace a node
(add it back immediately after
                        the removal is complete).
  -s {PRE,POST} [{PRE,POST} ...], --skip-test {PRE,POST} [{PRE,POST} ...]
                        Do not test the cluster health. By default, all tests
are run; specify individual tests to be skipped.
  -R, --refresh         Allow OpenTofu to synchronize its state with current
infrastructure resources. Internally sends a -refresh-only command to both
tofu plan and apply commands.
  -D, --dry-run         Test mode. Identifies new or affected nodes without
applying changes. Stops in the init phase.

    Examples:
     ./removeK8sNode.py
     ./removeK8sNode.py --debug
     ./removeK8sNode.py -nb -d
     ./removeK8sNode.py --debug --no-backup --dry-run
     ./removeK8sNode.py --ignore-disruption
     ./removeK8sNode.py --ignore-quota --refresh
     ./removeK8sNode.py -d --skip-test PRE POST -R
```

7.3.6 Adding a New External Network

This section provides the procedure to add a new external network that applications can use to talk to external clients, by adding a Peer Address Pool (PAP) in a virtualized CNE (vCNE) and Bare Metal, after installation in CNE.

The cluster must be in good working condition. All pods and services must be running and no existing LBVMs must be in a FAILED state. Use the following command to run a full cluster test before starting the procedure:

```
OCCNE_STAGES=(TEST) pipeline.sh
```

7.3.6.1 Adding a New External Network in vCNE

The following procedure provides the steps to add a single Peer Address Pool (PAP) in vCNE.

Each time the script is run, the system creates a log file with a timestamp. The format of the log file is, `addpapCapture-<mmddyyyy_hhmmss>.log`. For example, `addPapCapture-09172021_000823.log`. The log includes the output from the Terraform and the pipeline call to configure the new LBVMs.

Each time the script is run, the system creates a new directory, `addPapSave-<mmddyyyy-hhmmss>`. The following files from the `/var/occne/cluster/<cluster_name>` directory are saved in the `addPapSave-<mmddyyyy-hhmmss>` directory:

- lbvm/lbCtrlData.json
- metallb.auto.tfvars
- mb_resources.yaml
- terraform.tfstate
- hosts.ini
- cluster.tfvars

Prerequisites

1. On an OpenStack deployment, run the following steps to source the OpenStack environment file. This step is not required for a VMware deployment as the credential settings are derived automatically.
   a. Log in to Bastion Host and change the directory to the cluster directory:

      ```
      $ cd /var/occne/cluster/${OCCNE_CLUSTER}
      ```

   b. Source the OpenStack environment file:

      ```
      $ source openrc.sh
      ```

Procedure

1. Update the `/var/occne/cluster/<cluster_name>/<cluster_name>/cluster.tfvars` file to include the new pool that is required.

   For more information about the following, see *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*:

   - Updating the `cluster.tfvars` file.

- Adding a Peer Address Pool (PAP) object to the existing `cluster.tfvars` file.
- Adding the additional PAP name to the `occne_metallb_peer_addr_pool_names` list.
- Adding the additional pool objects to the `occne_metallb_list` object.

2. Run the `addPeerAddrPools.py` script:

   The script is located on the Bastion Host at `/var/occne/cluster/<cluster_name>/scripts`. The script is fully automated. When the script completes, the new LBVM pair is fully integrated into the deployment. The script doesn't require any parameter and performs all the steps required to complete the addition of the new Peer Address Pool (PAP) including a validation at the end. All output echos back to the terminal.

   It is recommended to perform the following before running the script:

   - Start a terminal output capture process to ensure that all data output is captured (for example, the script).
   - Run `tail -f` on the current `addPapCapture` log file to see how the Terraform and pipeline is running.

   a. Run the following commands to run the `addPeerAddrPools.py` script:

      ```
      $ cd /var/occne/cluster/<cluster_name>
      $ ./scripts/addPeerAddrPools.py
      ```

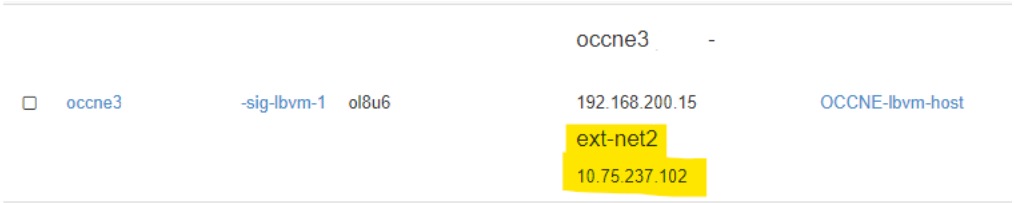
      Sample output to show a new PAP, "sig", added. The cluster_name in the sample output is considered as occne1-cluster:

      ```
      - Capturing current lbCtrlData.json data...

       - Generating new metallb.auto.tfvars file...
         Successfully generated the metallb.auto.tfvars file.

       - Executing terraform apply to generate new LBVM and port resources...
         . terraform apply attempt 1
         Successful execution of terraform apply -auto-approve -compact-
      warnings -var-file=/var/occne/cluster/occne1-cluster/occne1-cluster/
      cluster.tfvars

       - Generating new mb_resources.yaml file...
         Successfully updated the /var/occne/cluster/occne1-cluster/
      mb_resources.yaml file.

       - Applying new mb_resources.yaml file...
         Successfully applied mb_resources.yaml file.

       - Generating new lbvm/lbCtrlData.json file (can take longer due to
      number of existing LBVM pairs)...
         Successfully updated the lbvm/lbCtrlData.json file.

       - Generating new pool list...

       - Updating hosts.ini with new LBVMs...
         Successfully updated hosts.ini.

       - Running pipeline to config the new LBVMs (can take 10 minutes or
      more)...
      ```

```
   Successfully updated the new LBVM config.

 - Updating /etc/hosts with new LBVMs...
   Successfully updated /etc/hosts

 - Generating new config maps for lb-controller...
   . Updating config map: lb-controller-ctrl-data from file: /var/occne/
cluster/occne1-cluster/lbvm/lbCtrlData.json
     Successfully applied new config map: lb-controller-ctrl-data from
file: /var/occne/occne1-cluster/lbvm/lbCtrlData.json
     Pausing for 30 seconds to allow completion of config map: lb-
controller-ctrl-data update from file: /var/occne/cluster/occne1-
cluster/lbvm/lbCtrlData.json.
   . Updating config map: lb-controller-master-ip from file: /etc/hosts
     Successfully applied new config map: lb-controller-master-ip from
file: /etc/hosts
     Pausing for 30 seconds to allow completion of config map: lb-
controller-master-ip update from file: /etc/hosts.
   . Updating config map: lb-controller-mb-resources from file: /var/
occne/cluster/occne1-cluster/mb_resources.yaml
     Successfully applied new config map: lb-controller-mb-resources
from file: /var/occne/cluster/occne1-cluster/mb_resources.yaml
     Pausing for 30 seconds to allow completion of config map: lb-
controller-mb-resources update from file: /var/occne/cluster/occne1-
cluster/mb_resources.yaml.
     Successfully restarted deployment: occne-lb-controller-server
     Waiting for occne-lb-controller-server deployment to return to
Running status.
     Deployment "occne-lb-controller-server" successfully rolled out

 - Generating the LBVM HAProxy templates...
   Successfully updated the templates files in the LBVMs.

 - Updating the lb-controller Db...
   Successfully added new pools to the lb_controller Db.

 - Restarting occne-egress-controller pods...
     Successfully restarted daemonset: occne-egress-controller
     Waiting for occne-egress-controller daemonset to return to Running
status.
   Daemon set "occne-egress-controller" successfully rolled out

 - Restarting occne-metallb-controller pod...
     Successfully restarted deployment: occne-metallb-controller
     Waiting for occne-metallb-controller deployment to return to
Running status.
   Deployment "occne-metallb-controller" successfully rolled out

 - Restarting occne-metallb-speaker pods...
     Successfully restarted daemonset: occne-metallb-speaker
     Waiting for occne-metallb-speaker daemonset to return to Running
status.
   Daemon set "occne-metallb-speaker" successfully rolled out

 - Validating LBVM configuration
   . Validating IPAddressPool CRD for pool: sig
```

```
      IPAddressPool CRD validated successfully for pool: sig
   . Validating BGPAdvertisements CRD for pool: sig
     BGPAdvertisements bgpadvertisement1 validated successfully for
pool: sig
   . Validating ACTIVE LBVM for pool: sig
     ACTIVE LBVM haproxy.cfg validation successful for pool: sig
   . Validating LB Controller Db for pool: tme
     LB Controller Db validation successful for pool: sig

Successfully added new LBVMs and ports for the new Peer Address Pool.
```

b. Log in to the OpenStack GUI and validate if the new pool LBVMs are created and the new external egress port is attached to the Active LBVM.



7.3.6.2 Adding a New External Network in Bare Metal

This section describes the procedure to add an additional network to an existing bare metal installation of CNE.

> **Note**
>
> Run all commands in this procedure from the Bastion Host.

1. Navigate to the `/var/occne/cluster/${OCCNE_CLUSTER}` directory.
2. Edit the `mb_resources.yaml` file to reflect the new network configuration. Add the following new address pool configuration as per the directions and example provided in the "Populate the MetalLB Configuration" section of *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*:
   - Add the new IPAddressPool section.
   - Add the new pool's name to the BGPAdvertisement description.
3. Run the following command to apply the new metalLB configuration file:

   ```
   $ kubectl apply -f mb_resources.yaml
   ```

4. Perfrom the following steps to delete the address pool:
   a. Remove the address pool from the `IPAddressPool` section of the `mb_resources.yaml` file.
   b. Remove the address pool's name from the `BGPAdvertisement` description.

c. Run the following command to effect the removal of the advertisement:

```
kubectl apply -f mb_resources.yaml
```

d. Run the following command to delete the now orphaned IPAddressPool resource description:

```
kubectl delete IPAddressPool <pool-name>  -n <namespace>
```

7.3.7 Renewing the Platform Service Mesh Root Certificate

This section describes the procedure to renew the root certificate used by the platform service mesh to generate certificates for Mutual Transport Layer Security (mTLS) communication when the Intermediate Certification Authority (ICA) issuer type is used.

Prerequisites

1. The CNE platform service mesh must have been configured to use the Intermediate CA issuer type.
2. A network function configured with the platform service mesh, commonly istio, must be available.

Procedure

1. Renew the root CA certificate
   a. Obtain a new certificate and key

      Generate a new signing certificate and key from the external CA that generated the original root CA certificate and key. The generated certificate and key values must be base64 encoded.

      Check the Certificate Authority documentation for generating the required certificate and key.

   b. Set required environment variables

      Set the `OCCNE_NEW_CA_CERTIFICATE` and `OCCNE_NEW_CA_KEY` as follows:

      ```
      $ OCCNE_NEW_CA_CERTIFICATE=<base64 encoded root CA certificate>
      $ OCCNE_NEW_CA_KEY=<base64 encoded root CA key>
      ```

      > **Note**
      >
      > Ensure that for each certificate and key is encoded with a base64 value.

      Example:

      ```
      OCCNE_NEW_CA_CERTIFICATE=LS0tLS1CRUdJTiBDRVJUSUZJQ0F...0tRU5EIENFUlRJRkl
      DQVRFLS0tLS0K
      OCCNE_NEW_CA_KEY=LS0tLS1CRUdJTiBSU0EgUFJJVkFURSBLRVk...CBSU0EgUFJJVkFURS
      BLRVktLS0tLQo
      ```

   c. Renew the root certificate

Run the following script to renew the root certificate:

```
$ /var/occne/cluster/${OCCNE_CLUSTER}/artifacts/
renew_istio_root_certificate.sh ${OCCNE_NEW_CA_CERTIFICATE} $
{OCCNE_NEW_CA_KEY}
```

2. Verify that root certificate is renewed
   a. Check that the Kubernetes Secret containing the certificate and key is updated

      Run the following command to retrieve the *istio-ca* secret:

      ```
      $ kubectl -n istio-system get secret istio-ca -o
      jsonpath="{.data['tls\.crt']}"
      ```

      Verify that the retrieved certificate and key match with the ones provided in the previous step.

   b. Verify that the service mesh is configured to use the new certificate:
      i. Run the following command to retrieve the Istio configured root certificate:

         ```
         $ kubectl -n istio-system get cm istio-ca-root-cert -o
         jsonpath="{.data['root-cert\.pem']}" | base64 -w0; echo
         ```

      ii. Verify that the retrieved certificate and key match with the ones provided in the previous step.

   c. Verify that NF pods are aware of the new root certificate.

      Check that NF pod is updated with new root certificate value. It must be same as `$ {OCCNE_NEW_CA_CERTIFICATE}`. Repeat the step for other NF pods as follows:

      ```
      # set the istio binary path
      $ ISTIO_BIN=/var/occne/cluster/${OCCNE_CLUSTER}/artifacts/istio-$
      (cat /var/occne/cluster/${OCCNE_CLUSTER}/artifacts/
      CFG_container_images.txt | grep istio/pilot | cut -d: -f 2)/bin/istioctl

      # set the pod name
      $ POD_NAME=<nf-pod-name>

      # set the namespace
      $ NAME_SPACE=<nf-namespace>

      # execute istio proxy-config command to get the root certificate of the
      NF pod
      $ ${ISTIO_BIN} proxy-config secret ${POD_NAME} -n ${NAME_SPACE} -o json
      | grep -zoP 'trustedCa.*\n.*inlineBytes.*' | tail -n 1 | awk -d:
      '{ print $2 }' | tr -d \"
      ```

7.3.8 Performing an etcd Data Backup

This section describes the procedure to back up the etcd database.

A backup copy of the etcd database is required to restore the CNE Kubernetes cluster in case all controller nodes fail simultaneously. You must back up the etcd data in the following scenarios:

- After a 5G NF is installed, uninstalled, or upgraded
- Before and after CNE is upgraded

This way the backed-up etcd data can be used to recover the CNE Kubernetes cluster during disaster scenarios. The etcd data is consistent across all controller nodes within a cluster. Therefore it is sufficient to take a backup from any one of the active Kubernetes controller nodes.

Procedure

1. Find Kubernetes controller hostname: Run the following command to get the names of Kubernetes controller nodes. The backup must be taken from any one of the controller nodes that is in **Ready** state.

   ```
   $ kubectl get nodes
   ```

2. Run the etcd-backup script:
   a. On the Bastion Host, switch to the `/var/occne/cluster/${OCCNE_CLUSTER}/artifacts` directory:

      ```
      $ cd /var/occne/cluster/${OCCNE_CLUSTER}/artifacts
      ```

   b. Run the `etcd_backup.sh` script:

      ```
      $ ./etcd_backup.sh
      ```

      On running the script, the system prompts you to enter the **k8s-ctrl node** name. Enter the name of the controller node from which you want to back up the etcd data.

      > **Note**
      >
      > The script keeps only three backup snapshots in the PVC and automatically deletes the older snapshots.

7.4 Managing Kyverno

Policies are used to audit workloads running on Kubernetes. Kubernetes 1.21.x deprecated its policy framework PodSecurityPolicies (PSP) and halted its support in Kubernetes release 1.25.x. Therefore, CNE supports Kyverno, an open-source tool, as an alternate to PSP for managing Kubernetes policies. This section provides information about Kyverno deployment in CNE, migrating from PodSecurityPolicies (PSP) to Kyverno, and using Kyverno to manage Kubernetes policies.

Note

- PodSecurityPolicies (PSP) are not supported from CNE 23.2.x onwards (that is, Kubernetes 1.25.x onwards).
- If you are creating your own custom Kyverno policies, ensure that you exclude `occne-infra` namespace as shown in the following example. This ensures that the existing `occne-infra` deployments are not affected.

```
policyExclude:
  disallow-capabilities:
    any:
    - resources:
        kinds:
        - Pod
        - DaemonSet
        namespaces:
        - kube-system
        - occne-infra
        - rook-ceph
```

Kyverno Deployment

Kyverno framework is deployed as a common service in CNE. All PSP based policies are removed. CNE is configured with number of baseline policies that are applied across CNE clusters.

The following table provides information about the policies that are deployed in CNE:

Table 7-20 Kyverno Policies

Policy	Policy Level (23.1.x)	Policy Level (23.2.x to 24.2.x)	Policy Level (24.3.x onwards)
disallow-capabilities	audit	enforced	enforced
disallow-host-namespaces	audit	enforced	enforced
disallow-host-path	audit	enforced	enforced
disallow-host-ports	audit	enforced	enforced
disallow-host-process	audit	enforced	enforced
disallow-privileged-containers	audit	enforced	enforced
disallow-proc-mount	audit	enforced	enforced
disallow-selinux	audit	enforced	enforced
restrict-apparmor-profiles	audit	enforced	enforced
restrict-seccomp	audit	enforced	enforced
restrict-sysctls	audit	enforced	enforced
require-emptydir-requests-and-limits	NA	NA	audit

In release 23.1.x, the baseline policies are set to the "audit" level. This means that, the cluster keeps record of the policy failures, but doesn't cause non-compliant resources to fail. Starting 23.2.x, the policies are set to the "enforced" level. This means that, any resource that are non-compliant to any policy will fail. When a new policy is added in a release, CNE determines the level of the policy to control how a non-compliant scenario is handled.

References:

- Kyverno pod security policy: https://github.com/kyverno/kyverno/tree/main/charts/kyverno-policies
- Kyverno policy validation and enforcement: https://kyverno.io/docs/writing-policies/validate/
- Kyverno policy writing: https://kyverno.io/docs/kyverno-policies/
- Kyverno reporting: https://kyverno.io/docs/policy-reports/
- Kyverno metrics: https://kyverno.io/docs/monitoring/#installation-and-setup

7.4.1 Accessing Cluster Policy Report

Kyverno performs regular scans and updates validation status in "`ClusterPolicyReport`". When a new resource is created by a user or process, Kyverno checks the properties of the resource against the validation rule. This section provides information about access `ClusterPolicyReport`.

Run the following command to access `ClusterPolicyReport` :

```
$kubectl get policyreport -A
```

Sample output:

```
NAMESPACE       NAME                    PASS   FAIL   WARN   ERROR   SKIP
AGE
cert-manager    polr-ns-cert-manager    36     0      0      0       0
10d
ingress-nginx   polr-ns-ingress-nginx   11     1      0      0       0
10d
istio-system    polr-ns-istio-system    12     0      0      0       0
10d
occne-infra     polr-ns-occne-infra     263    13     0      0       0
10d
```

You can use the `describe policyreport` command to get details about the policies that is violated. For example, in the above example, the `ingress-nginx` deployment reports one violation. You can use the following command to get details about the policy violation in `ingress-nginx`:

```
$kubectl describe policyreport polr-ns-ingress-nginx -n ingress-nginx
```

Sample output:

```
Name:         polr-ns-ingress-nginx
Namespace:    ingress-nginx
Labels:       managed-by=kyverno
Annotations:  <none>
API Version:  wgpolicyk8s.io/v1alpha2
Kind:         PolicyReport
.
.
.
```

```
Results:
  Category:  Pod Security Standards (Baseline)
  Message:   validation error: Use of host ports is disallowed. The fields
spec.containers[*].ports[*].hostPort ,
spec.initContainers[*].ports[*].hostPort, and
spec.ephemeralContainers[*].ports[*].hostPort must either be unset or set to
`0`. Rule autogen-host-ports-none failed at path /spec/template/spec/
containers/0/ports/0/hostPort/
  Policy:    disallow-host-ports
  Resources:
    API Version:  apps/v1
    Kind:         DaemonSet
    Name:         ingress-nginx-controller
    Namespace:    ingress-nginx
```

The sample output shows that the `ingress-nginx-controller` resource violates the `disallow-host-ports` policy.

7.4.2 Migrating from PSP to Kyverno

Every component that runs on CNE 23.2.x and above must migrate all PSP based policy resources to Kyverno pod security policies. For information and examples about performing a migration from PSP to Kyveno, see Kyverno pod security policy and Kyverno source documentations.

7.4.3 Adding Policy Exclusions and Exceptions

This section provides details about adding exclusions and exceptions to Kyverno policies.

Adding Exclusions

Exclusions simplify policy management when used alongside Pod Security Admission (PSA). Instead of creating multiple policies for each control in PSA, you can leverage Kyverno to provide detailed and selective exclusions, reducing policy overhead and enhancing overall manageability. You can add exclusion to policies by editing the current policies or running `kubectl` patch. For more information about policy exclusions, see Kyverno documentation.

Adding Exceptions

There are scenarios where users need to deploy resources that require privileged access. This can be done by adding exceptions to the Kyverno policies for individual resources. The following code block provides a sample YAML file with the required information to create a `PolicyException` resource:

```
apiVersion: v1
items:
- apiVersion: kyverno.io/v2alpha1
  kind: PolicyException
  metadata:
    name: cncc-exception
    namespace: occne-infra
  spec:
    exceptions:
    - policyName: disallow-capabilities
      ruleNames:
```

```
      - adding-capabilities
    match:
      any:
      - resources:
          kinds:
          - Pod
          - Deployment
          names:
          - cncc-debug-tool*
          namespaces:
          - cncc
kind: List
metadata:
  resourceVersion: ""
```

In this example, `PolicyException` allows the pods named `cncc-debug-tool*` (the `*` character indicates the system to include any resources belonging to a deployment to be allowed) in the `"cncc"` namespace to bypass the `"disallow-capabilities > adding-capabilities"` policy.

After creating the policy exception file (in this case, `policyException.yaml`), proceed to create the resource:

```
$ kubectl create -f policyException.yaml
```

7.4.4 Managing Kyverno Metrics

When you install Kyverno using Helm, additional services are created inside the Kyverno namespace that expose metrics on port 8000. This section provides details about managing Kyverno metrics.

You can the following command to get the Kyverno metric services:

```
$ kubectl -n kyverno get svc
```

By default, the service type of these services is `ClusterIP`.

Turning off Metrics in Kyverno

This section provides the procedure to turnoff Kyverno metrics.
Before turning off Kyverno metrics, be aware that turning off Kyverno metrics has the following implications:

- Kyverno Grafana dashboard will stop working, losing insights into policy enforcement and compliance monitoring.
- There will be lack of resource usage monitoring for Kyverno controller.
- There will be reduced troubleshooting capabilities and difficulty in identifying issues.
- There will be limited observability and visibility into Kyverno's behavior and performance.
- It impacts decision-making process as you become less data-driven.

1. Retrieve the current configuration of FluentBit to the `fluent-bit.yaml` file:

   ```
   $ helm -n occne-infra get values occne-fluent-bit -o yaml > fluent-bit.yaml
   ```

2. Open the `fluent-bit.yaml` file you created in the previous step in edit mode:

   ```
   $ vi fluent-bit.yaml
   ```

3. Delete the content in the "`metricsService`" section:

   ```
   ...


   metricsService:
       create: true
       type: ClusterIP
       port: 8000


   ...
   ```

4. Upgrade your installation using Helm:

   ```
   $ helm -n occne-infra upgrade occne-fluent-bit fluent/fluent-bit -f fluent-
   bit.yaml
   ```

7.4.5 Validating Kyverno Compliance

This section provides the steps to validate if the CNE cluster runs Kyverno policy management tool and if all CNE resources run in compliance mode.

Prerequisites

Before validating Kyverno compliance, ensure that the following prerequisites are met:

- CNE cluster must be healthy.
- The CNE cluster version must be at least 23.2.0.
- All pods in the cluster must be running.
- There must be no violations in the Kyverno report.

1. Verify Kyverno Policies:
   a. Run the following command to list all `clusterpolicy` configured by Kyverno:

      ```
      $ kubectl get clusterpolicy -n kyverno
      ```

      Sample output:

      ```
      NAME                            BACKGROUND   VALIDATE ACTION   READY
      AGE
      disallow-capabilities           true         Enforce           true
      10h
      disallow-host-namespaces        true         Enforce           true
      10h
      disallow-host-path              true         Enforce           true
      10h
      disallow-host-ports             true         Enforce           true
      10h
      ```

```
disallow-host-process            true         Enforce           true
10h
disallow-privileged-containers   true         Enforce           true
10h
disallow-proc-mount              true         Enforce           true
10h
disallow-selinux                 true         Enforce           true
10h
restrict-apparmor-profiles       true         Enforce           true
10h
restrict-seccomp                 true         Enforce           true
10h
restrict-sysctls                 true         Enforce           true
10h
```

b. Run the following command and ensure that there are no policy violations in any policy report in any namespace:

```
$ kubectl get policyreport -A
```

Sample output:

```
NAMESPACE       NAME                                PASS   FAIL
WARN   ERROR   SKIP   AGE
cert-manager    cpol-disallow-capabilities          3      0
0      0       0      9h
cert-manager    cpol-disallow-host-namespaces       3      0
0      0       0      9h
cert-manager    cpol-disallow-host-path             3      0
0      0       0      9h
cert-manager    cpol-disallow-host-ports            3      0
0      0       0      9h
cert-manager    cpol-disallow-host-process          9      0
0      0       0      9h
cert-manager    cpol-disallow-privileged-containers 3      0
0      0       0      9h
cert-manager    cpol-disallow-proc-mount            9      0
0      0       0      9h
cert-manager    cpol-disallow-selinux               18     0
0      0       0      9h
cert-manager    cpol-restrict-apparmor-profiles     9      0
0      0       0      9h
cert-manager    cpol-restrict-seccomp               9      0
0      0       0      9h
cert-manager    cpol-restrict-sysctls               9      0
0      0       0      9h
ingress-nginx   cpol-disallow-capabilities          4      0
0      0       0      10h
ingress-nginx   cpol-disallow-host-namespaces       4      0
0      0       0      10h
ingress-nginx   cpol-disallow-host-path             4      0
0      0       0      10h
ingress-nginx   cpol-disallow-host-process          5      0
0      0       0      10h
ingress-nginx   cpol-disallow-privileged-containers 4      0
```

```
0      0       0      10h
ingress-nginx   cpol-disallow-proc-mount             5      0
0      0       0      10h
ingress-nginx   cpol-disallow-selinux                10     0
0      0       0      10h
ingress-nginx   cpol-restrict-apparmor-profiles      5      0
0      0       0      10h
ingress-nginx   cpol-restrict-seccomp                5      0
0      0       0      10h
ingress-nginx   cpol-restrict-sysctls                5      0
0      0       0      10h
istio-system    cpol-disallow-capabilities           1      0
0      0       0      9h
istio-system    cpol-disallow-host-namespaces        1      0
0      0       0      9h
istio-system    cpol-disallow-host-path              1      0
0      0       0      9h
istio-system    cpol-disallow-host-ports             1      0
0      0       0      9h
istio-system    cpol-disallow-host-process           3      0
0      0       0      9h
istio-system    cpol-disallow-privileged-containers  1      0
0      0       0      9h
istio-system    cpol-disallow-proc-mount             3      0
0      0       0      9h
istio-system    cpol-disallow-selinux                6      0
0      0       0      9h
istio-system    cpol-restrict-apparmor-profiles      3      0
0      0       0      9h
istio-system    cpol-restrict-seccomp                3      0
0      0       0      9h
istio-system    cpol-restrict-sysctls                3      0
0      0       0      9h
kube-system     cpol-disallow-host-process           62     0
0      0       0      10h
kube-system     cpol-disallow-proc-mount             62     0
0      0       0      10h
kube-system     cpol-disallow-selinux                124    0
0      0       0      10h
kube-system     cpol-restrict-apparmor-profiles      62     0
0      0       0      10h
kube-system     cpol-restrict-seccomp                62     0
0      0       0      10h
kube-system     cpol-restrict-sysctls                62     0
0      0       0      10h
kyverno         cpol-disallow-capabilities           3      0
0      0       0      9h
kyverno         cpol-disallow-host-namespaces        3      0
0      0       0      9h
kyverno         cpol-disallow-host-path              3      0
0      0       0      9h
kyverno         cpol-disallow-host-ports             3      0
0      0       0      9h
kyverno         cpol-disallow-host-process           5      0
0      0       0      9h
kyverno         cpol-disallow-privileged-containers  3      0
```

```
0      0       0      9h
kyverno         cpol-disallow-proc-mount              5      0
0      0       0      9h
kyverno         cpol-disallow-selinux                 10     0
0      0       0      9h
kyverno         cpol-restrict-apparmor-profiles       5      0
0      0       0      9h
kyverno         cpol-restrict-seccomp                 5      0
0      0       0      9h
kyverno         cpol-restrict-sysctls                 5      0
0      0       0      9h
occne-infra     cpol-disallow-host-process            86     0
0      0       0      9h
occne-infra     cpol-disallow-proc-mount              86     0
0      0       0      9h
occne-infra     cpol-disallow-selinux                 172    0
0      0       0      9h
occne-infra     cpol-restrict-apparmor-profiles       86     0
0      0       0      9h
occne-infra     cpol-restrict-seccomp                 86     0
0      0       0      9h
occne-infra     cpol-restrict-sysctls                 86     0
0      0       0      9h
```

c. Run the following command to verify that there are no pods running in the cluster due to Kyverno clusterpolicy:

```
$ kubectl get pods -A | grep -v Runn
```

Sample output:

```
NAMESPACE      NAME      READY       STATUS       RESTARTS          AGE
```

2. Verify the daemonset, statefulset, and deployment in the cluster:

a. Run the following command to verify all the deamonset (ds) in the cluster:

```
$ kubectl -n occne-infra get ds
```

Sample output:

```
NAME                                              DESIRED   CURRENT
READY   UP-TO-DATE   AVAILABLE   NODE SELECTOR
AGE
occne-egress-controller                           4         4
4       4            4
11h
occne-fluent-bit                                  4         4
4       4            4
11h
occne-kube-prom-stack-prometheus-node-exporter    7         7
7       7            7
11h
occne-metallb-speaker                             4         4
4       4            4           kubernetes.io/os=linux
```

```
11h
occne-tracer-jaeger-agent                          4         4
4       4            4                             11h
```

b. Run the following command to verify all the statefulset (sts) in the cluster:

```
$ kubectl -n occne-infra get sts
```

Sample output:

```
NAME                                                READY
AGE

alertmanager-occne-kube-prom-stack-kube-alertmanager   2/2
11h

occne-opensearch-cluster-client                     3/3
11h

occne-opensearch-cluster-data                       3/3
11h

occne-opensearch-cluster-master                     3/3
11h

prometheus-occne-kube-prom-stack-kube-prometheus    2/2     11h
```

c. Run the following command to verify all the deploy in the cluster:

```
$ kubectl -n occne-infra get deploy
```

Sample output:

```
NAME                                    READY   UP-TO-DATE
AVAILABLE
AGE

occne-bastion-controller                1/1     1
1
11h

occne-kube-prom-stack-grafana           1/1     1
1
11h

occne-kube-prom-stack-kube-operator     1/1     1
1
11h

occne-kube-prom-stack-kube-state-metrics   1/1     1
1
11h

occne-lb-controller-server              1/1     1
```

```
1
11h

occne-metallb-controller                  1/1     1
1
11h

occne-metrics-server                      1/1     1
1
11h

occne-opensearch-dashboards               1/1     1
1
11h

occne-promxy                              1/1     1
1
11h

occne-promxy-apigw-nginx                  2/2     2
2
11h

occne-snmp-notifier                       1/1     1
1
11h

occne-tracer-jaeger-collector             1/1     1
1
11h

occne-tracer-jaeger-query                 1/1     1
1           11h
```

3. Scale down and scale up the deployments to verify any impact of Kyverno clusterpolicy:
   a. Run the following command to scale down the deployment in the cluster:

      ```
      kubectl scale --replicas=0 deploy --all -n occne-infra
      ```

   b. Run the following command to scale up the deployment in the cluster:

      ```
      $ kubectl scale --replicas=1 deploy --all -n occne-infra
      $ kubectl scale --replicas=2 deploy occne-promxy-apigw-nginx -n occne-
      infra
      ```

   c. Run the following command to get the deployment list:

      ```
      $ kubectl -n occne-infra get deploy
      ```

      Sample output:

      ```
      NAME                                      READY   UP-TO-DATE
      AVAILABLE
      AGE
      ```

```
occne-bastion-controller                   1/1     1
1
12h

occne-kube-prom-stack-grafana              1/1     1
1
12h

occne-kube-prom-stack-kube-operator        1/1     1
1
12h

occne-kube-prom-stack-kube-state-metrics   1/1     1
1
12h

occne-lb-controller-server                 1/1     1
1
12h

occne-metallb-controller                   1/1     1
1
12h

occne-metrics-server                       1/1     1
1
12h

occne-opensearch-dashboards                1/1     1
1
12h

occne-promxy                               1/1     1
1
12h

occne-promxy-apigw-nginx                   2/2     2
2
12h

occne-snmp-notifier                        1/1     1
1
12h

occne-tracer-jaeger-collector              1/1     1
1
12h

occne-tracer-jaeger-query                  1/1     1
1           12h
```

d. Run the following command to scale down the statefulset (sts) in the cluster:

```
$ kubectl scale --replicas=0 sts --all -n occne-infra
```

Sample output:

```
statefulset.apps/alertmanager-occne-kube-prom-stack-kube-alertmanager
scaled
statefulset.apps/occne-opensearch-cluster-client scaled
statefulset.apps/occne-opensearch-cluster-data scaled
statefulset.apps/occne-opensearch-cluster-master scaled
statefulset.apps/prometheus-occne-kube-prom-stack-kube-prometheus scaled
```

e. Run the following command to scale up the statefulset (sts) in the cluster:

```
$ kubectl scale sts occne-opensearch-cluster-master occne-opensearch-
cluster-data occne-opensearch-cluster-client -n occne-infra --replicas 3
```

f. Run the following command to get the list of statefulset:

```
$ kubectl -n occne-infra get sts
```

Sample output:

```
NAME                                                READY   AGE
alertmanager-occne-kube-prom-stack-kube-alertmanager   2/2     2d19h
occne-opensearch-cluster-client                     3/3     2d19h
occne-opensearch-cluster-data                       3/3     2d19h
occne-opensearch-cluster-master                     3/3     2d19h
prometheus-occne-kube-prom-stack-kube-prometheus    2/2     2d19h
```

g. Run the following command to restart the daemonset (ds):

```
$ kubectl rollout restart ds -n occne-infra
```

Sample output:

```
daemonset.apps/occne-egress-controller restarted
daemonset.apps/occne-fluent-bit restarted
daemonset.apps/occne-kube-prom-stack-prometheus-node-exporter restarted
daemonset.apps/occne-metallb-speaker restarted
daemonset.apps/occne-tracer-jaeger-agent restarted
```

h. Run the following command to get the list of daemonset:

```
$ kubectl -n occne-infra get ds
```

Sample output:

```
NAME                                          DESIRED   CURRENT
READY   UP-TO-DATE   AVAILABLE   NODE SELECTOR          AGE
occne-egress-controller                       4         4
4       4            4           <none>                 2d19h
occne-fluent-bit                              4         4
4       4            4           <none>                 2d19h
occne-kube-prom-stack-prometheus-node-exporter   7         7
7       7            7           <none>                 2d19h
```

```
occne-metallb-speaker                          4         4
4       4            4           kubernetes.io/os=linux   2d19h
occne-tracer-jaeger-agent                      4         4
4       4            4           <none>                   2d19h
```

4. Reverify Kyverno Policies:
   a. Run the following command to list all the cluster policies configured by Kyverno:

      ```
      $ kubectl get clusterpolicy -n kyverno
      ```

      Sample output:

      ```
      NAME                            BACKGROUND   VALIDATE ACTION   READY
      AGE

      disallow-capabilities           true         Enforce           true
      12h

      disallow-host-namespaces        true         Enforce           true
      12h

      disallow-host-path              true         Enforce           true
      12h

      disallow-host-ports             true         Enforce           true
      12h

      disallow-host-process           true         Enforce           true
      12h

      disallow-privileged-containers  true         Enforce           true
      12h

      disallow-proc-mount             true         Enforce           true
      12h

      disallow-selinux                true         Enforce           true
      12h

      restrict-apparmor-profiles      true         Enforce           true
      12h

      restrict-seccomp                true         Enforce           true
      12h

      restrict-sysctls                true         Enforce           true
      12h
      ```

   b. Run the following command and ensure that there are no policy violations in any policy report in any namespace:

      ```
      $ kubectl get policyreport -A
      ```

Sample output:

```
NAMESPACE       NAME                                    PASS   FAIL
WARN   ERROR   SKIP   AGE
cert-manager    cpol-disallow-capabilities              3      0
0      0       0      2d15h
cert-manager    cpol-disallow-host-namespaces           3      0
0      0       0      2d15h
cert-manager    cpol-disallow-host-path                 3      0
0      0       0      2d15h
cert-manager    cpol-disallow-host-ports                3      0
0      0       0      2d15h
cert-manager    cpol-disallow-host-process              9      0
0      0       0      2d15h
cert-manager    cpol-disallow-privileged-containers     3      0
0      0       0      2d15h
cert-manager    cpol-disallow-proc-mount                9      0
0      0       0      2d15h
cert-manager    cpol-disallow-selinux                   18     0
0      0       0      2d15h
cert-manager    cpol-restrict-apparmor-profiles         9      0
0      0       0      2d15h
cert-manager    cpol-restrict-seccomp                   9      0
0      0       0      2d15h
cert-manager    cpol-restrict-sysctls                   9      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-capabilities              4      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-host-namespaces           4      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-host-path                 4      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-host-process              5      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-privileged-containers     4      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-proc-mount                5      0
0      0       0      2d15h
ingress-nginx   cpol-disallow-selinux                   10     0
0      0       0      2d15h
ingress-nginx   cpol-restrict-apparmor-profiles         5      0
0      0       0      2d15h
ingress-nginx   cpol-restrict-seccomp                   5      0
0      0       0      2d15h
ingress-nginx   cpol-restrict-sysctls                   5      0
0      0       0      2d15h
istio-system    cpol-disallow-capabilities              1      0
0      0       0      2d15h
istio-system    cpol-disallow-host-namespaces           1      0
0      0       0      2d15h
istio-system    cpol-disallow-host-path                 1      0
0      0       0      2d15h
istio-system    cpol-disallow-host-ports                1      0
0      0       0      2d15h
istio-system    cpol-disallow-host-process              3      0
0      0       0      2d15h
```

```
istio-system    cpol-disallow-privileged-containers   1      0
0      0       0      2d15h
istio-system    cpol-disallow-proc-mount              3      0
0      0       0      2d15h
istio-system    cpol-disallow-selinux                 6      0
0      0       0      2d15h
istio-system    cpol-restrict-apparmor-profiles       3      0
0      0       0      2d15h
istio-system    cpol-restrict-seccomp                 3      0
0      0       0      2d15h
istio-system    cpol-restrict-sysctls                 3      0
0      0       0      2d15h
kube-system     cpol-disallow-host-process            62     0
0      0       0      2d15h
kube-system     cpol-disallow-proc-mount              62     0
0      0       0      2d15h
kube-system     cpol-disallow-selinux                 124    0
0      0       0      2d15h
kube-system     cpol-restrict-apparmor-profiles       62     0
0      0       0      2d15h
kube-system     cpol-restrict-seccomp                 62     0
0      0       0      2d15h
kube-system     cpol-restrict-sysctls                 62     0
0      0       0      2d15h
kyverno         cpol-disallow-capabilities            3      0
0      0       0      2d15h
kyverno         cpol-disallow-host-namespaces         3      0
0      0       0      2d15h
kyverno         cpol-disallow-host-path               3      0
0      0       0      2d15h
kyverno         cpol-disallow-host-ports              3      0
0      0       0      2d15h
kyverno         cpol-disallow-host-process            5      0
0      0       0      2d15h
kyverno         cpol-disallow-privileged-containers   3      0
0      0       0      2d15h
kyverno         cpol-disallow-proc-mount              5      0
0      0       0      2d15h
kyverno         cpol-disallow-selinux                 10     0
0      0       0      2d15h
kyverno         cpol-restrict-apparmor-profiles       5      0
0      0       0      2d15h
kyverno         cpol-restrict-seccomp                 5      0
0      0       0      2d15h
kyverno         cpol-restrict-sysctls                 5      0
0      0       0      2d15h
occne-infra     cpol-disallow-host-process            88     0
0      0       0      2d15h
occne-infra     cpol-disallow-proc-mount              88     0
0      0       0      2d15h
occne-infra     cpol-disallow-selinux                 176    0
0      0       0      2d15h
occne-infra     cpol-restrict-apparmor-profiles       88     0
0      0       0      2d15h
occne-infra     cpol-restrict-seccomp                 88     0
0      0       0      2d15h
```

```
occne-infra     cpol-restrict-sysctls                88     0
0      0       0      2d15h
```

c. Run the following command to verify that there are no pods running in the cluster due to Kyverno clusterpolicy:

```
$ kubectl get pods -A | grep -v Runn
```

Sample output:

```
NAMESPACE       NAME       READY       STATUS       RESTARTS          AGE
```

7.5 Updating Grafana Password

This section describes the procedure to update the password of Grafana which is used to access the graphical user interface of Grafana dashboard.

Prerequisites

1. A CNE cluster of version 22.x or above must be deployed.
2. The Grafana pod must be up and running.
3. The Load Balancer IP of Grafana must be accessible through browser.

Limitations and Expectations

- This procedure works on the existing Grafana deployments instantly. However, this procedure requires a restart of the Grafana pod causing temporary unavailability of the service.
- The grafana-cli is used to update the password by running an `exec` to get into the pod, which means it's ephemeral.
- The newly set password is not persistent. Therefore, if the Grafana pod restarts or crashes due to any unfortunate incidents, then rerun this procedure to set the password. Otherwise, the GUI displays the Invalid Username or Password errors.
- Only the password that is updated during an installation is persistent. However, if you change this password impromptu and patch the new password into the secret again, the password change doesn't take effect. To update and persist a password, use this procedure during installation of the CNE cluster.

Procedure

1. Log in to the Bastion Host of your CNE cluster.
2. Get the name of the Grafana pod in the `occne-infra` namespace:

   ```
   $ kubectl get pods -n occne-infra | grep grafana
   ```

   For example:

   ```
   $ kubectl get pods | grep grafana
   ```

Sample output:

```
occne-prometheus-grafana-7f5fb7c4d4-lxqsr 3/3 Running 0 12m
```

3. Use exec to get into the Grafana pod:

```
$ kco exec -it occne-prometheus-grafana-7f5fb7c4d4-lxqsr bash
```

4. Run the following command to update the password:

> **Note**
>
> Use a strong unpredictable password consisting of complex strings of more than 10 mixed characters.

```
$ grafana-cli admin reset-admin-password <password>
```

where, <password> is the new password to be updated.

For example:

```
occne-prometheus-grafana-7f5fb7c4d4-lxqsr:/usr/share/grafana$ grafana-cli
admin reset-admin-password samplepassword123#
```

Sample output:

```
INFO [01-29|07:44:25] Starting Grafana logger=settings version= commit=
branch= compiled=1970-01-01T00:00:00Z
WARN [01-29|07:44:25] "sentry" frontend logging provider is deprecated and
will be removed in the next major version. Use "grafana" provider instead.
logger=settings
INFO [01-29|07:44:25] Config loaded from logger=settings file=/usr/share/
grafana/conf/defaults.ini
INFO [01-29|07:44:25] Config overridden from Environment variable
logger=settings var="GF_PATHS_DATA=/var/lib/grafana/"
INFO [01-29|07:44:25] Config overridden from Environment variable
logger=settings var="GF_PATHS_LOGS=/var/log/grafana"
INFO [01-29|07:44:25] Config overridden from Environment variable
logger=settings var="GF_PATHS_PLUGINS=/var/lib/grafana/plugins"
INFO [01-29|07:44:25] Config overridden from Environment variable
logger=settings var="GF_PATHS_PROVISIONING=/etc/grafana/provisioning"
INFO [01-29|07:44:25] Config overridden from Environment variable
logger=settings var="GF_SECURITY_ADMIN_USER=admin"
INFO [01-29|07:44:25] Config overridden from Environment variable
logger=settings var="GF_SECURITY_ADMIN_PASSWORD=*********"
INFO [01-29|07:44:25] Target logger=settings target=[all]
INFO [01-29|07:44:25] Path Home logger=settings path=/usr/share/grafana
INFO [01-29|07:44:25] Path Data logger=settings path=/var/lib/grafana/
INFO [01-29|07:44:25] Path Logs logger=settings path=/var/log/grafana
INFO [01-29|07:44:25] Path Plugins logger=settings path=/var/lib/grafana/
plugins
INFO [01-29|07:44:25] Path Provisioning logger=settings path=/etc/grafana/
provisioning
```

```
INFO [01-29|07:44:25] App mode production logger=settings
INFO [01-29|07:44:25] Connecting to DB logger=sqlstore dbtype=sqlite3
INFO [01-29|07:44:25] Starting DB migrations logger=migrator
INFO [01-29|07:44:25] migrations completed logger=migrator performed=0
skipped=484 duration=908.661µs
INFO [01-29|07:44:25] Envelope encryption state logger=secrets
enabled=true current provider=secretKey.v1

Admin password changed successfully ŋ
```

5. After updating the password, log in to the Grafana GUI using the updated password. Ensure that you are aware of the limitations listed in Limitations and Expectations.

7.6 Updating OpenStack Credentials

This section describes the procedure to update the OpenStack credentials for vCNE.

Prerequisites

1. You must have access to active Bastion Host of the cluster.
2. All commands in this procedure must be run from the active CNE Bastion Host.
3. You must have knowledge of kubectl and handling base64 encoded and decoded strings.

Modifying Password for Cinder Access

Kubernetes uses the *cloud-config* secret when interacting with OpenStack Cinder to acquire persistent storage for applications. The following steps describe how to update this secret to include the new password.

1. Run the following command to decode and save the current *cloud-config* secret configurations in a temporary file:

   ```
   $ kubectl get secret cloud-config -n kube-system -o
   jsonpath="{.data.cloud\.conf}" | base64 --decode > /tmp/
   decoded_cloud_config.txt
   ```

2. Run the following command to open the temporary file in vi editor and update the username and password fields in the file with required values:

   ```
   $ vi /tmp/decoded_cloud_config.txt
   ```

   Sample to edit the username and password:

   ```
   username="new_username"
   password="new_password"
   ```

   After updating the credentials, save and exit from the file.

3. Run the following command to re-encode the `cloud-config` secret in Base64. Save the encoded output to use it in the following step.

   ```
   $ cat /tmp/decoded_cloud_config.txt | base64 -w0
   ```

4. Run the following command to edit the `cloud-config` Kubernetes secret:

   ```
   $ kubectl edit secret cloud-config -n kube-system
   ```

   Refer to the following sample to edit the `cloud-config` Kubernetes secret:

   > **Note**
   >
   > Replace `<encoded-output>` in the following sample with the encoded output that you saved in the previous step.

   ```
   # Please edit the object below. Lines beginning with a '#' will be ignored,
   # and an empty file will abort the edit. If an error occurs while saving
   this file will be
   # reopened with the relevant failures.
   #
   apiVersion: v1
   data:
    cloud.conf: <encoded-output>
   kind: Secret
   metadata:
    annotations:
    kubectl.kubernetes.io/last-applied-configuration: |
    {"apiVersion":"v1","data":{"cloud.conf":"<encoded-
   output>"},"kind":"Secret","metadata":{"annotations":{},"name":"cloud-
   config","namespace":"kube-system"}}
    creationTimestamp: "2022-01-12T02:34:52Z"
    name: cloud-config
    namespace: kube-system
    resourceVersion: "2225"
    uid: 0994b024-6a4d-41cf-904c
   type: Opaque
   ```

   Save the changes and exit the editor.

5. Run the following command to remove the temporary file:

   ```
   $ rm /tmp/decoded_cloud_config.txt
   ```

Modifying Password for OpenStack Cloud Controller Access

Kubernetes uses the `external-openstack-cloud-config` secret when interacting with the OpenStack Controller. The following steps describe the procedure to update the secret to include the new credentials.

1. Run the following command to decode the current `external-openstack-cloud-config` secret configurations in a temporary file:

   ```
   $ kubectl get secret external-openstack-cloud-config -n kube-system -o
   jsonpath="{.data.cloud\.conf}" | base64 --decode > /tmp/
   decoded_external_openstack_cloud_config.txt
   ```

2. Run the following command to open the temporary file in vi editor and update the username and password fields in the file with required values:

   ```
   $ vi /tmp/decoded_external_openstack_cloud_config.txt
   ```

   Sample to edit the username and password:

   ```
   username="new_username"
   password="new_password"
   ```

   After updating the credentials, save and exit from the file.

3. Run the following command to re-encode `external-openstack-cloud-config` in Base64. Save the encoded output to use it in the following step.

   ```
   $ cat /tmp/decoded_external_openstack_cloud_config.txt | base64 -w0
   ```

4. Run the following command to edit the Kubernetes Secret named, `external-openstack-cloud-config`:

   ```
   $ kubectl edit secret external-openstack-cloud-config -n kube-system
   ```

   Refer to the following sample to edit the `external-openstack-cloud-config` Kubernetes Secret with the new encoded value:

   > **Note**
   >
   > - Replace `<encoded-output>` in the following sample with the encoded output that you saved in the previous step.
   > - An empty file aborts the edit. If an error occurs while saving, the file reopens with the relevant failures.

   ```
   apiVersion: v1
   data:
     ca.cert:
     cloud.conf:<encoded-output>
   kind: Secret
   metadata:
     annotations:
       kubectl.kubernetes.io/last-applied-configuration: |
         {"apiVersion":"v1","data":{"ca.cert":" ","cloud.conf":"<encoded-
   output>"},"kind":"Secret","metadata":{"annotations":{},"name":"external-
   openstack-cloud-config","namespace":"kube-system"}}
     creationTimestamp: "2022-07-21T17:05:26Z"
     name: external-openstack-cloud-config
     namespace: kube-system
     resourceVersion: "16"
     uid: 9c18f914-9c78-401d-ae79
   type: Opaque
   ```

   Save the changes and exit the editor.

5. Run the following command to remove the temporary file:

```
$ rm /tmp/decoded_external_openstack_cloud_config.txt
```

Restarting Affected Pods to Use the New Password

Services that use OpenStack credentials must be restarted to use the new password. The following steps describe how to restart the services.

> **Note**
>
> Before restarting the services, verify that all the affected Kubernetes resources to be restarted are in healthy state.

1. Perform the following steps to restart Cinder Container Storage Interface (Cinder CSI) controller plugin:
   a. Run the following command to restart Cinder Container Storage Interface (Cinder CSI) deployment:

      ```
      $ kubectl rollout restart deployment csi-cinder-controllerplugin -n
      kube-system
      ```

      Sample output:

      ```
      deployment.apps/csi-cinder-controllerplugin restarted
      ```

   b. Run the following command to get the pod and verify if it is running:

      ```
      $ kubectl get pods -l app=csi-cinder-controllerplugin -n kube-system
      ```

      Sample output:

      ```
      NAME                                          READY   STATUS
      RESTARTS   AGE
      csi-cinder-controllerplugin-7c9457c4f8-88sbt   6/6     Running
      0          19m
      ```

   c. [Optional]: If the pod is not up or if the pod is in the `crashloop` state, get the logs from the `cinder-csi-plugin` container inside the `csi-cinder-controller` pod using labels and validate the logs for more information:

      ```
      $ kubectl logs -l app=csi-cinder-controllerplugin -c cinder-csi-plugin -
      n kube-system
      ```

      Sample output to show a successful log retrieval:

      ```
      I0904 21:36:09.162886       1 server.go:106] Listening for connections
      on address: &net.UnixAddr{Name:"/csi/csi.sock", Net:"unix"}
      ```

Sample output to show a log retrieval failure:

```
W0904 21:34:34.252515       1 main.go:105] Failed to
GetOpenStackProvider: Authentication failed
```

2. Perform the following steps to restart Cinder Container Storage Interface (Cinder CSI) nodeplugin daemonset:
   a. Run the following command to restart Cinder Container Storage Interface (Cinder CSI) nodeplugin daemonset:

      ```
      $ kubectl rollout restart -n kube-system daemonset csi-cinder-nodeplugin
      ```

      Sample output:

      ```
      daemonset.apps/csi-cinder-nodeplugin restarted
      ```

   b. Run the following command to get the pod and verify if it is running:

      ```
      $ kubectl get pods -l app=csi-cinder-nodeplugin -n kube-system
      ```

      Sample output:

      ```
      NAME                          READY   STATUS    RESTARTS   AGE
      csi-cinder-nodeplugin-pqqww   3/3     Running   0          3d19h
      csi-cinder-nodeplugin-vld6m   3/3     Running   0          3d19h
      csi-cinder-nodeplugin-xg2kj   3/3     Running   0          3d19h
      csi-cinder-nodeplugin-z5vck   3/3     Running   0          3d19h
      csi-cinder-nodeplugin-z5vck   3/3     Running   0          3d19h
      csi-cinder-nodeplugin-z5vck   3/3     Running   0          3d19h
      csi-cinder-nodeplugin-z5vck   3/3     Running   0          3d19h
      ```

   c. [Optional]: If the pod is not up or if the pod is in the `crashloop` state, verify the logs for more information
3. Run the following command to restart the OpenStack cloud controller daemonset:
   a. Run the following command to restart the OpenStack cloud controller daemonset:

      ```
      $ kubectl rollout restart -n kube-system daemonset openstack-cloud-
      controller-manager
      ```

      Sample output:

      ```
      daemonset.apps/openstack-cloud-controller-manager restarted
      ```

   b. Run the following command to get the pod and verify if it is running:

      ```
      $ kubectl get pods -l k8s-app=openstack-cloud-controller-manager -n
      kube-system
      ```

Sample output:

```
NAME                                        READY   STATUS    RESTARTS
AGE
openstack-cloud-controller-manager-qtfff    1/1     Running   0
38m
openstack-cloud-controller-manager-sn2pg    1/1     Running   0
38m
openstack-cloud-controller-manager-w5dcv    1/1     Running   0
38m
```

c. [Optional]: If the pod is not up, or is in the `crashloop` state, verify the logs for more information.

Changing Inventory File

When you perform the steps to modify password for Cinder access and modify password for OpenStack cloud controller access, you modify the Kubernetes secrets to contain the new credentials. However, running the pipeline (for example, performing a standard upgrade or adding a new node to the cluster) takes the current credentials stored in the `occne.ini` file, causing the changes to be overridden. Therefore, it is important to update the `occne.ini` file with the new credentials.

1. Navigate to the cluster directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}/
   ```

2. Open the `occne.ini` file:

   ```
   $ vi occne.ini
   ```

3. Update External Openstack credentials (both username and password) as shown below:

   ```
   external_openstack_username = USER
   external_openstack_password = PASSWORD
   ```

4. Update Cinder credentials (both username and password) as shown below:

   ```
   cinder_username = USER
   cinder_password = PASSWORD
   ```

Updating Credentials for lb-controller-user

> **Note**
>
> Run all the commands in this section from Bastion Host.

1. Run the following commands to update lb-controller-user credentials:

   ```
   $ echo -n "<Username>" | base64 -w0 | xargs -I{} kubectl -n occne-infra
   patch --type=merge secret lb-controller-user --patch '{"data":
   {"USERNAME":"{}"}}'
   ```

   ```
   $ echo -n "<Password>" | base64 -w0 | xargs -I{} kubectl -n occne-infra
   patch --type=merge secret lb-controller-user --patch '{"data":
   {"PASSWORD":"{}"}}'
   ```

   where:

   - <Username>, is the new OpenStack username.
   - <Password>, is the new OpenSatck password.

2. Run the following command to restart lb-controller-server to use the new credentials:

   ```
   $ kubectl rollout restart deployment occne-lb-controller-server -n occne-
   infra
   ```

3. Wait until the `lb-controller` restarts and run the following command to get the lb-controller pod status using labels. Ensure that only one pod is in the Running status:

   ```
   $ kubectl get pods -l app=lb-controller -n occne-infra
   ```

   Sample output:

   ```
   NAME                                          READY   STATUS    RESTARTS
   AGE
   occne-lb-controller-server-74fd947c7c-vtw2v   1/1     Running   0
   50s
   ```

4. Validate the new credentials by printing the username and password directly from the new pod's environment variables:

   ```
   $ kubectl exec -it $(kubectl get pod -n occne-infra | grep lb-controller-
   server | cut -d " " -f1) -n occne-infra -- bash -c "echo -n \$USERNAME"
   $ kubectl exec -it $(kubectl get pod -n occne-infra | grep lb-controller-
   server | cut -d " " -f1) -n occne-infra -- bash -c "echo -n \$PASSWORD"
   ```

7.7 Updating OpenStack TLS Certificate

When the Certificate Authority (CA) certificate for OpenStack is updated, you can use this procedure to update the certificate which CNE uses to access OpenStack.

> **Note**
>
> This procedure is applicable only to CNE instances running on OpenStack.

Procedure to update the certificate

> **Note**
>
> All commands must be run from the default CNE user account (for example, `cloud-user`) on the active Bastion host.

1. Use SSH to log in to the active Bastion and run the following command to confirm if it is the active Bastion:

   ```
   $ is_active_bastion
   ```

   Sample output:

   ```
   IS active-bastion
   ```

2. Get the renewed OpenStack `cacert.pem` file from the Openstack admin.
3. Copy the new `.pem` certificate file to `/var/occne/cluster/${OCCNE_CLUSTER}/openstack-cacert.pem`, replacing the existing file.
4. Change to cluster directory and read the `.pem` certificate file into variables:

   ```
   $ cdcl
   $ PEM=$(<openstack-cacert.pem)
   $ ENCODED_PEM=$(base64 -w0 openstack-cacert.pem)
   ```

5. Write the new PEM content into the `.pem` files used for OpenStack access throughout the cluster:

   ```
   $ occne_all.sh "echo -n '${PEM}' | sudo tee /etc/kubernetes/cinder-
   cacert.pem /etc/kubernetes/external-openstack-cacert.pem" k8s-cluster
   ```

6. If the cluster uses LBVM for load balancing, add the PEM to the lb controller config map entry (ensure newlines are converted to escape sequences). If LBVM is not used, you can skip this step or ignore any errors.

   ```
   $ kco patch cm lb-controller-openstack-cert --patch "{\"data\":
   {\"openstack-cacert.pem\": \"${PEM//$'\n'/\\n}\"}}"
   ```

7. On one of the control nodes, update the Kubernetes secret that stores the base64-encoded PEM data.

   ```
   $ SECRET_PATH=/etc/kubernetes/external-openstack-cloud-config-secret.yml
   $ occne_all.sh "if [ -f '${SECRET_PATH}' ] ; then sudo sed -i '/
   ca.cert/c\  ca.cert: ${ENCODED_PEM}' ${SECRET_PATH}; sudo -E env
   "PATH=\$PATH" kubectl apply -f ${SECRET_PATH}; fi" kube-master
   ```

8. Restart all OpenStack controller and cinder pods:

   ```
   $ kubectl -n kube-system rollout restart ds/openstack-cloud-controller-
   manager  ds/csi-cinder-nodeplugin  deployment/csi-cinder-controllerplugin
   ```

9. If the cluster uses LBVM for load balancing, restart the lb-controller to apply the new certificate. If LBVM is not used, you can skip this step or disregard any related errors.

   ```
   $ kubectl rollout restart deployment/occne-lb-controller-server
   ```

7.8 Updating the Guest or Host OS

You must update the host OS (for Bare Metal installations) or guest OS (for both Bare Metal and virtualized installations) periodically so that CNE has the latest Oracle Linux software. If the cluster is not upgraded recently, or there are known security patches then perform an update by referring to the "Performing an Upgrade" section in *Oracle Communications Cloud Native Core, Cloud Native Environment Installation, Upgrade, and Fault Recovery Guide*. Ensure that you follow the specific steps for performing an OS update (the cluster version remains the same), and not a Cluster Upgrade.

7.9 CNE Grafana Dashboards

Grafana is an observability tool available as open source and enterprise versions. Grafana supports number of data sources such as Prometheus from where it can read data for analytics. You can find the official list of supported data sources at Grafana Datasources.

CNE offers the following default Grafana dashboards:

- CNE Kubernetes dashboard
- CNE Prometheus dashboard
- CNE logging dashboard
- CNE persistent storage dashboard (only for Bare Metal)

> **Note**
>
> The Grafana dashboards provisioned by CNE are read-only. Refrain from updating or modifying these default dashboards.

You can clone these dashboards to customize them as per your requirement and save the customized dashboards in JSON format. This section provides details about the features offered by the open source Grafana version to add the required observability framework to CNE.

7.9.1 Accessing Grafana Interface

This section provides the procedure to access Grafana web interface.

1. Perform the following steps to get the Load Balancer IP address and port number for accessing the Grafana web interface:
   a. Run the following command to get the Load Balancer IP address of the Grafana service:

      ```
      $ export GRAFANA_LOADBALANCER_IP=$(kubectl get services occne-kube-prom-
      stack-grafana --namespace occne-infra -o
      jsonpath="{.status.loadBalancer.ingress[*].ip}")
      ```

b. Run the following command to get the LoadBalancer port number of the Grafana service:

```
$ export GRAFANA_LOADBALANCER_PORT=$(kubectl get services occne-kube-prom-stack-grafana --namespace occne-infra -o jsonpath="{.spec.ports[*].port}")
```

c. Run the following command to get the complete URL for accessing Grafana in an external browser:

```
$ echo http://$GRAFANA_LOADBALANCER_IP:$GRAFANA_LOADBALANCER_PORT/$OCCNE_CLUSTER/grafana
```

Sample output:

```
http://10.75.225.60:80/mycne-cluster/grafana
```

2. Use the URL obtained in the previous step (in this case, http://10.75.225.60:80/mycne-cluster/grafana) to access the Grafana home page.
3. Click **Downloads** and select **Browse**.
4. Expand the CNE folder to view the CNE dashboards.

> **Note**
>
> CNE doesn't support user access management on Grafana.

7.9.2 Cloning a Grafana Dashboard

This section describes the procedure to clone a Grafana dashboard.

1. Open the dashboard that you want to clone.
2. Click the **Share dashboard or panel** icon next to the dashboard name.
3. Select **Export** and click **Save to file** to save the dashboard in JSON format in your local system.
4. Perform the following steps to import the saved dashboard to Grafana:
   a. Click **Dashboards** and select **Import**.
   b. Click **Upload JSON file** and select the dashboard that you saved in step 3.
   c. Change the name and UID of the dashboard.
   You have cloned the dashboard successfully. You can now use the cloned dashboard to customize the options as per your requirement.

7.9.3 Restoring a Grafana Dashboard

The default Grafana dashboards provided by CNE are stored as configmap in the CNE cluster and artifact directory to restore them to their default state. This section describes the procedure to restore a Grafana dashboard.

> **Note**
>
> - This procedure is used to restore the dashboards to the default state (that is, the default dashboards provided by CNE).
> - When you restore the dashboards, you lose all the customizations that you made on the dashboards. You can't use this procedure to restore the customizations that you made on top of the CNE default dashboards.
> - You can't use this procedure to restore other Grafana dashboards that you created.

1. Navigate to the `occne-grafana-dashboard` directory:

   ```
   $ cd /var/occne/cluster/${OCCNE_CLUSTER}/artifacts/occne-grafana-dashboard
   ```

2. Run the following command to restore all the dashboards present in the `occne-grafana-dashboard` directory to its default state. The command uses the YAML files of the dashboards in the directory to restore them.

   ```
   $ kubectl -n occne-infra apply -R -f occne-grafana-dashboard
   ```

   You can also restore a specific dashboard by providing a specific YAML file name in the command. For example, you can use the following command to restore only the CNE Kubernetes dashboard:

   ```
   $ kubectl -n occne-infra apply -f occne-grafana-dashboard/occne-k8s-cluster-dashboard.yaml
   ```

7.10 Managing 5G NFs

This section describes procedures to manage 5G NFs in CNE.

7.10.1 Installing an NF

This section describes the procedure to install an NF in the CNE Kubernetes cluster.

Prerequisites

- Load container images and Helm charts onto Central Server repositories.
  Container and Helm repositories are created on a Central Server for easy CNE deployment at multiple customer sites. These repositories store all of the container images and Helm charts required to install CNE. When necessary, Helm pulls container images and Helm charts to the central server repositories on the local CNE Bastion Hosts. Similarly, NF installation uses Helm so that the container images and Helm charts needed to install NFs are loaded onto the same Central Server repositories. This procedure assumes that all container images and Helm charts required to install the NF are already loaded onto the Central Server repositories.
- Determine the NF deployment parameters
  The following values determine the NF's identity and where it is deployed. These values are used in the following procedure:

Table 7-21 NF Deployment Parameters

Parameters	Value	Description
nf-namespace	Any valid namespace name	The namespace where you want to install the NF. Typically each NF is installed in its own namespace.
nf-deployment-name	Any valid Kubernetes deployment name	The name that this NF instance is known to the Kubernetes.

Load NF artifacts onto Bastion Host repositories

All the steps in this section are run on the CNE Bastion Host where the NF installation happens.

Load NF container images

1. Create a file **container_images.txt** listing the Container images and tags as required by the NF:

   ```
   <image-name>:<release>
   ```

   Example:

   ```
   busybox:1.29.0
   ```

2. Run the following command to load the container images into the CNE Container registry:

   ```
   $ retrieve_container_images.sh <external-container-repo-name>:<external-container-repo-port> ${HOSTNAME}:5000 < container_images.txt
   ```

   Example:

   ```
   $ retrieve_container_images.sh mycentralrepo:5000 ${HOSTNAME%%.*}:5000 < container_images.txt
   ```

Load NF Helm charts

1. Create a file **helm_charts.txt** listing the Helm chart and version:

   ```
   <external-helm-repo-name>/<chart-name> <chart-version>
   ```

   Example:

   ```
   mycentralhelmrepo/busybox 1.33.0
   ```

2. Run the following command to load the charts into the CNE Helm chart repository:

   ```
   $ retrieve_helm.sh /var/www/html/occne/charts http://<external-helm-repo-name>/occne/charts [helm_executable_full_path_if_not_default] < helm_charts.txt
   ```

Example:

```
$ retrieve_helm.sh /var/www/html/occne/charts http://mycentralrepo/occne/
charts < helm_charts.txt
```

Install the NF

1. On the Bastion Host, create a YAML file named `<nf-short-name>-values.yaml` to contain the values to be passed to the NF Helm chart.
2. Add NF-specific values to file
   See the NF installation instructions to understand which keys and values must be included in the values file.
3. Additional NF configuration
   Before installing the NF, see the installation instructions to understand the requirements of additional NF configurations along with Helm chart values.
4. Run the following command to install the NF:

   ```
   $ helm install --namespace <nf-namespace> --create-namespace -f <nf-short-
   name>-values.yaml <nf-deployment-name> <chart-or-chart-location>
   ```

7.10.2 Upgrading an NF

This section describes the procedure to upgrade a 5G network function that was previously installed in the CNE Kubernetes cluster.

Prerequisites

Load container images and Helm charts onto Central Server repositories.

Container and Helm repositories are created on a Central Server for easy CNE deployment at multiple customer sites. These repositories store all of the container images and Helm charts required to install CNE. When necessary, Helm pulls container images and Helm charts to the central server repositories on the local CNE Bastion Hosts. Similarly, Network Function (NF) installation uses Helm so that the container images and Helm charts needed to install NFs are loaded onto the same Central Server repositories. This procedure assumes that all container images and Helm charts required to install the NF are already loaded onto the Central Server repositories.

Procedure

Perform the following steps to upgrade an NF. All commands must be run from the Bastion Host.

1. Load NF artifacts onto Bastion Host repositories.
2. Upgrade the NF.

Load NF artifacts onto Bastion Host repositories

All the steps in this section are run on the CNE Bastion Host where the NF installation happens.

Load NF container images

1. Create a file **container_images.txt** listing the Container images and tags as required by the NF:

   ```
   <image-name>:<release>
   ```

   Example:

   ```
   busybox:1.29.0
   ```

2. Run the following command to load the container images into the CNE Container registry:

   ```
   $ retrieve_container_images.sh <external-container-repo-name>:<external-container-repo-port> ${HOSTNAME%%.*}:5000 < container_images.txt
   ```

   Example:

   ```
   $ retrieve_container_images.sh mycentralrepo:5000 ${HOSTNAME%%.*}:5000 < container_images.txt
   ```

Load NF Helm charts

1. Create a file **helm_charts.txt** listing the Helm chart and version:

   ```
   <external-helm-repo-name>/<chart-name> <chart-version>
   ```

   Example:

   ```
   mycentralhelmrepo/busybox 1.33.0
   ```

2. Run the following command to load the charts into the CNE Helm chart repository:

   ```
   $ retrieve_helm.sh /var/www/html/occne/charts http://<external-helm-repo-name>/occne/charts [helm_executable_full_path_if_not_default] < helm_charts.txt
   ```

   Example:

   ```
   $ retrieve_helm.sh /var/www/html/occne/charts http://mycentralrepo/occne/charts < helm_charts.txt
   ```

Upgrade the NF

Change Helm input values used in previous NF release

To change any input value in the Helm chart during the upgrade, refer to the NF-specific upgrade instructions in *<NF-specific> Installation, Upgrade, and Fault Recovery Guide* for the new release. If any new input parameters are added in the new release, then run the following steps:

1. On the Bastion Host, create a YAML file named `<nf-short-name>-values.yaml` to contain the values to be passed to the NF Helm chart.
2. Create a YAML file that contains new and changed values needed by the NF Helm chart. See the NF installation instructions to understand which keys and values must be included in the values file. Only values for parameters that were not included in the Helm input

values applied to the previous release, or parameters whose names changed from the previous release, must be included in this file.

3. If the yaml file is created for this upgrade, run the following command to upgrade the NF with new values:

```
$ helm upgrade -f <nf-short-name>-values.yaml <nf-deployment-name> <chart-name-or-chart-location>
```

> **Note**
>
> The `nf-deployment-name` value must match the value used when installing the NF.

Retain all Helm input values used in previous NF release
If there is no requirement to change the Helm chart input values during upgrade and if no new input parameters were added in the new release, then run the following command to upgrade and retain all the NF values:

```
$ helm upgrade --reuse-values <nf-deployment-name> <chart-name-or-chart-location>
```

> **Note**
>
> The `nf-deployment-name` value must match the value used when installing the NF.

7.10.3 Uninstalling an NF

This section describes the procedure to uninstall a 5G network function that was previously installed in the CNE Kubernetes cluster.

Prerequisites

- Determine the NF deployment parameters. The following values determine the NF's identity and where it is deployed:

Table 7-22 NF Deployment Parameters

Variable	Value	Description
nf-namespace	Any valid namespace name	The namespace where you want to install the NF. Typically each NF is installed in its own namespace.
nf-deployment-name	Any valid Kubernetes deployment name	The name by which the Kubernetes identifies this NF instance.

- All commands in this procedure must be run from the Bastion Host.

Procedure

1. Run the following command to uninstall an NF:

   ```
   $ helm uninstall <nf-deployment-name> --namespace <nf-namespace>
   ```

2. If there are remaining NF resource such as PVCs and namespace, run the following command to remove them:
   a. Run the following command to remove residual PVCs:

      ```
      $ kubectl --namespace <nf-namespace> get pvc | awk '{print $1}'| xargs -
      L1 -r kubectl --namespace <nf-namespace> delete pvc
      ```

   b. Run the following command to delete namespace:

      ```
      $ kubectl delete namespace <nf-namespace>
      ```

> **Note**
>
> Steps a and b are used to remove all the PVCs from the <nf-namespace> and delete the <nf-namespace>, respectively. If there are other components running in the <nf-namespace>, manually delete the PVCs that need to be removed and skip the `kubectl delete namespace <nf-namespace>` command.

7.10.4 Update Alerting Rules for an NF

This section describes the procedure to add or update the alerting rules for any Cloud Native Core 5G NF in Prometheus Operator and OSO.

Prerequisites

- For CNE Prometheus Operator, a YAML file containing an PrometheusRule CRD defining the NF-specific alerting rules is available. The YAML file must be an ordinary text file in a valid YAML format with the extension `.yaml`.
- For OSO Prometheus, a valid OSO release must be installed and an alert file describing all NF alert rules according to old format is required.

Procedure for Prometheus Operator

1. To copy the NF-specific alerting rules file from your computer to the */tmp* directory on the Bastion Host, see the Accessing the Bastion Host procedure.
2. Run the following command to create or update the PrometheusRule CRD containing the alerting rules for the NF:

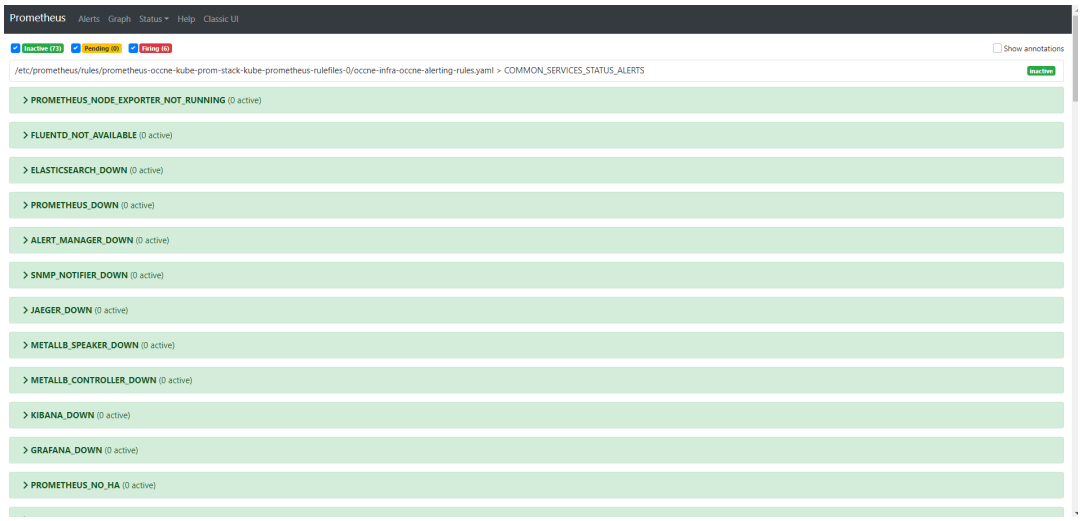
   ```
   $ kubectl apply -f /tmp/rules_file.yaml -n occne-infra
   # To verify the creation of the alert-rules CRD, run the following command:
   $ kubectl get prometheusrule -n occne-infra
   NAME                              AGE
   occne-alerting-rules              43d
   ```

```
occne-dbtier-alerting-rules       43d
test-alerting-rules               5m
```

The alerting rules automatically loads into all running Prometheus instances within 1 minute.

3. In the Prometheus GUI, select the Alerts tab. Select individual rules from the list to view the alert details and verify if the new rules are loaded.

Figure 7-1 New Alert Rules are loaded in Prometheus GUI



Procedure for OSO

Perform the following steps to add alert rules in OSO promethues GUI:

1. Take the backup of the current configuration map of OSO Prometheus:

   ```
   $ kubectl get configmaps <OSO-prometheus-configmap-name> -o yaml -n
   <namespace> > /tmp/tempPrometheusConfig.yaml
   ```

2. Check and add the NF alert file name inside Prometheus configuration map. The NF alert file names vary from NF to NF. Retrieve the name of the NF alert rules file to add the name in Prometheus configuration map. Once you retrieve the file name, run the following commands to add the NF alert file name inside Prometheus configuration map:

   ```
   $ sed -i '/etc\/config\/<nf-alertsname>/d' /tmp/tempPrometheusConfig.yaml
   $ sed -i '/rule_files:/a\    \- /etc/config/<nf-alertsname>' /tmp/
   tempPrometheusConfig.yaml
   ```

3. Update configuration map with the updated file:

   ```
   $ kubectl -n <namespace> replace configmap <OSO-prometheus-configmap-name>
   -f /tmp/tempPrometheusConfig.yaml
   ```

4. Patch the NF Alert rules in OSO Prometheus configuration map by mentioning the alert rule file path:

   ```
   $ kubectl patch configmap <OSO-prometheus-configmap-name> -n <namespace> --
   type merge --patch "$(cat ./NF_altertrules.yaml)"
   ```

7.10.5 Configuring Egress NAT for an NF

This section provides information about configuring NF microservices that originate egress requests to ensure compatibility with CNE.

Annotation for Specifying Egress Network

Starting CNE 22.4.x, egress requests do not get the IP address of the Kubernetes worker node assigned to the source IP field. Instead, each microservice that originates egress requests specifies an egress network through an annotation. An IP address from the indicated network is inserted into the source IP field for all egress requests.

For each microservice that originates egress requests, add the following annotation to the deployment specification and its pods:

```
annotations:
  oracle.com.cnc/egress-network: "oam"
```

Note

- The value of the annotation must match the name of an external network configured.
- This annotation must not be added for microservices that do not originate egress requests, as it leads to decreased CNE performance.
- CNE does not allow any microservice to pick a separate IP address. When CNE is installed, a single IP address is selected for each network.
- All pods in a microservice get the same source IP address attached to all egress requests.
- CNE 22.4.x supports this annotation in vCNE deployments only.

Configuring Egress Controller Environment

Egress controller runs as Kubernetes resource of type DaemonSet. The following table provides details about the environmental variables that can be edited in the Egress controller manifest file:

Note

Do not edit any variables that are not listed in the following table.

Table 7-23 Egress Controller Environment Configuration

Environment Variable	Default Value	Possible Value	Description
DAEMON_MON_TIME	0.5	Between 0.1 and 5	This value reflects the time in seconds and highlights the frequency at which the Egress controller checks the cluster status.

Configuring Egress NAT for Destination Subnet or IP Address

Destination subnet or IP address must be specified to route traffic trough a particular network. The destination subnet or IP address is specified in the form of a dictionary, where the pools are the dictionary keys and the lists of subnets or IP addresses are the dictionary values.

The following annotations show different scenarios of adding pools and destination subnets or IP addresses with examples:

- Specifying annotation for destination subnet:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"<pool>" : ["<subnet_ip_address>/
  <subnet_mask>"]}'
  ```

  For example:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"oam" : ["10.20.30.0/24"]}'
  ```

- Specifying annotation for destination IP address:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"<pool>" : ["<ip_address>"]}'
  ```

  For example:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"oam" : ["10.20.30.40"]}'
  ```

- Specifying annotation for multiple pools:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"<pool_one>" :
  ["<subnet_ip_address>/<subnet_mask>"], "<pool_two>" :
  ["<subnet_ip_address>/<subnet_mask>"]}'
  ```

  For example:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"oam" : ["10.20.30.0/24"], "sig" :
  ["30.20.10.0/24"]}'
  ```

- Specifying annotation for multiple pools and multiple destinations:

  ```
  annotations:
    oracle.com.cnc/egress-destination: '{"<pool_one>" :
  ["<subnet_ip_address>/<subnet_mask>", "<subnet_ip_address>/
  <subnet_mask>"], "<pool_two>" : ["<subnet_ip_address>/<subnet_mask>",
  "<ip_address>"]}'
  ```

For example:

```
annotations:
  oracle.com.cnc/egress-destination: '{"oam" : ["10.20.30.0/24",
"100.200.30.0/22"], "sig" : ["30.20.10.0/24", "20.10.5.1"]}'
```

Compatibility Between Egress NAT and Destination Egress NAT

Both Egress NAT and Destination Egress NAT annotations are independent and compatible. This means that they can be used independently or combined to create more specific rules. Egress NAT is enabled to route all traffic from a particular pod through a particular network. Whereas, Destination Egress NAT permits traffic to be routed using a destination subnet or IP address before regular Egress NAT rules are matched within the routing table. This feature allows more granularity to route traffic through a particular network.

For example, the following annotations show both the features combined to route a pod's traffic through the `sig` network, except the traffic destined for `10.20.30.0/24` subnet, which is routed through the `oam` network:

```
annotations:
  oracle.com.cnc/egress-destination: '{"oam" : ["10.20.30.0/24"]}'
  oracle.com.cnc/egress-network: sig
```

7.11 Updating CNLB Network Attachments

This section provides information on how to update the network in an existing CNLB deployment and also explains the non-disruptive and disruptive network updates.

> **Note**
>
> Network attachment updates are supported for vCNE OpenStack, vCNE VMware, and BareMetal deployments only.

Prerequisites

Before updating the network, ensure that the following prerequisites are met:

1. CNLB-enabled cluster must be installed and configured.
2. You must know how to configure the `cnlb.ini` file.
3. All nodes are up and reachable and their network settings are properly setup.
4. For vCNE on VMware, it is recommended that before running this procedure, while performing any disruptive update, application traffic must be diverted to another georedundant site.
   For more information about the disruptive update, see *Disruptive Updates* section.

Non-Disruptive Updates

Non-disruptive updates perform network operations on an existing network that does not affect the current traffic flow. For example, Adding a new network, Adding an IP address to an existing network, and so on.

> **Note**
>
> Deleting a network or an IP address can be non-disruptive depending on how the network or IP address is configured in the cluster.

The following table lists the operations that are performed for a non-disruptive network update:

Table 7-24 Non-Disruptive Updates

Description	Assumptions	Platform
Adding a new network	None	OpenStack
Adding an IP address to the `service_ip_addr` list of an existing network	None	OpenStack and VMware
Adding an IP address to the `egress_dest` list of an existing network	None	OpenStack and VMware
Removing an unused network	There are no applications or NFs (for example, Deployments or StatefulSets) with annotations pointing to this network.	OpenStack
Removing an IP address to the `service_ip_addr` list of an existing network	There is no application or NF (for example, Deployment or StatefulSets) with an annotation that uses this service IP address.	OpenStack and VMware
Removing an IP address to the `egress_dest` list of an existing network	There is no application or NF (for example, Deployments or StatefulSets) with an annotation that uses this IP address.	OpenStack and VMware
Replacing an existing IP address from the `service_ip_addr` list of an existing network	There is no application or NF (for example, Deployments or StatefulSets) with an annotation that uses this service IP address.	OpenStack and VMware

Disruptive Updates

Disruptive updates remove or modify the settings in the `cnlb.ini` file, which can affect the traffic flow due to the current cloud configuration. In such instances, the impact varies depending on the platform and may include an outage of all applications or NFs' that use CNLB.

The following table lists the operations that are performed for a disruptive network update:

Table 7-25 Disruptive Updates

Description	Assumptions	Platform	How to prevent outage
Adding a new network	All the applications or NFs (for example, Deployments and StatefulSets) including CNE common services must be restarted after the script completes. This allows CNLB to refresh its status from each annotation.	VMware	This change will switch around the order and network interface names (mac addresses and IPs may also be impacted). This is an inherent limitation that arises due to VMware Cloud Director (VCD) and OpenTofu providers. The outage will occur as soon as OpenTofu applies the new configuration (as part of the script), and will resolve only after the script has successfully completed and all the applications or NFs or common services have been restarted.
Removing an unused network	All the applications or NFs (for example, Deployments and StatefulSets) including CNE common services must be restarted after the script is run. This allows CNLB to refresh its status from each annotation.	VMware	This change will switch around the order and network interface names (mac addresses and IPs can be impacted). This is an inherent limitation that arises due to VMware Cloud Director (VCD) and OpenTofu providers. The outage will occur as soon as OpenTofu applies the new configuration (as part of the script), and will resolve only after the script has successfully finished and all the applications or NFs or common services have been restarted.
Removing a network	The network is used by annotated applications or NFs.	OpenStack and VMware	Before performing this action, all applications or NFs annotated with this network must be reconfigured, that is change the annotation to point to a different active network to avoid an outage.

Table 7-25 (Cont.) Disruptive Updates

Description	Assumptions	Platform	How to prevent outage
Removing an IP address from `service_ip_addr` list of an existing network	The service IP is used by an annotated application or NF.	OpenStack and VMware	Before performing this action, the application or NF using this `service_ip` must be reconfigured, that is change the annotation to point to a different `service_ip` in the same network or another network, to avoid an outage.
Removing an IP address from an `egress_dest` list of an existing network	The `egress_dest` is used by one or more annotated applications or NFs. There can be more than one `egress_dest` in the list.	OpenStack and VMware	Before performing this action, all applications or NFs annotated with the `egress_dest` list must be reconfigured, that is change the annotation to point to a different `egress_dest`.
Replacing an existing IP address from the service_ip_addr list of an existing network	There is an application or NF (for example, Deployments or StatefulSets) with annotation that is actively using this service IP address. The annotations are updated immediately after the script finishes.	OpenStack and VMware	To clear the outage, the application or NFs annotations must be reconfigured.
Updating an existing network `network_id` or `subnet_id`	The network is being used by annotated applications or NFs. The annotations (for all the applicable applications or NFs) are updated immediately after the script execution is complete. Fields such as `service_ip_addr` and `egress_dest` must also be updated to match the new network.	OpenStack and VMware	To clear the outage, the application or NFs' annotations must be reconfigured.

Table 7-25 (Cont.) Disruptive Updates

Description	Assumptions	Platform	How to prevent outage
Modifying shared-internal variable from `true` to `false` (or vice versa)	The network is being used by annotated applications or NFs. Network attachment definitions (for all the applicable applications or NFs) are updated immediately after the script is run completely. Restart annotated applications or NFs for the changes made to network attachment definitions to reflect.	OpenStack and VMware	To clear the outage, the application deployments using modified network attachment definitions must be restarted to reflect the updated configuration.

Procedure to update a network attachment

To add, delete, or update a CNLB network, perform the following procedure.

Update the `cnlb.ini` file before running the script, located at `/var/occne/cluster/${OCCNE_CLUSTER}/installer/updNetwork.py`. Once the script is run successfully, verification must be performed.

> **Note**
>
> It is recommended to identify the changes to be made to `cnlb.ini` file before running the `updNetwork.py` script. Running the script with updates that include deletion and/or updates of configuration made to the `cnlb.ini` file, can be disruptive to the current CNLB configuration. In such cases, validation can be performed only on the syntax of the `cnlb.ini` file.

Running the `updNetwork.py` script, it performs the following steps:

1. The `cnlb.ini` file is validated, ensuring the changes made are syntactically correct and that there are no unsupported duplicate IPs used.
2. The updated `cnlb.auto.tfvars` file is generated.
3. The `OpenTofu` is run to generate the new configuration resources.
4. The `installCnlb.py` is run to generate the Kubernetes objects in the cluster.

The following two files are generated which show the results of the script after it completes. Check these files to ensure that the script is successful.

1. `updNetwork-<timestamp>.log`
   This file must include the output from the **OpenTofu** run.
2. `installer.log`
   This file must include any logs generated by the `installCnlb.py` script.

> **Note**
>
> The `-h` option in the command syntax, displays the help.

> **Note**
>
> For this release, only `occne-infra` namespace is operational. If the script is run without any parameters, the default namespace used is `occne-infra`. The `-ns/--namespace` option can be used, but must be set to `occne-infra` namespace only. It is recommended not to insert any other namespace.

Run the following command to display the help option.

```
$ installer/updNetwork.py -h
```

The following sample output shows the usage of the configuration options:

```
usage: updNetwork.py [-h] [-ns NAMESPACE] [-db]

Used to update the network on an existing CNLB deployment.
Parameters:
  Required parameters:
    None

  Optional Parameters:
    -ns/--namespace: Namespace for network
    -db/--debug: Print tracebacks on error

optional arguments:
  -h, --help            show this help message and exit
  -ns NAMESPACE, --namespace NAMESPACE
                        namespace for network
  -db, --debug

    Examples:
     ./updNetwork.py
     ./updNetwork.py -ns occne-infra -db
```

Updating an Existing CNLB Network Configuration
This procedure provides the steps to follow when updating an existing CNLB network configuration. The following example demonstrates how to add a network to the existing CNLB Network configuration.

For specific examples, refer to *Examples cases* section in this chapter. After running the `updNetwork.py` script, all changes made must be manually verified. Refer to *Validating updates* section, to validate the update.

1. Edit the `cnlb.ini` file located at `/var/occne/cluster/$OCCNE_CLUSTER/` to add the configuration for the new network. In this case, the network named **sig** is added to the `cnlb.ini` file, to the existing **oam** network. This includes adding the necessary service IPs along with all other necessary fields for the new network.
   The following sample code snippet shows how to add a **sig** network.

Run the following command to add the configurations required for the new network:

```
$ vi /var/occne/cluster/$OCCNE_CLUSTER/cnlb.ini
```

Below is a sample `cnlb.ini` file:

```
[cnlb]

[cnlb:vars]
cnlb_replica_cnt = 4

[cnlb:children]
oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "43df8249-8316-48ed-a6b7-79de5413ddbb"
network_id = "18e0s112-ac40-4c57-bedf-a16b9df497cf"
external_network_range = "10.199.180.0/24"
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.11", "10.199.180.189"]
internal_network_range = "132.16.0.0/24"
service_ip_addr = ["10.199.180.128", "10.199.180.10", "10.199.180.247",
"10.199.180.174", "10.199.180.131", "10.199.180.4"]
egress_dest = ["10.199.180.0/24","10.123.155.0/25"]

[sig:vars]
service_network_name = "sig"
subnet_id = "2f317932-91bd-4440-a2fe-f3e5fc0af49c"
network_id = "7375bbd7-a787-4f33-ae60-dbcc58c075c2"
external_network_range = 10.199.201.0/24
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.10", "10.199.201.11"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.15","10.199.201.16"]
shared_internal = False
```

2. For OpenStack-only deployment, source the `openrc.sh` file in the cluster directory and provide the OpenStack credentials as prompted.

   ```
   $ source openrc.sh
   ```

3. Run the `updNetworks.py` script to add a **sig** network.

   ```
   $ ./installer/updNetwork.py
   ```

   Sample output:

   ```
   Updating CNLB network as indicated in the cnlb.ini file
   - Validating the cnlb.ini file
       - Successfully validated cnlb.ini file
   - Generating new cnlb.auto.tfvars file
       - Successfully created cnlb.auto.tfvars file
   ```

```
- Initializing and running tofu apply
    - Tofu initialized
    - Running tofu apply... (may take several minutes)
      - Apply complete! Resources: 14 added, 0 changed, 0 destroyed
      - Successful run of tofu apply - check /var/occne/cluster/occne-user/
updNetwork-08122024_164714.log for details
- Running installCnlb.py
    - Successfully ran installCnlb.py
- Restarting cnlb-manager and cnlb-app deployments
    - Deployment: cnlb-manager was restarted. Please wait for the pods
status to be 'running'
    - Deployment: cnlb-app was restarted. Please wait for the pods status
to be 'running'
- Network update successfully completed
```

> **Note**
>
> When operating on BareMetal clusters, running the `updNetwork.py` script does not utilize Terraform or Tofu for the creation or deletion of resources.

Validating Updates

This procedure is to validate the configurations of the updated CNLB network after running the `updNetwork.py` script. The changes must be manually verified using the following commands.

```
kubectl describe cm cnlb-manager-networks -n occne-infra
kubectl get net-attach-def -A
```

The commands required for validation are based on the changes made to the `cnlb.ini` file.

Procedure

1. Run the following `describe` command to retrieve and display the data from `cnlb-manager-networks`.

   ```
   kubectl describe cm cnlb-manager-networks -n occne-infra
   ```

   Sample output:

   ```
   Name:         cnlb-manager-networks
   Namespace:    occne-infra
   Labels:       <none>
   Annotations:  <none>

   Data
   ====
   cnlb_manager_net_cm.json:
   ----
   {
       "networks": [
           {
               "external-network": [
                   {
                       "range": "10.199.180.0/24",
   ```

```
                        "gatewayIp": "10.199.180.1"
                    }
                ],
                "internal-network": [
                    {
                        "range": "132.16.0.0/24",
                        "egressIp": [
                            [
                                "10.199.180.11",
                                "132.16.0.193"
                            ],
                            [
                                "10.199.180.189",
                                "132.16.0.194"
                            ]
                        ]
                    }
                ],
                "networkName": "oam"
            },
            {
                "external-network": [
                    {
                        "range": "10.199.201.0/24",
                        "gatewayIp": "10.199.201.1"
                    }
                ],
                "internal-network": [
                    {
                        "range": "172.16.0.0/24",
                        "egressIp": [
                            [
                                "10.199.201.10",
                                "172.16.0.193"
                            ],
                            [
                                "10.199.201.11",
                                "172.16.0.194"
                            ]
                        ]
                    }
                ],
                "networkName": "sig"
            }
        ]
    }

    BinaryData
    ====
```

2. The data can also be retrieved and displayed using the `kubectl get net-attach-def -A` command. This command retrieves the set of network attachment objects created for the **oam** and **sig** networks.

   ```
   $ kubectl get net-attach-def -A
   ```

Sample output:

```
NAMESPACE     NAME          AGE
default       nf-oam-egr1   3h5m
default       nf-oam-egr2   3h5m
default       nf-oam-ie1    3h5m
default       nf-oam-ie2    3h5m
default       nf-oam-ie3    3h5m
default       nf-oam-ie4    3h5m
default       nf-oam-ie5    3h5m
default       nf-oam-ie6    3h5m
default       nf-oam-int1   3h5m
default       nf-oam-int2   3h5m
default       nf-oam-int3   3h5m
default       nf-oam-int4   3h5m
default       nf-oam-int5   3h5m
default       nf-oam-int6   3h5m
default       nf-sig-egr1   26m
default       nf-sig-egr2   26m
default       nf-sig-ie1    26m
default       nf-sig-ie2    26m
default       nf-sig-int1   86m
default       nf-sig-int2   86m
occne-infra   lb-oam-ext    3h5m
occne-infra   lb-oam-int    3h5m
occne-infra   lb-sig-ext    86m
occne-infra   lb-sig-int    86m
```

3. Validate the following:
   - There is 1 "ie" object and 1 "int" for each `service_ip_addr` list.
   - There is 1 "int" and 1 "egr" for each `egress_ip-addr` list.
   - There are `lb` objects for external and internal networks for **oam** and **sig**.

Multiple networks only
If SIN was enabled or disabled, confirm the change by selecting a net-attach-def (for example, **int1**) and running the command below to verify that the network interfaces previously configured for SIN were updated accordingly.

Example with SIN enabled: the enabled networks use the same interface as OAM

```
$ for x in oam sig; do kubectl describe net-attach-def nf-${x}-ie1 | egrep
"Name:|Config:";echo; done
```

Sample output:

```
Name:         nf-oam-ie1
  Config:  {"cniVersion": "0.4.0", "name": "nf-oam-ie1", "plugins": [{"type":
"macvlan", "mode": "bridge", "master": "oam-int", "ipam": {"type":
"whereabouts", "range": "142.16.0.0/24", "range_start": "142.16.0.129",
"range_end": "142.16.0.190", "gateway": "142.16.0.1", "routes": [{"dst":
"10.75.212.0/23", "gw": "142.16.0.1"}]}}]}

Name:         nf-sig-ie1
  Config:  {"cniVersion": "0.4.0", "name": "nf-sig-ie1", "plugins": [{"type":
```

```
"macvlan", "mode": "bridge", "master": "oam-int", "ipam": {"type":
"whereabouts", "range": "143.16.0.0/24", "range_start": "143.16.0.129",
"range_end": "143.16.0.190", "gateway": "143.16.0.1", "routes": [{"dst":
"10.75.212.0/23", "gw": "143.16.0.1"}]}}]}
```

Example with SIN disabled: the disabled networks use their own interface

```
$ for x in oam sig; do kubectl describe net-attach-def nf-${x}-ie1 | egrep
"Name:|Config:";echo; done
```

Sample output:

```
Name:         nf-oam-ie1
  Config:  {"cniVersion": "0.4.0", "name": "nf-oam-ie1", "plugins": [{"type":
"macvlan", "mode": "bridge", "master": "oam-int", "ipam": {"type":
"whereabouts", "range": "142.16.0.0/24", "range_start": "142.16.0.129",
"range_end": "142.16.0.190", "gateway": "142.16.0.1", "routes": [{"dst":
"10.75.212.0/23", "gw": "142.16.0.1"}]}}]}

Name:         nf-sig-ie1
  Config:  {"cniVersion": "0.4.0", "name": "nf-sig-ie1", "plugins": [{"type":
"macvlan", "mode": "bridge", "master": "sig-int", "ipam": {"type":
"whereabouts", "range": "143.16.0.0/24", "range_start": "143.16.0.129",
"range_end": "143.16.0.190", "gateway": "143.16.0.1", "routes": [{"dst":
"10.75.212.0/23", "gw": "143.16.0.1"}]}}]}
```

Example cases:
The examples provided in this section are for an OpenStack cluster deployment. The flow of the script is same for both the platforms, however, VMware includes additional configurations for the infrastructure after running **OpenTofu Apply**.

> **Note**
>
> The examples provided in this section, indicate at the beginning, if it corresponds to the output of the script ran on a vCNE cluster or on a VMware cluster.

Refer to *Validating Updates* section, to validate the update of the CNLB network configuration.

> **Note**
>
> These are examples only. The IPs used must be changed as per the system on which these commands are run.

The subsequent sections provide in detail the following operations with a sample output:

- Adding a New Network
- Deleting a network
- **Adding an IP to the `service_ip_addr` list of an existing network**
- **Changing an IP in the `service_ip_addr` list of an existing network**

- Deleting an IP from the `service_ip_addr` list of an existing network
- Adding a CIDR to the `egress_dest` field of an existing network
- Deleting a CIDR from the `egress_dest` field of an existing network
- #unique_153
- #unique_154

7.11.1 Adding a New Network

This section describes the steps to add a new network to an existing CNLB deployment.

Prerequisites

Before adding a network, ensure that the **oam** network is added during CNE installation.

Procedure

The following procedure provides an example output of a script run on a VMware vCNE cluster.

1. Edit the `cnlb.ini` file to add the **sig** network to the `cnlb.ini` file.

```
[cnlb]

[cnlb:vars]
# if set to true, it will use list of worker nodes mentioned in cnlb group
to host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]

# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group

oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "cnlb-dhcp2"
network_id = "cnlb-dhcp2"
external_network_range = 10.199.180.0/25
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.76","10.199.180.77"]
internal_network_range = 132.16.0.0/24
service_ip_addr =
["10.199.180.78","10.199.180.79","10.199.180.80","10.199.180.81","10.199.18
0.82","10.199.180.83"]
# Optional variable. Uncomment and specify external destination subnets to
communicate with.
# If egress NADs are not needed for a network, then below variable should
not be added.
egress_dest = ["10.199.180.0/25"]
```

```
[sig:vars]
service_network_name = "sig"
subnet_id = "cnlb-dhcp2"
network_id = "cnlb-dhcp2"
external_network_range = 10.199.201.0/25
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.2","10.199.201.6"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.16","10.199.201.28"]
# Optional variable. Uncomment and specify external destination subnets to
communicate with.
# If egress NADs are not needed for a network, then below variable should
not be added.
egress_dest = ["10.199.201.0/25"]
shared_internal = False
```

2. Run the `updNetwork.py` script to update the CNLB network.
   ```
   $ ./installer/updNetwork.py
   ```
   Sample output:

   ```
   Updating CNLB network as indicated in the cnlb.ini file
   - Validating the cnlb.ini file
       - Successfully validated cnlb.ini file
   - Generating new cnlb.auto.tfvars file
       - Successfully created cnlb.auto.tfvars file
   - Removing Stale Network Interfaces
       - No stale interfaces found to remove
   - Initializing and running tofu apply
       - Tofu initialized
       - Running tofu apply... (may take several minutes)
         - Apply complete! Resources: 1 added, 4 changed, 0 destroyed
         - Successful run of tofu apply - check /var/occne/cluster/occne-user/
   updNetwork-08092024_183741.log for details
   - Renew DHCP Lease
       - Renewing DHCP lease for host occne-user-k8s-node-1...
       - Renewing DHCP lease for host occne-user-k8s-node-2...
       - Renewing DHCP lease for host occne-user-k8s-node-3...
       - Renewing DHCP lease for host occne-user-k8s-node-4...
       - DHCP lease was successfully renewed
   - Validate Number of Networks and NICs match
       - Compare active connections against TF state number of networks
       - Success: Correct number of Active Connections across all nodes
   - Refresh tofu state, refresh IP allocation
       - Successful run of tofu refresh - check /var/occne/cluster/occne-user/
   updNetwork-08092024_183741.log for details
   - Running installCnlb.py
       - Successfully ran installCnlb.py
   - Restarting cnlb-manager and cnlb-app deployments
       - Deployment: cnlb-manager was restarted. Please wait for the pods
   status to be 'running'
       - Deployment: cnlb-app was restarted. Please wait for the pods status
   to be 'running'
   - Network update successfully completed
   ```

3. Verify the changes using the following command.

```
$ kubectl describe cm cnlb-manager-networks -n occne-infra
```

Sample output:

```
Name:         cnlb-manager-networks
Namespace:    occne-infra
Labels:       <none>
Annotations:  <none>

Data
====
cnlb_manager_net_cm.json:
----
{
    "networks": [
        {
            "external-network": [
                {
                    "range": "10.199.180.0/24",
                    "gatewayIp": "10.199.180.1"
                }
            ],
            "internal-network": [
                {
                    "range": "132.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.180.76",
                            "132.16.0.193"
                        ],
                        [
                            "10.199.180.77",
                            "132.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "oam"
        },
        {
            "external-network": [
                {
                    "range": "10.199.201.0/24",
                    "gatewayIp": "10.199.201.1"
                }
            ],
            "internal-network": [
                {
                    "range": "172.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.201.2",
                            "172.16.0.193"
```

```
                        ],
                        [
                            "10.199.201.6",
                            "172.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "sig"
        }
    ]
}

BinaryData
====
```

After the verification, run the following command to fetch the additional default network attachment definitions `ie1` and `ie2` for **sig** network.

```
$ kubectl get net-attach-def -A
```

Sample output:

```
NAMESPACE     NAME          AGE
default       nf-oam-egr1   118m
default       nf-oam-egr2   118m
default       nf-oam-ie1    118m
default       nf-oam-ie2    118m
default       nf-oam-ie3    118m
default       nf-oam-ie4    118m
default       nf-oam-ie5    118m
default       nf-oam-ie6    118m
default       nf-oam-int1   118m
default       nf-oam-int2   118m
default       nf-oam-int3   118m
default       nf-oam-int4   118m
default       nf-oam-int5   118m
default       nf-oam-int6   118m
default       nf-sig-int1   19m
default       nf-sig-int2   19m
occne-infra   lb-oam-ext    118m
occne-infra   lb-oam-int    118m
occne-infra   lb-sig-ext    19m
occne-infra   lb-sig-int    19m
```

7.11.2 Deleting a network

This section describes the steps to delete a network.

Prerequisites

Before deleting a network, ensure that the **sig** network is added as explained in the section, Adding a New Network or ensure that the cluster was initially deployed with this network.

Procedure

The following procedure provides an example output of a script run on a VMware vCNE cluster.

1. Edit the `cnlb.ini` file to delete the **sig** network. Remove the **sig** name under the `cnlb:children` and the `sig:vars` groups with all the indicated fields as shown below.

```
[cnlb]

[cnlb:vars]
# if set to true, it will use list of worker nodes mentioned in cnlb group
to host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]

# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group

oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "cnlb-dhcp2"
network_id = "cnlb-dhcp2"
external_network_range = 10.199.180.0/25
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.76","10.199.180.77"]
internal_network_range = 132.16.0.0/24
service_ip_addr =
["10.199.180.78","10.199.180.79","10.199.180.80","10.199.180.81","10.199.18
0.82","10.199.180.83"]
# Optional variable. Uncomment and specify external destination subnets to
communicate with.
# If egress NADs are not needed for a network, then below variable should
not be added.
egress_dest = ["10.199.180.0/25"]
```

2. Run the **updNetwork.py** script to update the CNLB network.
```
$ ./installer/updNetwork.py
```

Sample output:

```
Updating CNLB network as indicated in the cnlb.ini file
- Validating the cnlb.ini file
    - Successfully validated cnlb.ini file
- Generating new cnlb.auto.tfvars file
    - Successfully created cnlb.auto.tfvars file
- Removing Stale Network Interfaces
    - No stale interfaces found to remove
- Initializing and running tofu apply
    - Tofu initialized
    - Running tofu apply... (may take several minutes)
      - Apply complete! Resources: 0 added, 4 changed, 1 destroyed
      - Successful run of tofu apply - check /var/occne/cluster/occne-user/
updNetwork-08092024_183741.log for details
- Renew DHCP Lease
    - Renewing DHCP lease for host occne-user-k8s-node-1...
    - Renewing DHCP lease for host occne-user-k8s-node-2...
    - Renewing DHCP lease for host occne-user-k8s-node-3...
    - Renewing DHCP lease for host occne-user-k8s-node-4...
    - DHCP lease was successfully renewed
- Validate Number of Networks and NICs match
    - Compare active connections against TF state number of networks
    - Success: Correct number of Active Connections across all nodes
- Refresh tofu state, refresh IP allocation
    - Successful run of tofu refresh - check /var/occne/cluster/occne-user/
updNetwork-08092024_183741.log for details
- Running installCnlb.py
    - Successfully ran installCnlb.py
- Restarting cnlb-manager and cnlb-app deployments
    - Deployment: cnlb-manager was restarted. Please wait for the pods
status to be 'running'
    - Deployment: cnlb-app was restarted. Please wait for the pods status
to be 'running'
- Network update successfully completed
```

3. Verify the changes using the following command:

```
$ kubectl describe cm cnlb-manager-networks -n occne-infra
```

Sample output:

```
Name:         cnlb-manager-networks
Namespace:    occne-infra
Labels:       <none>
Annotations:  <none>

Data
====
cnlb_manager_net_cm.json:
----
{
    "networks": [
        {
            "external-network": [
```

```
                {
                    "range": "10.199.180.0/24",
                    "gatewayIp": "10.199.180.1"
                }
            ],
            "internal-network": [
                {
                    "range": "132.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.180.76",
                            "132.16.0.193"
                        ],
                        [
                            "10.199.180.77",
                            "132.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "oam"
        }
    ]
}
```

After the verification, run the following command to fetch the additional default network attachment definitions for **oam** `ie1` and `ie2`.

```
$ kubectl get net-attach-def -A
```

Sample output:

```
NAMESPACE     NAME          AGE
default       nf-oam-egr1   3h24m
default       nf-oam-egr2   3h24m
default       nf-oam-ie1    3h24m
default       nf-oam-ie2    3h24m
default       nf-oam-ie3    3h24m
default       nf-oam-ie4    3h24m
default       nf-oam-ie5    3h24m
default       nf-oam-ie6    3h24m
default       nf-oam-int1   3h24m
default       nf-oam-int2   3h24m
default       nf-oam-int3   3h24m
default       nf-oam-int4   3h24m
default       nf-oam-int5   3h24m
default       nf-oam-int6   3h24m
occne-infra   lb-oam-ext    3h24m
occne-infra   lb-oam-int    3h24m
```

7.11.3 Adding an IP to the `service_ip_addr` list of an existing network

This section describes the steps to add an IP to the `service_ip_addr` list of an existing network.

Prerequisites

Before adding an IP to a network, ensure that the **sig** network is added as explained in the section, Adding a New Network.

Procedure

1. Edit the `cnlb.ini` file and add a valid external IP to the end of the `service_ip_addr` field for the **sig** network.
   Below is a sample `cnlb.ini` file.

```
[cnlb]

[cnlb:vars]
# if set to true will use list of worker nodes mentioned in cnlb group to
host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]
# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group
oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "43df8249-8316-48ed-a6b7-79de5413ddbb"
network_id = "18e0s112-ac40-4c57-bedf-a16b9df497cf"
external_network_range = "10.199.180.0/24"
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.11", "10.199.180.189"]
internal_network_range = "132.16.0.0/24"
service_ip_addr = ["10.199.180.128", "10.199.180.10", "10.199.180.247",
"10.199.180.174", "10.199.180.131", "10.199.180.4"]
egress_dest = ["10.199.180.0/24","10.123.155.0/25"]

[sig:vars]
service_network_name = "sig"
subnet_id = "2f317932-91bd-4440-a2fe-f3e5fc0af49c"
network_id = "7375bbd7-a787-4f33-ae60-dbcc58c075c2"
external_network_range = 10.199.201.0/24
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.10", "10.199.201.11"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.15","10.199.201.16","10.199.201.76"]
shared_internal = False
```

   The IP 10.199.201.76 is added.

2. Run the **updNetwork.py** script to update the CNLB network.

```
$ ./installer/updNetwork.py
```

Sample output:

```
Updating CNLB network as indicated in the cnlb.ini file
- Validating the cnlb.ini file
    - Successfully validated cnlb.ini file
- Generating new cnlb.auto.tfvars file
    - Successfully created cnlb.auto.tfvars file
- Initializing and running tofu apply
    - Tofu initialized
    - Running tofu apply... (may take several minutes)
      - Apply complete! Resources: 1 added, 0 changed, 0 destroyed
      - Successful run of tofu apply - check /var/occne/cluster/occne-user/
updNetwork-08122024_171433.log for details
- Running installCnlb.py
    - Successfully ran installCnlb.py
- Restarting cnlb-manager and cnlb-app deployments
    - Deployment: cnlb-manager was restarted. Please wait for the pods
status to be 'running'
    - Deployment: cnlb-app was restarted. Please wait for the pods status
to be 'running'
- Network update successfully completed
```

3. Verify the changes using the following command:

```
$ kubectl describe cm cnlb-manager-networks -n occne-infra
```

Sample output:

```
Name:         cnlb-manager-networks
Namespace:    occne-infra
Labels:       <none>
Annotations:  <none>

Data
====
cnlb_manager_net_cm.json:
----
{
    "networks": [
        {
            "external-network": [
                {
                    "range": "10.199.180.0/24",
                    "gatewayIp": "10.199.180.1"
                }
            ],
            "internal-network": [
                {
                    "range": "132.16.0.0/24",
                    "egressIp": [
```

```
                            [
                                "10.199.180.11",
                                "132.16.0.193"
                            ],
                            [
                                "10.199.180.189",
                                "132.16.0.194"
                            ]
                        ]
                    }
                ],
                "networkName": "oam"
            },
            {
                "external-network": [
                    {
                        "range": "10.199.201.0/24",
                        "gatewayIp": "10.199.201.1"
                    }
                ],
                "internal-network": [
                    {
                        "range": "172.16.0.0/24",
                        "egressIp": [
                            [
                                "10.199.201.10",
                                "172.16.0.193"
                            ],
                            [
                                "10.199.201.11",
                                "172.16.0.194"
                            ]
                        ]
                    }
                ],
                "networkName": "sig"
            }
        ]
}

BinaryData
====
```

4. After the verification, run the following command to fetch the additional default network attachment definitions.

   ```
   $ kubectl get net-attach-def -A
   ```

   Sample output:

   ```
   NAMESPACE     NAME          AGE
   default       nf-oam-egr1   132m
   default       nf-oam-egr2   132m
   default       nf-oam-ie1    132m
   ```

```
default       nf-oam-ie2    132m
default       nf-oam-ie3    132m
default       nf-oam-ie4    132m
default       nf-oam-ie5    132m
default       nf-oam-ie6    132m
default       nf-oam-int1   132m
default       nf-oam-int2   132m
default       nf-oam-int3   132m
default       nf-oam-int4   132m
default       nf-oam-int5   132m
default       nf-oam-int6   132m
default       nf-sig-int1   33m
default       nf-sig-int2   33m
default       nf-sig-int3   6m11s
occne-infra   lb-oam-ext    132m
occne-infra   lb-oam-int    132m
occne-infra   lb-sig-ext    33m
occne-infra   lb-sig-int    33m
```

7.11.4 Deleting an IP from the `service_ip_addr` list of an existing network

This section describes the steps to delete an IP from the `service_ip_addr` list of an existing network.

Prerequisites

Before proceeding to delete an IP from a network, ensure that the **sig** network is added as explained in the section, Adding a New Network in addition to the service IP `10.199.201.76`.

Procedure

1. Edit the `cnlb.ini` file to remove the external IP `10.199.201.76` from the `service_ip_addr` field for the **sig** network.
   Below is a sample `cnlb.ini` file.

```
[cnlb]

[cnlb:vars]
# if set to true, it will use list of worker nodes mentioned in cnlb group
to host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]

# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group
oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "43df8249-8316-48ed-a6b7-79de5413ddbb"
network_id = "18e0s112-ac40-4c57-bedf-a16b9df497cf"
external_network_range = "10.199.180.0/24"
```

```
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.11", "10.199.180.189"]
internal_network_range = "132.16.0.0/24"
service_ip_addr = ["10.199.180.128", "10.199.180.10", "10.199.180.247",
"10.199.180.174", "10.199.180.131", "10.199.180.4"]
egress_dest = ["10.199.180.0/24","10.123.155.0/25"]

[sig:vars]
service_network_name = "sig"
subnet_id = "2f317932-91bd-4440-a2fe-f3e5fc0af49c"
network_id = "7375bbd7-a787-4f33-ae60-dbcc58c075c2"
external_network_range = 10.199.201.0/24
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.10", "10.199.201.11"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.15","10.199.201.16"]
shared_internal = False
```

2. Run the **updNetwork.py** script to update the CNLB network.

   ```
   $ ./installer/updNetwork.py
   ```

   Sample output:

   ```
   Updating CNLB network as indicated in the cnlb.ini file
   - Validating the cnlb.ini file
       - Successfully validated cnlb.ini file
   - Generating new cnlb.auto.tfvars file
       - Successfully created cnlb.auto.tfvars file
   - Initializing and running tofu apply
       - Tofu initialized
       - Running tofu apply... (may take several minutes)
         - Apply complete! Resources: 0 added, 0 changed, 1 destroyed
         - Successful run of tofu apply - check /var/occne/cluster/occne-user/
   updNetwork-08122024_172857.log for details
   - Running installCnlb.py
       - Successfully ran installCnlb.py
   - Restarting cnlb-manager and cnlb-app deployments
       - Deployment: cnlb-manager was restarted. Please wait for the pods
   status to be 'running'
       - Deployment: cnlb-app was restarted. Please wait for the pods status
   to be 'running'
   - Network update successfully completed
   ```

3. Verify the changes using the following command.

   ```
   $ kubectl describe cm cnlb-manager-networks -n occne-infra
   ```

   Sample output:

   ```
   Name:         cnlb-manager-networks
   Namespace:    occne-infra
   Labels:       <none>
   Annotations:  <none>
   ```

```
Data
====
cnlb_manager_net_cm.json:
----
{
    "networks": [
        {
            "external-network": [
                {
                    "range": "10.199.180.0/24",
                    "gatewayIp": "10.199.180.1"
                }
            ],
            "internal-network": [
                {
                    "range": "132.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.180.11",
                            "132.16.0.193"
                        ],
                        [
                            "10.199.180.189",
                            "132.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "oam"
        },
        {
            "external-network": [
                {
                    "range": "10.199.201.0/24",
                    "gatewayIp": "10.199.201.1"
                }
            ],
            "internal-network": [
                {
                    "range": "172.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.201.10",
                            "172.16.0.193"
                        ],
                        [
                            "10.199.201.11",
                            "172.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "sig"
        }
    ]
```

```
}

BinaryData
====
```

After the verification, run the following command to fetch the additional default network attachment definitions.

```
$ kubectl get net-attach-def -A
```

Sample output:

```
NAMESPACE     NAME          AGE
default       nf-oam-egr1   143m
default       nf-oam-egr2   143m
default       nf-oam-ie1    143m
default       nf-oam-ie2    143m
default       nf-oam-ie3    143m
default       nf-oam-ie4    143m
default       nf-oam-ie5    143m
default       nf-oam-ie6    143m
default       nf-oam-int1   143m
default       nf-oam-int2   143m
default       nf-oam-int3   143m
default       nf-oam-int4   143m
default       nf-oam-int5   143m
default       nf-oam-int6   143m
default       nf-sig-int1   44m
default       nf-sig-int2   44m
occne-infra   lb-oam-ext    143m
occne-infra   lb-oam-int    143m
occne-infra   lb-sig-ext    44m
occne-infra   lb-sig-int    44m
```

7.11.5 Changing an IP in the `service_ip_addr` list of an existing network

This section describes the steps to change an IP in the `service_ip_addr` list of an existing network.

Prerequisites

Before proceeding to delete an IP from a network, ensure that the **sig** network is added as explained in the section, Adding a New Network in addition to the service IP `10.199.201.76`.

Procedure

1. Edit the `cnlb.ini` file to change the service IP `10.199.201.76` to `10.199.201.16` in the **service_ip_addr** field for the **sig** network.
   Below is a sample `cnlb.ini` file.

```
[cnlb]

[cnlb:vars]
# if set to true will use list of worker nodes mentioned in cnlb group to
```

```
host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]

# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group
oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "43df8249-8316-48ed-a6b7-79de5413ddbb"
network_id = "18e0s112-ac40-4c57-bedf-a16b9df497cf"
external_network_range = "10.199.180.0/24"
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.11", "10.199.180.189"]
internal_network_range = "132.16.0.0/24"
service_ip_addr = ["10.199.180.128", "10.199.180.10", "10.199.180.247",
"10.199.180.174", "10.199.180.131", "10.199.180.4"]
egress_dest = ["10.199.180.0/24","10.123.155.0/25"]

[sig:vars]
service_network_name = "sig"
subnet_id = "2f317932-91bd-4440-a2fe-f3e5fc0af49c"
network_id = "7375bbd7-a787-4f33-ae60-dbcc58c075c2"
external_network_range = 10.199.201.0/24
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.10", "10.199.201.11"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.15","10.199.201.16","10.199.201.16"]
shared_internal = False
```

2. Run the **updNetwork.py** script to update the CNLB network.

```
$ ./installer/updNetwork.py
```

Sample output:

```
Updating CNLB network as indicated in the cnlb.ini file
- Validating the cnlb.ini file
    - Successfully validated cnlb.ini file
- Generating new cnlb.auto.tfvars file
    - Successfully created cnlb.auto.tfvars file
- Initializing and running tofu apply
    - Tofu initialized
    - Running tofu apply... (may take several minutes)
      - Apply complete! Resources: 1 added, 0 changed, 1 destroyed
      - Successful run of tofu apply - check /var/occne/cluster/occne-user/
updNetwork-08122024_173855.log for details
- Running installCnlb.py
    - Successfully ran installCnlb.py
- Restarting cnlb-manager and cnlb-app deployments
```

```
    - Deployment: cnlb-manager was restarted. Please wait for the pods
status to be 'running'
    - Deployment: cnlb-app was restarted. Please wait for the pods status
to be 'running'
- Network update successfully completed
```

3. Verify the changes using the following commands.

```
$ kubectl describe cm cnlb-manager-networks -n occne-infra
$ kubectl get net-attach-def -A
```

Sample output:

```
Name:         cnlb-manager-networks
Namespace:    occne-infra
Labels:       <none>
Annotations:  <none>

Data
====
cnlb_manager_net_cm.json:
----
{
    "networks": [
        {
            "external-network": [
                {
                    "range": "10.199.180.0/24",
                    "gatewayIp": "10.199.180.1"
                }
            ],
            "internal-network": [
                {
                    "range": "132.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.180.11",
                            "132.16.0.193"
                        ],
                        [
                            "10.199.180.189",
                            "132.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "oam"
        },
        {
            "external-network": [
                {
                    "range": "10.199.201.0/24",
                    "gatewayIp": "10.199.201.1"
                }
            ],
```

```
            "internal-network": [
                {
                    "range": "172.16.0.0/24",
                    "egressIp": [
                        [
                            "10.199.201.10",
                            "172.16.0.193"
                        ],
                        [
                            "10.199.201.11",
                            "172.16.0.194"
                        ]
                    ]
                }
            ],
            "networkName": "sig"
        }
    ]
}

BinaryData
====
```

Run the following command:

```
$ kubectl get net-attach-def -A
```

```
NAMESPACE     NAME          AGE
default       nf-oam-egr1   153m
default       nf-oam-egr2   153m
default       nf-oam-ie1    153m
default       nf-oam-ie2    153m
default       nf-oam-ie3    153m
default       nf-oam-ie4    153m
default       nf-oam-ie5    153m
default       nf-oam-ie6    153m
default       nf-oam-int1   153m
default       nf-oam-int2   153m
default       nf-oam-int3   153m
default       nf-oam-int4   153m
default       nf-oam-int5   153m
default       nf-oam-int6   153m
default       nf-sig-int1   53m
default       nf-sig-int2   53m
occne-infra   lb-oam-ext    153m
occne-infra   lb-oam-int    153m
occne-infra   lb-sig-ext    53m
occne-infra   lb-sig-int    53m
```

7.11.6 Adding a CIDR to the `egress_dest` field of an existing network

This section describes the steps to add a Classless Inter-Domain Routing (CIDR) to the `egress_dest` field of an existing network.

Prerequisites

Before adding a CIDR to the `egress_dest` field, ensure that the **sig** network is added as explained in the section, Adding a New Network.

Validation commands

The following commands are used to validate the changes.

Table 7-26 Validation commands

Command	Purpose
`kubectl describe cm cnlb-manager-networks -n occne-infra`	This command is used to retrieve and display the data from `cnlb-manager-networks`.
`kubectl get net-attach-def -A`	This command is used to get the network attachment definition through out the cluster. Here, `-A` represents all namespaces.
`kubectl describe net-attach-def nf-sig-egr1 -n default`	This command is used to retrieve the contents of the network attachment definition, `nf-sig-egr1` in default namespace.

Procedure

1. Edit the `cnlb.ini` file to add the IP, `10.199.100.0/25` to the `egress_dest` field for the **sig** network.
   For more information on how to add **sig** network, see Adding a New Network.

   Below is a sample `cnlb.ini` file.

```
[cnlb]

[cnlb:vars]
# if set to true, it will use list of worker nodes mentioned in cnlb group
to host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]

# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group
oam
sig

[oam:vars]
service_network_name = "oam"
subnet_id = "43df8249-8316-48ed-a6b7-79de5413ddbb"
network_id = "18e0s112-ac40-4c57-bedf-a16b9df497cf"
external_network_range = "10.199.180.0/24"
```

```
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.11", "10.199.180.189"]
internal_network_range = "132.16.0.0/24"
service_ip_addr = ["10.199.180.128", "10.199.180.10", "10.199.180.247",
"10.199.180.174", "10.199.180.131", "10.199.180.4"]
egress_dest = ["10.199.180.0/24","10.123.155.0/25"]

[sig:vars]
service_network_name = "sig"
subnet_id = "2f317932-91bd-4440-a2fe-f3e5fc0af49c"
network_id = "7375bbd7-a787-4f33-ae60-dbcc58c075c2"
external_network_range = 10.199.201.0/24
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.10", "10.199.201.11"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.15","10.199.201.16","10.199.201.16"]
egress_dest = ["10.199.201.0/25","10.199.100.0/25"]
shared_internal = False
```

2. Run the **updNetwork.py** script to update the CNLB network.

   ```
   $ ./installer/updNetwork.py
   ```

   Sample output:

   ```
   Updating CNLB network as indicated in the cnlb.ini file
   - Validating the cnlb.ini file
       - Successfully validated cnlb.ini file
   - Generating new cnlb.auto.tfvars file
       - Successfully created cnlb.auto.tfvars file
   - Initializing and running tofu apply
       - Tofu initialized
       - Running tofu apply... (may take several minutes)
         - Apply complete! Resources: 0 added, 0 changed, 0 destroyed
         - Successful run of tofu apply - check /var/occne/cluster/occne-user/
   updNetwork-08122024_174922.log for details
   - Running installCnlb.py
       - Successfully ran installCnlb.py
   - Restarting cnlb-manager and cnlb-app deployments
       - Deployment: cnlb-manager was restarted. Please wait for the pods
   status to be 'running'
       - Deployment: cnlb-app was restarted. Please wait for the pods status
   to be 'running'
   - Network update successfully completed
   ```

3. Verify the changes using the following command.

   ```
   $ kubectl describe net-attach-def nf-sig-egr1 -n default
   ```

   The parameter `net-attach-def` route from the configuration is added to the /Spec/Config section and also as shown below. See **"routes"** below where {"dst": "10.199.100.0/25", "gw": "172.16.0.193"} is added.

Sample output:

```
Name:         nf-sig-egr1
Namespace:    default
Labels:       <none>
Annotations:  <none>
API Version:  k8s.cni.cncf.io/v1
Kind:         NetworkAttachmentDefinition
Metadata:
  Creation Timestamp:  2024-08-12T17:48:09Z
  Generation:          2
  Resource Version:    55141
  UID:                 f3720ac4-f49e-487b-a0cc-5b2096d12432
Spec:
  Config:  {"cniVersion": "0.4.0", "name": "nf-sig-egr1", "plugins":
[{"type": "macvlan", "mode": "bridge", "master": "eth3", "ipam": {"type":
"whereabouts", "range": "132.16.0.0/24", "range_start": "132.16.0.129",
"range_end": "132.16.0.190", "gateway": "132.16.0.193", "routes": [{"dst":
"10.199.201.0/23", "gw": "132.16.0.193"}, {"dst": "10.199.100.0/25", "gw":
"172.16.0.193"}]}}]}
Events:    <none>
```

7.11.7 Deleting a CIDR from the `egress_dest` field of an existing network

This section describes the procedure to delete a CIDR from the `egress_dest` field from an existing network

Prerequisites

Before deleting a CIDR from the `egress_dest` field, ensure that the **sig** network is added as explained in the section, Adding a New Network.

The following is an example of adding an IP to the service_ip_addr list on a BareMetal cluster.

Procedure

1. Edit the `cnlb.ini` file and delete IP `10.199.100.0/25` from the `egress_dest` field for the **sig** network.
   Below is a sample `cnlb.ini` file.

```
[cnlb]

[cnlb:vars]
# if set to true, it will use list of worker nodes mentioned in cnlb group
to host lb client pods, if not set then use all
cnlb_replica_cnt = 4

[cnlb:children]
# Network names to be used for pod and external
# networking, these networks and ports
# will be created and attached to hosts
# in cnlb host group
oam
sig

[oam:vars]
```

```
service_network_name = "oam"
subnet_id = "43df8249-8316-48ed-a6b7-79de5413ddbb"
network_id = "18e0s112-ac40-4c57-bedf-a16b9df497cf"
external_network_range = "10.199.180.0/24"
external_default_gw = "10.199.180.1"
egress_ip_addr = ["10.199.180.11", "10.199.180.189"]
internal_network_range = "132.16.0.0/24"
service_ip_addr = ["10.199.180.128", "10.199.180.10", "10.199.180.247",
"10.199.180.174", "10.199.180.131", "10.199.180.4"]
egress_dest = ["10.199.180.0/24","10.123.155.0/25"]

[sig:vars]
service_network_name = "sig"
subnet_id = "2f317932-91bd-4440-a2fe-f3e5fc0af49c"
network_id = "7375bbd7-a787-4f33-ae60-dbcc58c075c2"
external_network_range = 10.199.201.0/24
external_default_gw = "10.199.201.1"
egress_ip_addr = ["10.199.201.10", "10.199.201.11"]
internal_network_range = 172.16.0.0/24
service_ip_addr = ["10.199.201.15","10.199.201.16","10.199.201.16"]
egress_dest = ["10.199.201.0/25"]
shared_internal = False
```

2. Run the **updNetwork.py** script to update the CNLB network.

   ```
   $ ./installer/updNetwork.py
   ```

   Sample output:

   ```
   Updating CNLB network as indicated in the cnlb.ini file
   - Validating the cnlb.ini file
       - Validation for bm cnlb.ini file succeeded.
   - Skipping validation for nodes reachability
   - Skipping network interfaces health validation
   - Running installCnlb.py
       - Successfully ran installCnlb.py
   - Restarting cnlb-manager and cnlb-app deployments
       - Deployment: cnlb-manager was restarted. Please wait for the pods
   status to be 'running'
       - Deployment: cnlb-app was restarted. Please wait for the pods status
   to be 'running'
   - Network update successfully completed
   ```

3. Verify the following changes by running the command `$ kubectl describe net-attach-def nf-sig-egr1 -n default`:

   - `route` `net-attach-def` is removed from `/spec/config` section as shown in the sample output below
   - Observe that in the `routes` field, the IPs `{"dst": "10.199.100.0/25", "gw": "172.16.0.193"}` are deleted.

   Sample output:

   ```
   Name:         nf-sig-egr1
   Namespace:    default
   ```

```
Labels:       <none>
Annotations:  <none>
API Version:  k8s.cni.cncf.io/v1
Kind:         NetworkAttachmentDefinition
Metadata:
  Creation Timestamp:  2024-08-12T17:48:09Z
  Generation:          2
  Resource Version:    55141
  UID:                 f3720ac4-f49e-487b-a0cc-5b2096d12432
Spec:
  Config:  {"cniVersion": "0.4.0", "name": "nf-sig-egr1", "plugins":
[{"type": "macvlan", "mode": "bridge", "master": "eth3", "ipam": {"type":
"whereabouts", "range": "132.16.0.0/24", "range_start": "132.16.0.129",
"range_end": "132.16.0.190", "gateway": "132.16.0.193", "routes": [{"dst":
"10.199.201.0/23", "gw": "132.16.0.193"}]}}]}
Events:    <none>
```

7.11.8 Common Issues and Solutions

This section outlines basic steps to resolve common errors encountered when running the network update procedure.

Failed to connect to nodes

This error typically occurs when one or more cluster nodes cannot be reached.

Cause	Solution
Nodes are powered off	Verify all nodes are powered on.
Nodes have incorrect or incomplete network settings	Ensure that network connectivity is enabled on all nodes and that network settings (IP, gateway, routes, DNS as applicable) are configured correctly. Confirm that the nodes are reachable over the management or control network (for example, using ping or SSH, depending on your environment).

Inconsistent interfaces found across nodes

This error typically occurs when one or more nodes have different network interface names than the rest of the cluster.

Cause	Solution
Network interface names changed on one or more nodes	Ensure interface names are consistent and enabled across all nodes. If naming is driven by udev rules, reloading udev rules may resolve the issue. A common approach is to safely reboot the affected nodes one at a time (drain each node before rebooting, if applicable to your cluster).
Network interface IP addresses are misconfigured	Verify the relevant interfaces are configured on the correct subnet and consistently across all nodes.

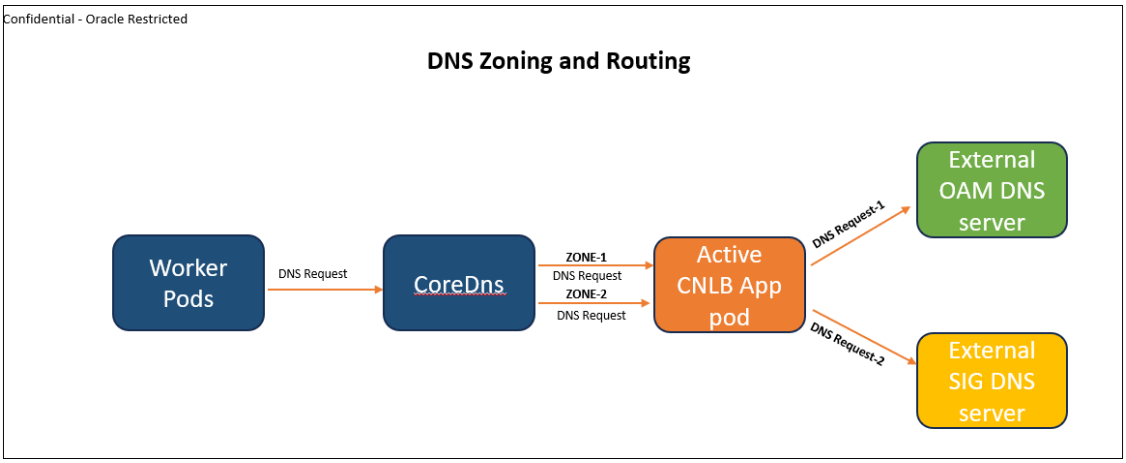
7.12 Secure DNS Zone Customization through CNLB

Overview

DNS Zone Customization functionality in the CNE environment enhances the security and scalability of DNS requests by routing traffic based on domain zones, such as OAM or Signaling. The feature isolates DNS traffic and forwards requests through Cloud Native Load Balancers (CNLB) to external DNS servers, which are managed by customers. CNE does not control these external servers, but ensures the secure routing of requests.

> **Note**
>
> When this feature is enabled, it is required that CoreDNS pods are not scheduled to run on control plane nodes.

DNS Zone Customization feature modifies the DNS resolution flow within the CNE environment to optimize name resolution and centralize DNS routing through the CNLB application. It improves the control over external DNS traffic by routing it through an active CNLB application, bypassing the Bastion-host-based resolution flow.



DNS requests originating from worker pods are routed through CoreDNS, which examines the requested domain zone (for example, OAM, Signaling). Depending on the zone type, the DNS request is forwarded through the appropriate CNLB (Cloud Native Load Balancer) application to the corresponding external DNS server.

Egress Network Attachment Definitions (NADs) isolate DNS traffic paths for different domain zones, such as OAM and Signaling. CoreDNS pods must not be running on control nodes when this feature is enabled, it must be restricted to worker nodes only, ensuring that DNS requests are handled within the local cluster network before being forwarded to external DNS servers.

DNS traffic is routed through specific CNLB interfaces, enabling detailed control over egress traffic and supporting customer-specific routing rules to ensure each zone's traffic uses a secure and dedicated path.

> **Note**
>
> - The cluster should be CNLB enabled.
> - External IPs of the DNS servers will be provided and maintained by the Customers.
> - During the implementation of the DNS enhancement procedure, CNE cluster may experience a momentary service disruption due to transient DNS lookup unavailability affecting Network Functions (NFs) and other dependent components during the configuration switchover. The disruption is brief and self-limiting, with services expected to automatically stabilize upon completion of the procedure.

> **Note**
>
> After activating the flow, no issues have been observed during subsequent self-update and upgrade processes. All components continue to function as expected. Additionally, the ConfigMap changes for NodeLocalDNS and CoreDNS remain intact.

Switch DNS Routing using CNLB

Switching DNS routing to utilize the Cloud Native Load Balancer (CNLB) improves scalability and reliability. The switchover procedure involves the following steps:

1. Determining the active Bastion Host
2. Defining variables to configure the External DNS server and zone settings in occne.ini
3. Enabling TLS in zones
4. Enabling DNS enhancement

7.12.1 Determining Active Bastion Host

1. Log in to either Bastion Host (typically Bastion 1).
2. Check if the Bastion Host is hosting the active cluster services by running the following command:

   ```
   $ is_active_bastion
   ```

   Sample output:

   ```
   IS active-bastion
   ```

3. If the current Bastion is not active, log out and connect to the mate Bastion Host.
4. Repeat the check using the same command:

   ```
   $ is_active_bastion
   ```

   Sample output:

   ```
   IS active-bastion
   ```

5. Confirm that the Bastion is hosting active services before proceeding with any further actions.

7.12.2 Defining Variables for External DNS Server

Populate the required values in the `occne.ini` file.

For this step, ensure the following values are correctly populated under the `[occne:vars]` section of the `occne.ini` file:

Table 7-27 Variables for External DNS Server

Field Name	Description	Required/Optional	Structure	Notes
enable_dns_enhancement	This field enables the DNS enhancement flow when set to `True`.	Required	`enable_dns_enhancement: True`	• Boolean value • Set to True to activate DNS enhancement logic • Set to False for rollout the DNS enhancement
upstream_dns_servers	Indicates if any request that does not match the zones defined in `coredns_external_zones` will be forwarded to these upstream servers for resolution.	Required	`upstream_dns_servers: ["IP1"]`	• Must be a list of IP addresses • If not set, non-matching queries will fail • Can include multiple IPs
coredns_egress_nad	Indicates the list of Network Attachment Definitions (NADs) for routing CoreDNS egress traffic.	Required	`coredns_egress_nad = ["default/nad-egr@nad-egr"]`	• Traffic is routed through CNLB interfaces • Can include one or more NAD names
coredns_external_zones	Each entry is a combination of the fields: zones, nameservers, and cache used to define how specific DNS queries must be resolved using external DNS servers.	Required	`coredns_external_zones = [{"cache": 30,"zones": ["zone1"],"nameservers":["IP1"]}]`	• JSON array defining zone names, caching TTL, and their corresponding nameservers. Must be a valid stringified JSON. • defines a list of external DNS zones and their respective upstream nameservers to which CoreDNS will forward matching queries, optionally with rewrite rules.

The following table lists the fields to be added to the `coredns_external_zones` variable.

Table 7-28 `coredns_external_zones` Fields

Field Name	Description	Required/Optional	Structure	Notes
zones	List of zones (domains) for which DNS queries should be forwarded	Required	"zones": ["zone1"]	• Must be a list of strings • Multiple zones can be added as part of this list
nameservers	List of External DNS server IPs to which these zone queries should be forwarded	Required	"nameservers": ["IP1"]	• Must be a list of valid IP addresses • Multiple entries are supported
cache	TTL (in seconds) for caching responses from the DNS servers	Required	"cache": 30	• Cache cannot be 0 or a negative number • Useful to reduce DNS resolution time for frequently queried domains
rewrite	Rules to rewrite DNS queries before forwarding (for example, changing domain names)	Optional	"rewrite": ["rule1", "rule2"]	• Must be a list of strings • List of rewrite rules • Each rule follows CoreDNS syntax

Example:

```
[occne:vars]
enable_dns_enhancement = True
upstream_dns_servers = ["10.**.**.**"]
coredns_egress_nad = ["default/egr-nad-name@egr-nad-name"]
coredns_external_zones = [{"zones":
["example1.com","example2.io:1053"],"nameservers":
["1.1.1.1","2.2.2.2"],"cache":5},{"zones":
["examplesvc1.local:4453"],"nameservers":["192.168.0.53"],"cache":9},{"zones":
["exampledomain.tld"],"nameservers":["10.233.0.3"],"cache":5,"rewrite":["name
stop example.tld example.namespace.svc.cluster.local"]}]
```

Note

- Ensure that zones are written entirely in lowercase letters.
- The `enable_dns_enhancement` parameter requires an exact boolean value of True (case-sensitive) to activate DNS enhancement. Any deviation from this value, such as true or 1, will result in the feature being disabled.
- DNS enhancement feature can also be enabled along with local DNS feature.
- If `enable_dns_enhancement` is set to `True`, then all the other 3 variables are required, else it will fail.

7.12.3 Enabling TLS in Zones

This section explains how to enable TLS for secure communication in the DNS Enhancement setup.

If TLS is not required for communication between CoreDNS and external DNS servers, this section can be skipped.

CoreDNS supports TLS connections with external DNS servers. DNS enhancement allows to enable TLS in each zone independently.

Enabling TLS in Zones

1. Edit the `occne.ini` file in the cluster directory.

   ```
   $ vi /var/occne/cluster/${OCCNE_CLUSTER}/occne.ini
   ```

2. To enable TLS in DNS enhancement, a JSON Object named `tls` must be defined in the `coredns_external_zones` variable.

   The following table lists the fields to be added to the `tls` JSON Object.

Table 7-29 tls JSON Object Variables

Field	Description	Required/ Optional	Structure	Notes
tls_port	Port used for communication with the external DNS server via TLS	Optional	"tls_port": "port_number"	• Default port for TLS is 853 • Other port numbers may be used
tls_servername	Server name of the external DNS server used during the TLS handshake.	Required	"tls_servername": "server_name"	• Used to validate certificates for TLS handshake

Table 7-29 (Cont.) tls JSON Object Variables

Field	Description	Required/ Optional	Structure	Notes
tls_key_path	Relative path of client's key used during the TLS handshake.	Optional	"tls_key_path": "client.key"	• Depends on the TLS configuration of the external DNS server • If defined, tls_crt_path must be also defined • When omitted, no client authentication is performed • The TLS client key must be created or located under the /var/occne/cluster/${OCCNE_CLUSTER}/installer/dns_enhancement directory. Sub directories are allowed.

Table 7-29 (Cont.) tls JSON Object Variables

Field	Description	Required/ Optional	Structure	Notes
tls_crt_path	Relative path of client's cert used during the TLS handshake.	Optional	"tls_crt_path": "client.crt"	• Depends on the TLS configuration of the external DNS server • If defined, tls_key_path must be also defined • When omitted, no client authentication is performed • The TLS client cert must be created or located under the `/var/occne/cluster/${OCCNE_CLUSTER}/installer/dns_enhancement` directory. Sub directories are allowed.

Table 7-29 (Cont.) tls JSON Object Variables

Field	Description	Required/ Optional	Structure	Notes
tls_ca_path	Relative path of CA cert used during the TLS handshake.	Optional	"tls_ca_path": "ca.crt"	• Depends on the TLS configuration of the external DNS server • Can be used without defining tls_crt_path and tls_key_path. • The TLS CA cert must be created or located under the `/var/occne/cluster/${OCCNE_CLUSTER}/installer/dns_enhancement` directory. Sub directories are allowed.

> **Note**
>
> - TLS configuration requires zones that have it enabled, to only have one nameserver defined.
> - Ensure that `tls_servername` is always defined in the zones that have TLS enabled.
> - If `tls_key_path`, `tls_crt_path`, or `tls_ca_path` uses subdirectories, the value must be specified using the following directory structure:
>
>   ```
>   sub_directory/second_sub_directory/client_key_crt_or_ca_crt
>   ```
>
>   Following is an example TLS configuration:
>
>   ```
>   [occne:vars]....coredns_external_zones = [{"zones":
>   ["example1.com","example2.io:1053"],"nameservers":
>   ["1.1.1.1"],"cache":5,"tls":
>   {"tls_port":"853","tls_key_path":"example1_zone_keys/
>   coredns.key","tls_crt_path":"example1_zone_keys/certs/
>   coredns.crt","tls_servername":"example.local"}},{"zones":
>   ["examplesvc1.local:4453"],"nameservers":
>   ["192.168.0.53"],"cache":5},{"zones":
>   ["exampledomain.tld"],"nameservers":
>   ["10.233.0.3"],"cache":5,"tls":
>   {"tls_ca_path":"ca.crt","tls_servername":"exampledomain.local"},"
>   rewrite":["name stop example.tld
>   example.namespace.svc.cluster.local"]}]
>   ```

7.12.4 Enabling DNS Enhancement

The `coreDnsEnhancement.py` script is used to enable the DNS enhancement feature.

This script automates the necessary configuration steps to update CoreDNS and related components as part of the DNS enhancement process.

Enabling DNS Enhancement

1. Navigate to the cluster directory.

   ```
   cd /var/occne/cluster/${OCCNE_CLUSTER}
   ```

2. Run the `coreDnsEnhancement.py` script.
   The coreDnsEnhancement.py script configures and enhances the DNS setup based on the `occne.ini` file configurations.

   ```
   ./installer/dns_enhancement/coreDnsEnhancement.py
   ```

   Sample output:

   ```
   2025-07-24 09:06:55,077 CNLB_LOGGER:INFO: step-1: Load ini file into file
   parser
   2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: step-2: Check for
   ```

```
enable_dns_enhancement parameter
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: step-3: Check for
upstream_dns_servers parameter
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: upstream_dns_servers is defined
with value: ['10.75.200.13']
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: step-4: Check for
coredns_egress_nad parameter
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: coredns_egress_nad is defined
with value: ['default/nf-oam-egr2@nf-oam-egr2']
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: NAD to be attached to coredns
is: nf-oam-egr2
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: step-5: Check for
coredns_external_zones parameter
2025-07-24 09:06:55,078 CNLB_LOGGER:INFO: step-6: Take back up of
configurations
2025-07-24 09:06:55,273 CNLB_LOGGER:INFO: step-7: Run kubernetes pipeline
to update coreDNS
2025-07-24 09:07:37,107 CNLB_LOGGER:INFO: step-8: update the zones file
with new data
2025-07-24 09:07:37,113 CNLB_LOGGER:INFO: step-9: restart resources for
adoption of changes
2025-07-24 09:07:37,322 CNLB_LOGGER:INFO: step-10: push dns validation
image to occne-repo-host
2025-07-24 09:07:42,134 CNLB_LOGGER:INFO: SUCCESS: DNS is enhanced, now
coredns can reach external zones
```

Using `coreDnsEnhancement.py` script:

```
[cloud-user@occne-cluster-name-bastion-1 cluster-name]$ ./installer/
dns_enhancement/coreDnsEnhancement.py -h
usage: coreDnsEnhancement.py [-h] [-nn TESTNODENAME] [-t TESTRECORD] [-sz]
[-d]

Used to update the network on an existing CNLB deployment.
Parameters:
  Required parameters:
    None

  Optional Parameters:
    -nn/--testNodeName: Node to be used for testing the DNS query (allowed
only with -t)
    -t/--testRecord: runs test only
    -sz/--syncZoneFile: Only syncs external zone file in bastion host
    -d/--debugOn: sets the debug level as On
```

Following are some example arguments that can be passed with the script:

```
./coreDnsEnhancement.py
     ./coreDnsEnhancement.py -nn k8s-node-1 -t testrecord.oam
     ./coreDnsEnhancement.py -t testrecord.oam
     ./coreDnsEnhancement.py -sz
     ./coreDnsEnhancement.py -d
```

Following are some of the optional arguments:

- -h, --help show this help message and exit
- -nn TESTNODENAME, --testNodeName TESTNODENAME Node used for testing the DNS query
- -t TESTRECORD, --testRecord TESTRECORD runs only test of enhancement for the given record
- -sz, --syncZoneFile only syncs the zone file in bastion host
- -d, --debugOn sets the log level as Debug

> **Note**
>
> - The `-sz` argument syncs the zone file in Bastion host with the `occne.ini` file.
> - Test node name can only be sent with the `-t` option, else it will be ignored and the setup proceeds with the default parameters.
>
> ```
> ./installer/dns_enhancement/coreDnsEnhancement.py -t <zonename> -nn
> k8s-node-1
> ```

3. **Testing DNS Resolution**:

   The DNS enhancement script includes a testing feature that enables verification of DNS resolution for a specified zone name. To perform a DNS test, run the script with the `-t` option followed by a valid zone name.
   Example 1:

   ```
   ./installer/dns_enhancement/coreDnsEnhancement.py -t testrecord.abc
   ```

   Sample output:

   ```
   2025-07-24 09:11:45,489 CNLB_LOGGER:INFO: Update configurations in
   validationPod.yaml and kubectl apply it.
   2025-07-24 09:11:49,845 CNLB_LOGGER:INFO: waiting for dnsvalidation pod to
   be up
   2025-07-24 09:11:50,265 CNLB_LOGGER:INFO: nslookup of testrecord.pranavs,
   result: Server:              169.254.25.10
   Address:        169.254.25.10#53

   Name:   testrecord.abc
   Address: 10.4.1.8
   Name:   testrecord.abc
   Address: abbb:abbb::1
   2025-07-24 09:11:50,265 CNLB_LOGGER:INFO: Deleting the temporary test pod
   ```

   Example 2:

   ```
   ./installer/dns_enhancement/coreDnsEnhancement.py -t dns1.abc
   ```

   Sample output:

   ```
   2025-07-24 09:13:45,955 CNLB_LOGGER:INFO: Update configurations in
   ```

```
validationPod.yaml and kubectl apply it.
2025-07-24 09:13:47,128 CNLB_LOGGER:INFO: waiting for dnsvalidation pod to
be up
2025-07-24 09:13:47,488 CNLB_LOGGER:INFO: nslookup of dns1.abc, result:
Server:             169.254.25.10
Address:        169.254.25.10#53

Name:   dns1.abc
Address: 10.4.1.1
2025-07-24 09:13:47,488 CNLB_LOGGER:INFO: Deleting the temporary test pod
```

This test checks DNS resolution for the specified zone name and provides insight into the functionality of the DNS enhancement. Additionally, the `-nn` option can be used to specify a particular node to test DNS connectivity, allowing for more targeted testing. For example:

```
./installer/dns_enhancement/coreDnsEnhancement.py -t <zonename> -nn
<node_name>
```

7.12.5 Verifying Packet Flow Through the CNLB Interface

This section explains about verifying packet flow through the CNLB interface to monitor network traffic in cloud-native environments.

1. Run the following command to get the coredns pod IPs (nf-oam-egr2):

```
kubectl -n kube-system describe po -l k8s-app=kube-dns | grep -A3 egr2

                            "name": "default/nf-oam-egr2",
                            "interface": "nf-oam-egr2",
                            "ips": [
                                "132.16.0.142"
                            ],
--
                      k8s.v1.cni.cncf.io/networks: default/nf-oam-egr2@nf-
oam-egr2
                      kubectl.kubernetes.io/restartedAt:
2025-04-03T09:10:41Z
Status:               Running
SeccompProfile:       RuntimeDefault
--
                            "name": "default/nf-oam-egr2",
                            "interface": "nf-oam-egr2",
                            "ips": [
                                "132.16.0.139"
                            ],
--
                      k8s.v1.cni.cncf.io/networks: default/nf-oam-egr2@nf-
oam-egr2
                      kubectl.kubernetes.io/restartedAt:
2025-04-03T09:10:41Z
Status:               Running
SeccompProfile:       RuntimeDefault
```

In the above sample output, the coredns pod IPs are `132.16.0.142` and `132.16.0.139`.

2. Run the following command to get the gateway IP from the net-attach-definition configuration:

```
kubectl describe net-attach-def nf-oam-egr2
```

Sample output:

```
Name:         nf-oam-egr2
Namespace:    default
Labels:       <none>
Annotations:  <none>
API Version:  k8s.cni.cncf.io/v1
Kind:         NetworkAttachmentDefinition
Metadata:
  Creation Timestamp:  2025-04-01T08:39:54Z
  Generation:          2
  Resource Version:    985125
  UID:                 75c9c2ef-141b-49b7-929e-93fb16cc2d67
Spec:
  Config:  {"cniVersion": "0.4.0", "name": "nf-oam-egr2", "plugins":
[{"type": "macvlan", "mode": "bridge", "master": "eth2", "ipam": {"type":
"whereabouts", "range": "132.16.0.0/24", "range_start": "132.16.0.129",
"range_end": "132.16.0.190", "gateway": "132.16.0.194", "routes": [{"dst":
"10.75.201.0/24", "gw": "132.16.0.194"}]}}]}
Events:    <none>
```

In the above sample output, the gateway IP is `132.16.0.194`.

3. Run the following command to get the pods IP using the gateway IP:

```
$ kubectl -n occne-infra exec -it $(kubectl -n occne-infra get po --no-
headers -l app=cnlb-manager -o
      custom-columns=:.metadata.name) -- curl http://localhost:5001/net-
info | python -m json.tool | jq
```

Sample output:

```
{
  "10.233.68.72": [
    {
      "egressIpExt": "10.75.200.91",
      "gatewayIp": "132.16.0.193",
      "networkName": "oam"
    }
  ],
  "10.233.68.73": [
    {
      "egressIpExt": "10.75.200.12",
      "gatewayIp": "132.16.0.194",
      "networkName": "oam"
    }
  ]
}
```

From the above sample output the pod IP is `10.233.68.73`.

4. Run the following command to retrieve the pod name using the pod IP:

   ```
   $ kubectl -n occne-infra get po -l app=cnlb-app -o wide | grep <active
   cnlb app ip>
   ```

   Sample output:

   ```
   cnlb-app-fd566bffb-mhmg2   1/1     Running   0          145m
   10.233.68.73
         occne3-prince-p-pranav-k8s-node-4   <none>
   ```

5. Get into the active pod to monitor the traffic.
   The pod whose name matches the IP address is the current active one, where traffic can be monitored. To do so, run the following commant in the same pod and monitor the traffic while performing the queries.

   ```
   kubectl -n occne-infra exec -it <POD_NAME> -- bash
   ```

6. Run the following command to capture the packets:

   ```
   bash-5.1# tcpdump -i lb-oam-int port 53 and udp -n -vv
   ```

   Sample output:

   ```
   dropped privs to tcpdump
   tcpdump: listening on lb-oam-int, link-type EN10MB (Ethernet), snapshot
   length 262144 bytes09:13:49.476867 IP (tos 0x0, ttl 64, id 60831, offset
   0, flags [DF], proto UDP (17), length 75)
       132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 50867+ [1au] A?
   testrecord.pranavs. ar: . OPT UDPsize=2048 DO (47)
   09:13:49.479133 IP (tos 0x0, ttl 61, id 19793, offset 0, flags [none],
   proto UDP (17), length 91)
       10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 50867* q: A?
   testrecord.pranavs. 1/0/1 testrecord.pranavs. A 10.4.1.8 ar: . OPT
   UDPsize=1232 DO (63)
   09:13:49.480514 IP (tos 0x0, ttl 64, id 60832, offset 0, flags [DF], proto
   UDP (17), length 75)
       132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 676+ [1au]
   AAAA? testrecord.pranavs. ar: . OPT UDPsize=2048 DO (47)
   09:13:49.481049 IP (tos 0x0, ttl 61, id 19794, offset 0, flags [none],
   proto UDP (17), length 103)
       10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 676* q: AAAA?
   testrecord.pranavs. 1/0/1 testrecord.pranavs. AAAA abbb:abbb::1 ar: . OPT
   UDPsize=1232 DO (75)
   09:13:49.701706 IP (tos 0x0, ttl 64, id 60833, offset 0, flags [DF], proto
   UDP (17), length 73)
       132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 65302+ [1au] A?
   ipv6test.pranavs. ar: . OPT UDPsize=2048 DO (45)
   09:13:49.702754 IP (tos 0x0, ttl 61, id 19871, offset 0, flags [none],
   proto UDP (17), length 125)
       10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 65302* q: A?
   ipv6test.pranavs. 0/1/1 ns: pranavs. SOA dns1.pranavs. hostmaster.pranavs.
   3001 21600 3600 604800 86400 ar: . OPT UDPsize=1232 DO (97)
   ```

```
09:13:49.704475 IP (tos 0x0, ttl 64, id 60834, offset 0, flags [DF], proto
UDP (17), length 73)
    132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 63895+ [1au]
AAAA? ipv6test.pranavs. ar: . OPT UDPsize=2048 DO (45)
09:13:49.704855 IP (tos 0x0, ttl 61, id 19873, offset 0, flags [none],
proto UDP (17), length 101)
    10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 63895* q: AAAA?
ipv6test.pranavs. 1/0/1 ipv6test.pranavs. AAAA abbb:abbb::2 ar: . OPT
UDPsize=1232 DO (73)
09:13:49.825753 IP (tos 0x0, ttl 64, id 60835, offset 0, flags [DF], proto
UDP (17), length 70)
    132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 5680+ [1au] A?
alias.pranavs. ar: . OPT UDPsize=2048 DO (42)
09:13:49.826438 IP (tos 0x0, ttl 61, id 19888, offset 0, flags [none],
proto UDP (17), length 111)
    10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 5680* q: A?
alias.pranavs. 2/0/1 alias.pranavs. CNAME testrecord.pranavs.,
testrecord.pranavs. A 10.4.1.8 ar: . OPT UDPsize=1232 DO (83)
09:13:49.942999 IP (tos 0x0, ttl 64, id 60836, offset 0, flags [DF], proto
UDP (17), length 64)
    132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 34442+ [1au]
MX? pranavs. ar: . OPT UDPsize=2048 DO (36)
09:13:49.943851 IP (tos 0x0, ttl 61, id 19911, offset 0, flags [none],
proto UDP (17), length 101)
    10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 34442* q: MX?
pranavs. 1/0/2 pranavs. MX mail.pranavs. 10 ar: mail.pranavs. A
10.4.1.15, . OPT UDPsize=1232 DO (73)
09:13:50.067124 IP (tos 0x0, ttl 64, id 60837, offset 0, flags [DF], proto
UDP (17), length 64)
    132.16.0.142.58822 > 10.75.201.36.domain: [udp sum ok] 30499+ [1au]
TXT? pranavs. ar: . OPT UDPsize=2048 DO (36)
09:13:50.067926 IP (tos 0x0, ttl 61, id 20007, offset 0, flags [none],
proto UDP (17), length 104)
    10.75.201.36.domain > 132.16.0.142.58822: [udp sum ok] 30499* q: TXT?
pranavs. 1/0/1 pranavs. TXT "v=spf1 ip4:10.4.1.0/24 -all" ar: . OPT
UDPsize=1232 DO (76)
^C
14 packets captured
14 packets received by filter
0 packets dropped by kernel
```

> **Note**
>
> To capture the above packets, DNS server's external IP must be in the range of **egress_dest = ["10.*.*.*/25"],** defined in the `cnlb.ini` file. If it doesn't, change the egress_dest with the required subnet range and run `updNtework.py`. Delete (or restart) each coredns pod manually so that the new annotation can take effect. The tcpdump command does not process any traffic until pods are restarted.

7.12.6 Rolling back coredns and nodelocaldns deployment and configmap

This section explains how to rollback CoreDNS deployment and nodelocaldns deployment, as well as any associated ConfigMap or zone files that were modified or added. This ensures that the DNS resolution returns to its original state before the changes were made.

1. Run the following command to change the directories to the cluster directory:

   ```
   cd /var/occne/cluster/${OCCNE_CLUSTER}
   ```

2. The following values must be modified under `[occne:vars]` in the `occne.ini` file:

   ```
   [occne:vars]
   enable_dns_enhancement = False
   #upstream_dns_servers = ["10.**.**.**"]
   #coredns_egress_nad = ["default/egr-nad-name@egr-nad-name"]
   #coredns_external_zones = [{"cache": 30,"zones":["sample1"],"nameservers":
   ["10.**.**.**"]}]
   ```

3. After commenting the above variables in occne.ini file, run the script `coreDnsEnhancement.py` to trigger cleanup:

   ```
   ./installer/dns_enhancement/coreDnsEnhancement.py
   ```

   Sample output:

   ```
   2025-07-21 13:11:28,230 CNLB_LOGGER:INFO: step-1: Load ini file into file
   parser
   2025-07-21 13:11:28,231 CNLB_LOGGER:INFO: step-2: Check for
   enable_dns_enhancement parameter
   2025-07-21 13:11:28,232 CNLB_LOGGER:INFO: step-3: Running cleanup since
   the enable_dns_enhancement variable is removed/made as False
   2025-07-21 13:11:28,682 CNLB_LOGGER:INFO: Ran ./tests/setupZones.sh -c in
   cloud-user@10.75.200.57 server
   2025-07-21 13:11:28,682 CNLB_LOGGER:INFO: running k8s pipeline to update
   coredns and nodelocaldns
   ```

7.12.7 Updating DNS Enhancement

In cases where the DNS enhancement setup script has already been run, and there is a need to either re-run the script without any changes or apply modifications to parameters in the occne.ini file such as nameservers, cache values, zone_name, or other configuration variables, the external_zones.yaml file generated under the dns_enhancement directory must be deleted prior to re-execution. This step ensures that any updated values are properly applied and prevents stale or conflicting configuration from previous runs.

7.12.8 Validating DNS Enhancement

To ensure the proper functioning of DNS Enhancement, it is necessary to check the following:

1. Ensure CoreDNS pods are in Running State
2. Verify CoreDNS ConfigMap
3. Ensure NodeLocalDNS pods are in Running State

Perform the following steps to validate DNS enhancement:

1. Ensure CoreDNS pods are in the running state. CoreDNS is an essential part of DNS enhancement therefore, CoreDNS pods must be healthy.

Run the following command to check the status of the CoreDNS pods:

```
$ kubectl -n kube-system get pod -l k8s-app=kube-dns
```

Sample output:

```
NAME                       READY   STATUS    RESTARTS   AGE
coredns-5965687c46-4hjfk   1/1     Running   0          13h
coredns-5965687c46-8q9d4   1/1     Running   0          13h
```

2. Review the CoreDNS pods logs. See ALL logs from both CoreDNS pods.

```
$ for pod in $(kubectl -n kube-system get pods | grep coredns | awk
'{print $1}'); do echo "----- $pod -----"; kubectl -n kube-system
logs $pod; done
```

Sample output:

```
----- coredns-8ddb9dc5d-5nvrv -----
[INFO] plugin/ready: Still waiting on: "kubernetes"
[INFO] plugin/auto: Inserting zone `occne.lab.oracle.com.' from: /etc/
coredns/..2023_04_12_16_34_13.510777403/db.occne.lab.oracle.com
.:53
[INFO] plugin/reload: Running configuration SHA512 =
2bc9e13e66182e6e829fe1a954359de92746468f433b8748589dfe16e1afd0e790e1ff75415
ad40ad17711abfc7a8348fdda2770af99962db01247526afbe24a
CoreDNS-1.9.3
linux/amd64, go1.18.2, 45b0a11
----- coredns-8ddb9dc5d-6lf5s -----
[INFO] plugin/auto: Inserting zone `occne.lab.oracle.com.' from: /etc/
coredns/..2023_04_12_16_34_15.930764941/db.occne.lab.oracle.com
.:53
[INFO] plugin/reload: Running configuration SHA512 =
2bc9e13e66182e6e829fe1a954359de92746468f433b8748589dfe16e1afd0e790e1ff75415
ad40ad17711abfc7a8348fdda2770af99962db01247526afbe24a
CoreDNS-1.9.3
linux/amd64, go1.18.2, 45b0a11

### TIP ###
# Additionally, the above command can be piped to a file, for better
readability and sharing purposes.
$ for pod in $(kubectl -n kube-system get pods | grep coredns | awk
'{print $1}'); do echo "----- $pod -----"; kubectl -n kube-system
logs $pod; done > coredns.logs
$ vi coredns.logs
```

3. Run the following command to verify the changes implemented by DNS Enhancement that can be viewed in the CoreDNS ConfigMap:

```
$ kubectl -n kube-system get cm coredns -o yaml
```

Sample output:

```
apiVersion: v1
data:
  Corefile: |
    example.com {
        log
        errors {
        }
        forward . tls://10.95.18.61:853 {
          tls /etc/ssl/example-com/tls.crt /etc/ssl/example-com/
tls.key /etc/ssl/example-com/ca.crt
          tls_servername named.local
        }
        loadbalance
        cache 5
        reload
    }
    test.com {
        log
        errors {
        }
        forward . tls://10.12.15.16 {
          tls /etc/ssl/test-com/tls.crt /etc/ssl/test-com/tls.key /etc/ssl/
test-com/ca.crt
          tls_servername named.local
        }
        loadbalance
        cache 5
        reload
    }
    .:53 {
        errors {
        }
        health {
            lameduck 5s
        }
        ready
        kubernetes occne-example in-addr.arpa ip6.arpa {
          pods insecure
          fallthrough in-addr.arpa ip6.arpa
        }
        prometheus :9153
        forward . 10.75.144.85 {
          prefer_udp
          max_concurrent 1000
        }
        cache 30

        loop
        reload
        loadbalance
    }
kind: ConfigMap
metadata:
  annotations:
```

```
    kubectl.kubernetes.io/last-applied-configuration: |
      {"apiVersion":"v1","data":{"Corefile":"example.com {\n    log\n
errors {\n    }\n    forward . tls://10.75.180.161:853 {\n
tls /etc/ssl/example-com/tls.crt /etc/ssl/example-com/tls.key /etc/ssl/
example-com/ca.crt\n      tls_servername named.local\n    }\n
loadbalance\n    cache 5\n    reload\n}\ntest.com {\n    log\n    errors
{\n    }\n    forward . tls://10.75.180.161 {\n      tls /etc/ssl/test-com/
tls.crt /etc/ssl/test-com/tls.key /etc/ssl/test-com/ca.crt\n
tls_servername named.local\n    }\n    loadbalance\n    cache 5\n
reload\n}\n.:53 {\n    errors {\n    }\n    health {\n        lameduck
5s\n    }\n    ready\n    kubernetes occne-example in-addr.arpa ip6.arpa
{\n      pods insecure\n      fallthrough in-addr.arpa ip6.arpa\n    }
\n    prometheus :9153\n    forward . 10.75.144.85 {\n
prefer_udp\n      max_concurrent 1000\n    }\n    cache 30\n\n
loop\n    reload\n    loadbalance\n}\n"},"kind":"ConfigMap","metadata":
{"annotations":{},"labels":{"addonmanager.kubernetes.io/
mode":"EnsureExists"},"name":"coredns","namespace":"kube-system"}}
  creationTimestamp: "2025-07-31T20:51:39Z"
  labels:
    addonmanager.kubernetes.io/mode: EnsureExists
  name: coredns
  namespace: kube-system
  resourceVersion: "1654250"
  uid: c5a4a0b6-3795-43ae-b0c2-1ec52212d0f5
```

4. Run the following command to ensure that NodeLocalDNS pods are in running state:

   ```
   $ kubectl -n kube-system get pod -l k8s-app=node-local-dns
   ```

   Sample output:

   ```
   NAME                  READY   STATUS    RESTARTS   AGE
   nodelocaldns-65657    1/1     Running   0          14h
   nodelocaldns-6hzn6    1/1     Running   0          14h
   nodelocaldns-8lrd7    1/1     Running   0          14h
   nodelocaldns-jdxct    1/1     Running   0          14h
   nodelocaldns-ktjsx    1/1     Running   0          14h
   nodelocaldns-qfvjx    1/1     Running   0          14h
   nodelocaldns-xcn7j    1/1     Running   0          14h
   ```

7.13 Enabling Public Endpoint for CNE (Kubernetes) API Server

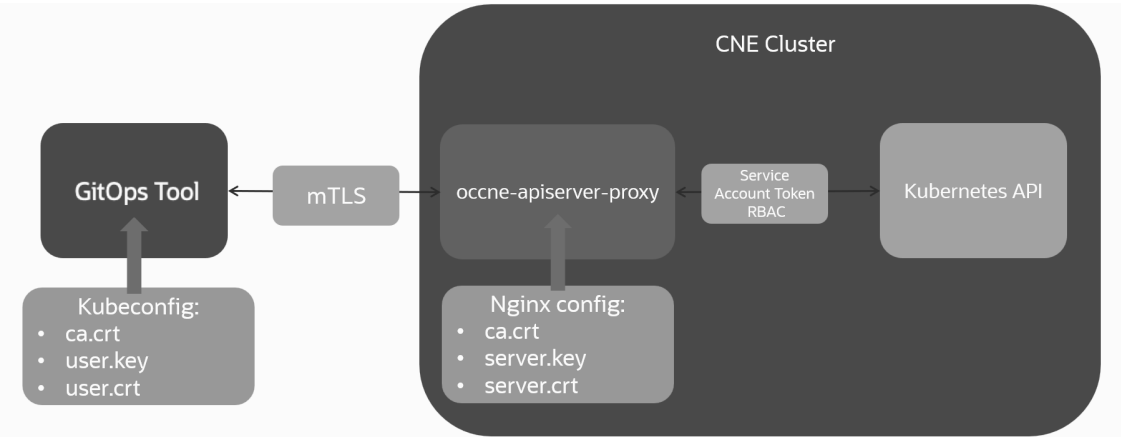
This section provides an overview of the implementation for exposing the Kubernetes API Server as a public endpoint.

The *occne-apiserver-proxy* service is designed to enable GitOps integration by exposing the Kubernetes API Server to an external network. This is achieved by deploying an nginx pod configured as a reverse proxy with mTLS encryption. The nginx proxy securely redirects incoming external traffic to the Kubernetes API Server, while CNLB (Cloud Native Load Balancer) manages ingress to the Kubernetes control plane.

> **Note**
>
> After enabling `occne-apiserver-proxy`, any client certificate signed by the same CA that signed the server certificate will be accepted and will grant full administrative access to the CNE cluster.

Users accessing the public endpoint are required to authenticate using mTLS. In the current release, the nginx proxy uses a service account token with cluster admin-level privileges.

Figure 7-2 CNE Cluster



> **Note**
>
> Ensure that all certificate files are generated and signed by the same Certificate Authority (CA).

Prerequisites

To enable the mTLS communication for the `occne-apiserver-proxy` service, the following three files are required:

- CA certificate
- Server key
- Server certificate

The CA certificate, server key, and server certificate must be generated and signed by the same Certificate Authority (CA) that is used to create the user certificates for communication with the `occne-apiserver-proxy`.

Examples on how to create keys and certificates

The following are examples about how to create keys and certificates but can vary according to the CA and the algorithm that will be used to create them.

Example 1: Create a nginx server's key and certificate

Following is an example about how to create a service key and certificate using a Certificate Authority (CA) key.

```
$ cat server.conf
```

Sample output:

```
[ req ]
default_bits = 2048
distinguished_name = req_distinguished_name
req_extensions = req_ext
prompt = no

[ req_distinguished_name ]
C = US
ST = NC
L = Morrisville
O = Oracle
CN = occne6-cluster-apiserver-proxy # This should match the name that will be
resolved to the occne-apiserver-proxy in the DNS servers

[ req_ext ]
subjectAltName = @alt_names
keyUsage = critical, digitalSignature, keyEncipherment
extendedKeyUsage = serverAuth
basicConstraints = critical, CA:FALSE

[ alt_names ]
DNS.1 = lb-apiserver.kubernetes.local # DNS entry
DNS.2 = OCCNE_CLUSTER-apiserver-proxy
IP.1 = 10.75.200.111 # The actual IP for the occne-apiserverver-proxy
```

Creating nginx key and certificate:

```
$ openssl genrsa -out server.key 4096
$ openssl req -new -key server.key -out server.csr -config server.conf
$ openssl x509 -req -in server.csr -CA ca.crt -CAkey ca_private.key -
CAcreateserial -out server.crt -days 365 -extensions req_ext -extfile
server.conf -passin pass:${CA_KEY_PASS}
```

Example 2: Create a user's key and certificate
Following is an example about how to create an user key and certificate using a Certificate Authority (CA) key:

```
$ cat client.conf
```

Sample output:

```
[ req ]
default_bits = 2048
distinguished_name = req_distinguished_name
req_extensions = req_ext
prompt = no[ req_distinguished_name ]
```

```
C = US
ST = NC
L = Morrisville
O = Oracle
CN = client.OCCNE_CLUSTER-apiserver-proxy

[ req_ext ]
keyUsage = critical, digitalSignature, keyEncipherment
extendedKeyUsage = clientAuth
basicConstraints = critical, CA:FALSE
```

Creating nginx key and certificate:

```
$ openssl genrsa -out client.key 4096
$ openssl req -new -key client.key -out client.csr -config client.conf
$ openssl x509 -req -in client.csr -CA ca.crt -CAkey ca_private.key -
CAcreateserial -out client.crt -days 365 -extensions req_ext -extfile
client.conf  -passin pass:${CA_KEY_PASS}
```

Limitations

> **Note**
>
> Once `occne-apiserver-proxy` is enabled, any client certificate signed by the same CA used to sign the server certificate will be trusted and will grant full administrative access to the CNE cluster.

1. CNE will not be in charge of creating or maintaining the certificates that will be used to connect to the occne-apiserver-proxy, instead, these certificates and keys will be provided, maintained and rotated by the OCCNE CLUSTER ADMINISTRATOR.
2. For Kubernetes API exposure, the nginx proxy uses a service account token which has cluster administrator equivalent privileges. Treat these certificates and access credentials with extreme caution as they grant full administrative control over the Kubernetes cluster.

7.13.1 Enabling occne-apiserver-proxy Service

Perform the following steps to enable `occne-apiserver-proxy` service:

1. **Provide required certificates**
   a. Create a directory to store the certificates. Run the following command on the bootstrap host to enable the service during installation, or on the Bastion host to enable it during an upgrade.
   Create certificates directory

   ```
   mkdir -m 700 -p /var/occne/certificates/occne-apiserver-proxy
   ```

   b. Place the certificates into the bootstrap or Bastion host. Run the following command to copy nginx server's key and certificate:

   ```
   $ scp <user>@<system>:/<path_to_certificates>/ca.crt <user>@<bootstrap/
   bastion_ip>:/var/occne/certificates/occne-apiserver-proxy/
   $ scp <user>@<system>:/<path_to_certificates>/server.key
   ```

```
<user>@<bootstrap/bastion_ip>:/var/occne/certificates/occne-apiserver-
proxy/
$ scp <user>@<system>:/<path_to_certificates>/server.crt
<user>@<bootstrap/bastion_ip>:/var/occne/certificates/occne-apiserver-
proxy/
```

2. **Configure `occne-apiserver-proxy` service**
   a. Edit the `occne.ini` file to enable the `occne-apiserver-proxy` and specify the IP address that will be used for access.

      ```
      $ vi /var/occne/cluster/${OCCNE_CLUSTER}/occne.ini
      ```

      Sample output:

      ```
      ... TRUNCATED ...
      occne_apiserver_cnlb = 10.75.200.111

      ... TRUNCATED ...

      # Specify 'True' (case matters, no quotes) to expose occne apiserver
      proxy publicly. Default is 'False'
      occne_apiserver_proxy_enabled = True
      ... TRUNCATED ...
      ```

   b. Ensure that the IP for the service is also defined in `cnlb.ini` file. Run the following command to enable the service as a standalone procedure:

      ```
      $ vi /var/occne/cluster/${OCCNE_CLUSTER}/cnlb.ini
      ```

      Sample output:

      ```
      ... TRUNCATED ...
      [oam:vars]
      ...
      service_ip_addr = [<IPs for other services>,"10.75.200.111"]
      ... TRUNCATED ...
      ```

3. **Enable occne-apiserver-proxy**
   a. **Enable occne-apiserver-proxy during CNE cluster installation and upgrades**:
      To enable the `occne-apiserver-proxy` service during CNE installation or upgrade, proceed with the standard installation or upgrade procedure.
   b. **Enable `occne-apiserver-proxy` as a standalone procedure**:
      To enable the service, run the following steps:
      i. If you added a new IP to the `service_ip_addr` variable in `cnlb.ini`, run the network upgrade script to create a new NetworkAttachmentDefinition for the service. if the IP used for the occne-apiserver-proxy already exists, skip this step.

         ```
         cd /var/occne/cluster/${OCCNE_CLUSTER}/
         ./installer/updNetwork.py
         ```

ii. Run the `pipeline.sh` script for installing the `occne-apiserver-proxy` deployment and its dependencies:

```
OCCNE_STAGES=(DEPLOY) OCCNE_CONTAINERS=(CFG) OCCNE_ARGS="--
tags=apiserver-proxy" pipeline.sh
```

7.13.2 Using occne-apiserver-proxy

To utilize the **occne-apiserver-proxy** service, you'll need to gather some essential information:

1. **Retrieve occne-apiserver-proxy External Details**:
   On the cluster where the Kubernetes API is exposed, perform the following steps:

   a. **Obtain the Service's External IP**
   Retrieve the external IP address for **occne-apiserver-proxy**:

   ```
   kubectl -n occne-infra get pod -l app.kubernetes.io/name=apiserver-
   proxy -o jsonpath="{.items[].metadata.annotations['oracle\.com\.cnc\/
   cnlb']}" | jq -r '.[].cnlbIp'
   ```

   b. **Encode Keys and Certificates**
   Encode the required certificate files in base64:

   ```
   export ca_crt=$(cat ca.crt | base64 -w 0)
   export client_cert=$(cat client.crt | base64 -w 0)
   export client_key=$(cat client.key | base64 -w 0)
   ```

2. **Create kubeconfig file**
   On the external or secondary Kubernetes cluster:

   a. **Create a Kubeconfig to connect into the exposed API cluster**
   Render the kubeconfig file with the previously obtained values:

   ```
   apiVersion: v1
   clusters:
   - cluster:
       certificate-authority-data: <Value for $ca_cert>
       server: https://<Value for occne-apiserver-proxy IP>:6443
     name: <Value for $CLUSTER_NAME>
   contexts:
   - context:
       cluster: <Value for $CLUSTER_NAME>
       user: flux-user-<Value for $CLUSTER_NAME>
     name: flux-user-<Value for $CLUSTER_NAME>@<Value for $CLUSTER_NAME>
   current-context: flux-user-<Value for $CLUSTER_NAME>@<Value
   for $CLUSTER_NAME>
   kind: Config
   preferences: {}
   users:
   - name: flux-user-<Value for $CLUSTER_NAME>
     user:
       client-certificate-data: <Value for $client_cert>
       client-key-data: <Value for $client_key>
   ```

   b. **Connect to the exposed API cluster**

Use the `kubeconfig` file that was created in the previous step to connect to the Kubernetes cluster using the `occne-apiserver-proxy`:

```
kubectl --kubeconfig ~/external_kubeconfig.conf get nodes
```

Sample output:

```
NAME                        STATUS    ROLES           AGE   VERSION
occne-cluster-k8s-ctrl-1    Ready     control-plane   136m   v1.31.1
occne-cluster-k8s-ctrl-2    Ready     control-plane   136m   v1.31.1
occne-cluster-k8s-ctrl-3    Ready     control-plane   136m   v1.31.1
occne-cluster-k8s-node-1    Ready     <none>          135m   v1.31.1
occne-cluster-k8s-node-2    Ready     <none>          135m   v1.31.1
occne-cluster-k8s-node-3    Ready     <none>          135m   v1.31.1
occne-cluster-k8s-node-4    Ready     <none>          135m   v1.31.1
```

7.13.3 Customizing the Nginx Configuration

This section describes how to update the configmap that manages **nginx.conf** for occne-apiserver-proxy. This procedure is optional.

1. **Retrieve the Current Nginx Configuration**
   The `nginx.conf` file is stored in the `occne-apiserver-proxy-nginx-config` configmap. To extract it, run the following command:

   ```
   kubectl -n occne-infra get cm occne-apiserver-proxy-nginx-config -o json |
   jq -r '.data."nginx.conf"' > nginx.conf
   ```

2. **Edit the nginx.conf**
   Modify the `nginx.conf` file as needed, ensuring all changes use valid Nginx parameters (invalid configurations will cause the pod to fail):

   ```
   vi nginx.conf
   ```

3. **Apply the Updated Configuration**
   Delete and re-create the configmap with your modified `nginx.conf` file, then restart the deployment. Perform the following steps:

   a. Run the following command to delete the configmap:

      ```
      kubectl -n occne-infra delete cm occne-apiserver-proxy-nginx-config
      ```

      Sample output:

      ```
      configmap "occne-apiserver-proxy-nginx-config" deleted
      ```

   b. Run the following command to create the configmap:

      ```
      kubectl -n occne-infra create cm occne-apiserver-proxy-nginx-config--
      from-file=data=nginx.conf
      ```

Sample output:

```
configmap/occne-apiserver-proxy-nginx-config created
```

c. Run the following command to restart the API server:

```
kubectl -n occne-infra rollout restart deployment occne-apiserver-proxy
```

4. **Verify the Update**
   Check the status of the pods to confirm that the update was successful:

```
kubectl -n occne-infra get pods | grep apiserver
```

Sample output:

```
occne-apiserver-proxy-7c55658548-ps469 1/1 Running 0 19s
```

A
References

This section lists the additional topics that are referred to while performing some of the procedures in the document.

A.1 Changing Retention Size of Prometheus

This section details the procedures for changing the retention size of Prometheus. Prometheus is configured to delete data only in the following conditions:

- Data is older than the configured retention period (14 days) and size.
- The PV is at least 90% full.

The retention level does not consider the write-ahead log (WAL) in its calculations. If the WAL size is greater than 10% of the PV size, then the PV fills up before Prometheus detect the "too full" condition. Therefore, it is recommended to calculate the WAL growth and adjust the retention size of Prometheus accordingly.

Calculating WAL Growth

1. Refer to the WAL space calculation document for all the formulas that are used in this section for calculating the WAL growth.
2. Users must have a benchmarking of the metrics size with each release to calculate the approximate WAL size Growth. Consider the following parameters for analyzing and understanding the metrics size:

   > **Note**
   > - The metrics size must be calculated for a time period of three hours.
   > - The traffic has to be active and running at the Maximum Transaction Per Second (MAX TPS). The TPS considered in this example is 5000.

   a. Samples scraped per scrape:

   ```
   sum(scrape_samples_scraped{kubernetes_namespace="<namespace>"})
   ```

   Example for CNE Samples:

   ```
   sum(scrape_samples_scraped{kubernetes_namespace="occne-infra"})
   ```

   Example for UDR Samples:

   ```
   sum(scrape_samples_scraped{kubernetes_namespace="udr"})
   ```

b. Samples must remain constant irrespective of the TPS rate. However, for some of the NFs, the samples may grow with increasing TPS. In such cases, collect the growth rate of samples.

c. PV disk growth with the increasing sample size. This metric is collected only for observation and is not used in calculating the metrics size.

3. After gathering the data as described in step 2, use the following formula to calculate WAL growth.
The formula considers the following values:

- scrape_samples_scraped = total samples gathered in Step 2
- One Sample Size = 13 bytes
- Time period = 3 hours, that is 180min (average of two and four hours is the generally observed compaction interval)
- Default scrape interval provided by CNE = 60s

Formula to calculate WAL growth

```
WAL Growth = sum(scrape_samples_scraped{kubernetes_namespace="occne-
infra"}) * 13 * 180 * (60/scrape-interval)
```

Example 1

Considering the following values:

- Samples scraped per scrape at 5000 TPS with 4 worker nodes (CNE+UDR) = 75,000
- scrape-interval = 60s
- Total samples scraped = 75,000 * 13 * 180 * 1 = 175,500,000 which approximates to 175MB

the upper limit of WAL growth can be considered as 250MB in 3 hours.

Example 2

Considering the following values:

- Samples scraped per scrape at 5000 TPS with 5 worker nodes (CNE+UDR) = 88,200
- scrape-interval = 10s
- Total samples scraped = 88200 * 13 * 180 * (60/10) = 1153282 which approximates to 1.15GB

the upper limit of WAL growth can be considered as 1.2GB in 3 hours.

> **Note**
>
> Prometheus runs a garbage collection only after PV is full by 40% (for more information, see Prometheus-Storage). The threshold garbage collection is not initiated before PV is 40% full. For example, if Prometheus PV is full by 90%, Prometheus doesn't start purging old persisted data immediately. Instead, it waits until the next cycle of Garbage Collection. Therefore, there is no fixed time interval and the entire process is internal to Prometheus. To avoid Prometheus getting completely full and crashing before garbage collector is called, CNE provides a buffer of 10% in retention size.

Calculating Retention Size

The following examples provides details on calculating retention size.

Example 1

Considering the following values:

- Size of PV equal to 8GB
- WAL growth in 3 hours greter than or equal to 250MB (0.25GB), which is approximately 5% when rounded to the nearest multiple of 5
- Buffer left for Garbage Collection (GC) cycle equal to 10%, which is greater than or equal to 0.8GB

the retention size is calculated as 85% (100 - 5 - 10), which is greater than or equal to 6.8GB (85% of 8GB).

Example 2

Considering the following values:

- Size of PV equal to 8GB
- WAL growth in 3 hours greater than or equal to 1.2GB, which is approximately 15% when rounded to the nearest multiple of 5
- Buffer left for Garbage Collection (GC) cycle equal to 10%, which is greater than or equal to 0.8GB

the retention size is calculated as 75% (100 - 15 - 10), which is greater than or equal to 6GB (75% of 8GB).

Changing the Retention Value for CNE 1.8.x and below

1. Perform the following steps to scale down Prometheus deployment to 0.

   > **⚠ Caution**
   >
   > This step can lead to loss of data as Prometheus do not scrape or store metrics during the down time.

   a. Run the following command to get the Prometheus deployment:

   ```
   $ kubectl get deploy -n <namespace>
   ```

   Example:

   ```
   $ kubectl get deploy -n occne-infra
   ```

   Sample output:

   ```
   NAME                                          READY   UP-TO-DATE
   AVAILABLE   AGE
   occne-elastic-exporter-elasticsearch-exporter   1/1     1
   1           9d
   occne-grafana                                 1/1     1
   ```

```
1           9d
occne-kibana                                  1/1     1
1           9d
occne-metrics-server                          1/1     1
1           9d
occne-prometheus-kube-state-metrics           1/1     1
1           9d
occne-prometheus-pushgateway                  1/1     1
1           9d
occne-prometheus-server                       1/1     1
1           9d
occne-snmp-notifier                           1/1     1
1           9d
occne-tracer-jaeger-collector                 1/1     1
1           9d
occne-tracer-jaeger-query                     1/1     1
1           9d
```

b. Run the following command to scale down the deployment to 0:

```
$ kubectl scale deploy occne-prometheus-server --replicas 0 -n occne-
infra
```

Sample output:

```
deployment.apps/occne-prometheus-server scaled
```

2. Edit the retention size of Prometheus deployment and save the deployment:

```
$ kubectl edit deploy occne-prometheus-server -n <namespace>
```

Example:

```
$ kubectl edit deploy occne-prometheus-server -n occne-infra
```

Sample output:

```
317       - args:
   318         - --storage.tsdb.retention.time=14d
   319         - --config.file=/etc/config/prometheus.yml
   320         - --storage.tsdb.path=/data
   321         - --web.console.libraries=/etc/prometheus/console_libraries
   322         - --web.console.templates=/etc/prometheus/consoles
   323         - --web.enable-lifecycle
   324         - --web.external-url=http://localhost/prometheus
   325         - --storage.tsdb.retention.size=8GB
```

> **Note**
>
> Edit line number 325 in the sample output, which displays the retention size, to 6.8GB (as per example 1 in Calculating Retention Size).

3. Scale up the Prometheus:

   ```
   $ kubectl scale deployment occne-prometheus-server --replicas 1 -n
   <namespace>
   ```

   Example:

   ```
   $ kubectl scale deploy occne-prometheus-server --replicas 1 -n occne-infra
   ```

   Sample output:

   ```
   deployment.apps/occne-prometheus-server scaled
   ```

4. Check if the pod is up and running:

   ```
   $ kubectl get pods -n <namespace>
   ```

   Example:

   ```
   $ kubectl get pods -n occne-infra | grep prometheus-server
   ```

   Sample output:

   ```
   NAME                                                              READY
   STATUS      RESTARTS   AGE
   occne-prometheus-server-58d4d5c459-7dq2d                          2/2
   Running     0          19h
   ```

5. Perform the following steps to check if the deployment reflects the updated retention size:

   a. Run the following command to get the Prometheus deployment:

      ```
      $ kubectl get deploy -n occne-infra
      ```

      Sample output:

      ```
      NAME                                          READY   UP-TO-DATE
      AVAILABLE   AGE
      occne-elastic-exporter-elasticsearch-exporter   1/1     1
      1           9d
      occne-grafana                                 1/1     1
      1           9d
      occne-kibana                                  1/1     1
      1           9d
      occne-metrics-server                          1/1     1
      1           9d
      occne-prometheus-kube-state-metrics           1/1     1
      1           9d
      occne-prometheus-pushgateway                  1/1     1
      1           9d
      occne-prometheus-server                       1/1     1
      1           9d
      occne-snmp-notifier                           1/1     1
      ```

```
1           9d
occne-tracer-jaeger-collector                  1/1     1
1           9d
occne-tracer-jaeger-query                      1/1     1
1           9d
```

b. Run the following commands to open the `occne-prometheus-server.yaml` file and verify the updated retention size:

```
$ kubectl get deploy occne-prometheus-server -n occne-infra -o yaml >
occne-prometheus-server.yaml
$ cat occne-prometheus-server.yaml
```

Sample output:

```
317       - args:
318           - --storage.tsdb.retention.time=14d
319           - --config.file=/etc/config/prometheus.yml
320           - --storage.tsdb.path=/data
321           - --web.console.libraries=/etc/prometheus/console_libraries
322           - --web.console.templates=/etc/prometheus/consoles
323           - --web.enable-lifecycle
324           - --web.external-url=http://localhost/prometheus
325           - --storage.tsdb.retention.size=6.8GB
```

> **Note**
>
> Use search or Grep "retention.size" in the `occne-prometheus-server.yaml` file to check if the retention size is updated to 6.8GB.

Changing the Retention Value for CNE 1.9.x and above

> **Note**
>
> As CNE 1.9.x and above uses HA for Prometheus, there is no service interruption or loss of data while performing this procedure. This is because one Prometheus pod is always up while performing the procedure.

1. Run the following command to list the Prometheus component:

```
$ kubectl get prometheus -n <namespace>
```

Example:

```
$ kubectl get prometheus -n occne-infra
```

Sample output:

```
NAME                                    VERSION   REPLICAS   AGE
occne-kube-prom-stack-kube-prometheus   v2.24.0   2          7d5h
```

2. Run the following command to edit the Prometheus component:

   ```
   $ kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n
   <namespace>
   ```

   Example:

   ```
   $ kubectl edit prometheus occne-kube-prom-stack-kube-prometheus -n occne-
   infra
   ```

   Sample output:

   ```
   51   replicas: 2
        52   retention: 14d
        53   retentionSize: 8GB
        54   routePrefix: /prometheus
        55   ruleNamespaceSelector: {}
        56   ruleSelector:
        57     matchLabels:
   ```

   Note

   a. Edit line number 53 in the sample output, which displays the retention size, to 6.8GB (as per example 1 in Calculating Retention Size).

   b. This initiates rolling update for the prometheus-occne-kube-prom-stack-kube-prometheus pods which takes a few minutes be complete.

3. Check if the pods are up and running.

   ```
   $ kubectl get pods -n <namespace>
   ```

   Example:

   ```
   $ kubectl get pods -n occne-infra | grep kube-prometheus
   ```

   Sample output:

   ```
   prometheus-occne-kube-prom-stack-kube-prometheus-0              2/2
   Running            1          4m22s
   prometheus-occne-kube-prom-stack-kube-prometheus-1              2/2
   Running            1          4m58s
   ```

4. Perform the following steps to check if the deployment reflects the updated retention size:

   a. Run the following command to get the Statefulset of the deployment:

      ```
      $ kubectl get sts -n occne-infra
      ```

Sample output:

```
NAME                                                 READY   AGE
alertmanager-occne-kube-prom-stack-kube-alertmanager 2/2     7d5h
occne-elastic-elasticsearch-client                   3/3     7d5h
occne-elastic-elasticsearch-data                     3/3     7d5h
occne-elastic-elasticsearch-master                   3/3     7d5h
prometheus-occne-kube-prom-stack-kube-prometheus     2/2     7d5h
```

b. Run the following commands to open the `occne-kube-prom-stack.yaml` file and verify the updated retention size:

```
$ kubectl get sts prometheus-occne-kube-prom-stack-kube-prometheus -n
occne-infra -o yaml > occne-kube-prom-stack.yaml
$ cat occne-kube-prom-stack.yaml
```

Sample output:

```
- args:
       - --web.console.templates=/etc/prometheus/consoles
       - --web.console.libraries=/etc/prometheus/console_libraries
       - --storage.tsdb.retention.size=6.8GB
```

> **Note**
>
> Use search or Grep "retention.size" in the `occne-kube-prom-stack.yaml` file to check if the retention size is updated to 6.8GB.