cnBNG Installation and Configuration

Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	cnBNG
Applicable Platform(s)	SMI
Feature Default Setting	Disabled - Configuration Required
Related Changes in this Release	Not Applicable
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
Introduced support for cnBNG cluster deployment on Red Hat OpenShift.	2025.01.0

Revision Details	Release
Introduced Maintenance Operation Procedure (MOP) for cnBNG Node Scaling.	2024.03.0
Introduced support for cnBNG Cluster Deployment Using Inception Server.	2023.04.0
Introduced support for the cnBNG CNF Deployment on AIO BareMetal Server.	2022.02.0
cnBNG CP deployment on bare metal server is supported (with support for IPoE, PPPoE, LAC and LNS call models and High Availability) and fully qualified in this release.	2022.01.0
First introduced.	2021.01.0

Feature Description

This chapter describes cnBNG installation and configuration using the Ultra Cloud Core Subscriber Microservices Infrastructure (SMI) Cluster Manager and the BNG Operations (Ops) Center. The BNG Ops Center is based on the ConfD command line interface (CLI).

To install the SMI Cluster Manager, refer to the "Deploying the SMI Cluster Manager on VMware vCenter" section in the *Ultra Cloud Core Subscriber Microservices Infrastructure - Deployment Guide*.

The SMI Ops Center is the platform to install the cnBNG cluster with the offline or online repository. It is mandatory to install the SMI Ops Center to set up and access the BNG Ops Center.

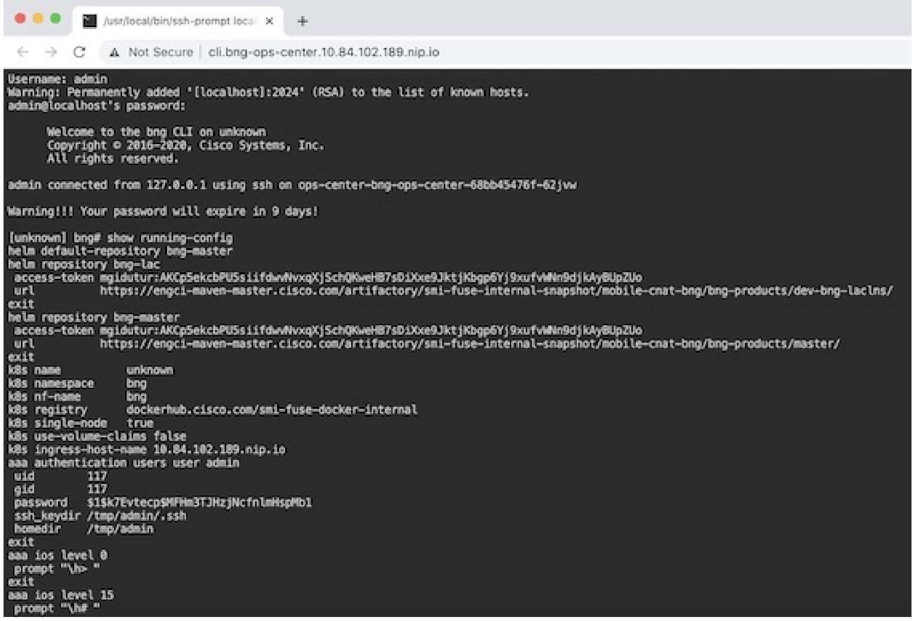
Note To access the offline or online repository, contact your Cisco Account Manager or representative to get access to the offline or online repository.

BNG Ops Center

The BNG Ops Center is a system-level infrastructure that provides the following functionality:

- A user interface to trigger a deployment of microservices with the flexibility of providing variable helm chart parameters to control the scale and properties of Kubernetes objects (deployment, pod, services, and so on) associated with the deployment.
- A user interface to push application-specific configuration to one or more microservices through Kubernetes configuration maps.
- A user interface to issue application-specific execution commands (such as show and clear commands). These commands:
  - Invoke some APIs in application-specific pods
  - Display the information returned on the user interface application

The following figure shows a sample of the web-based CLI presented to the user.



/usr/local/bin/ssh-prompt local
Not Secure | cli.bng-ops-center.10.84.102.189.nip.io

```
Username: admin
Warning: Permanently added '[localhost]:2024' (RSA) to the list of known hosts.
admin@localhost's password:

      Welcome to the bng CLI on unknown
      Copyright © 2016-2020, Cisco Systems, Inc.
      All rights reserved.

admin connected from 127.0.0.1 using ssh on ops-center-bng-ops-center-68bb45476f-62jvw

Warning!!! Your password will expire in 9 days!

[unknown] bng# show running-config
helm default-repository bng-master
helm repository bng-lac
 access-token mgidutur:AKCp5ekcbPU5siifdwNvxqXjSchQKweHB7sDiXxe9JktjKbgp6Yj9xufvWNn9djkAyBUpZUo
 url          https://engci-maven-master.cisco.com/artifactory/smi-fuse-internal-snapshot/mobile-cnat-bng/bng-products/dev-bng-laclns/
exit
helm repository bng-master
 access-token mgidutur:AKCp5ekcbPU5siifdwNvxqXjSchQKweHB7sDiXxe9JktjKbgp6Yj9xufvWNn9djkAyBUpZUo
 url          https://engci-maven-master.cisco.com/artifactory/smi-fuse-internal-snapshot/mobile-cnat-bng/bng-products/master/
exit
k8s name           unknown
k8s namespace      bng
k8s nf-name        bng
k8s registry       dockerhub.cisco.com/smi-fuse-docker-internal
k8s single-node    true
k8s use-volume-claims false
k8s ingress-host-name 10.84.102.189.nip.io
aaa authentication users user admin
 uid         117
 gid         117
 password    $1$k7Evtecp$MFHm3TJHzjNcfnlmHspMb1
 ssh_keydir /tmp/admin/.ssh
 homedir    /tmp/admin
exit
aaa ios level 0
 prompt "\h> "
exit
aaa ios level 15
 prompt "\h# "
```

The BNG Ops Center allows you to configure features such as licensing, REST endpoint, and CDL.

For information on how to deploy BNG Ops Center on bare metal servers (currently Cisco UCS-C servers) environment, see "Operating the SMI Cluster Manager on Bare Metal" section in the *Ultra Cloud Core Subscriber Microservices Infrastructure — Operations Guide*.

Installing cnBNG and Accessing BNG Ops Center

This section describes how to install cnBNG and access the BNG Ops Center.

The Ultra Cloud Core SMI platform is responsible for setting up and managing the Cloud Native Broadband Network Gateway application.

Prerequisites

Before installing cnBNG on the SMI layer in an offline environment:

- Ensure that the SMI Cluster Manager all-in-one (AIO) is installed. This helps orchestrate the K8s Cluster and load the image.
- Ensure that all SMI K8s cluster nodes are in Ready state.
- Run the SMI synchronization operation for the BNG Ops Center and Cloud Native Common Execution Environment (CN-CEE).

  For CEE installation, refer to the *Ultra Cloud Core Common Execution Environment- Configuration and Administration Guide*.
- Ensure that the local repositories, which host the product offline TAR ball version, is installed.

System Requirements

Feature	Description
Disk Space	2 x 800 GB SSD (RAID 1) or equivalent input/output operations per second (IOPS) and redundancy.
Hardware	• High-performance x86 64-bit chipset • CPU performance Passmark benchmark of 13K rating per chip and 1,365 rating per thread, or better • VMware ESXi-compatible **Note** The following is recommended: • Cisco UCSM5 series blade servers to achieve the best performance. • All the host servers should be UCSC-C240-M5SX or UCSC-C220-M5SX. • All the UCS systems should have SSD storge type. • UCS C240M5 servers for better performance and to avoid infrastructure issues.
Platform	VMware ESXi and VMware vCenter versions 6.5 and 6.7 **Note** SMI Cluster Manger support is qualified on the preceding platforms.
Memory	• At least DDR3-1600 or better than 1600 MT/s • ECC
Deployment Requirement	Hardware oversubscription, network saturation, or CPU oversubscription reduces application performance and productivity. The Cisco Ultra Cloud Core Subscriber Microservices Infrastructure detects and takes action when infrastructure requirements are not met.

Installing cnBNG in an Offline Environment

Using the SMI Cluster Manager, download the offline TAR ball of the cnBNG, the host and its charts, and corresponding images in the local registries. The SMI Cluster Manager supports the deployment of the BNG Ops Center and all the applications and services associated with it. This section describes the procedures involved in installing cnBNG in an offline environment using the SMI Cluster Manager.

To install cnBNG, complete the following steps:

1. Download the TAR ball from the URL.

   ```
   software-packages download URL
   ```

   Example:

```
SMI Cluster Manager# software-packages download
http://<ipv4address>:<port_number>/packages/bng-2021-02-1.tar
```

2. Verify whether the TAR balls are loaded.

   ```
   software-packages list
   ```

   Example:

   ```
   BNG Cluster Manager# software-packages list
   [ bng-2021-02-1 ]
   [ sample ]
   ```

3. Configure the necessary SMI Ops Center parameters in the cluster to install cnBNG.

   ```
   config
      cluster cluster_name
         ops-centers app_name instance_name
            repository url
            netconf-ip ipv4_address
            netconf-port port
            ssh-ip ipv4_address
            ssh-port port
            ingress-hostname <ipv4_address>.<customer_specific_domain_name>
            initial-boot-parameters use-volume-claims true/false
            initial-boot-parameters first-boot-password password
            initial-boot-parameters auto-deploy true/false
            initial-boot-parameters single-node true/false
            initial-boot-parameters image-pull-secrets
            exit
      exit
   ```

   Example:

   ```
   SMI Cluster Manager# config
   Entering configuration mode terminal
   SMI Cluster Manager(config)# clusters cnbng-smi-cluster-01
   SMI Cluster Manager(config-clusters-cnbng-smi-cluster-01)# ops-centers bng bng
   SMI Cluster Manager(config-ops-centers-bng/bng)# repository
   https://charts.10.10.105.50.nip.io/bng-2021.02.1
   SMI Cluster Manager(config-ops-centers-bng/bng)# ingress-hostname 10.10.105.34.nip.io
   SMI Cluster Manager(config-ops-centers-bng/bng)# initial-boot-parameters use-volume-claims
    true
   SMI Cluster Manager(config-ops-centers-bng/bng)# initial-boot-parameters
   first-boot-password test123
   SMI Cluster Manager(config-ops-centers-bng/bng)# initial-boot-parameters auto-deploy
   false
   SMI Cluster Manager(config-ops-centers-bng/bng)# initial-boot-parameters single-node
   false
   SMI Cluster Manager(config-ops-centers-bng/bng)# exit
   SMI Cluster Manager(config-clusters-cnbng-smi-cluster-01)# exit
   SMI Cluster Manager(config)#
   ```

4. Configure the secrets, if your local registry contains secrets.

   ```
   config
      cluster cluster_name
         secrets docker-registry secret_name
            docker-server server_name
            docker-username username
            docker-password password
   ```

```
            docker-email email
            namespace k8s namespace
            commit
            exit
        exit
```

Example:

```
SMI Cluster Manager# config
SMI Cluster Manager(config)# clusters test2
SMI Cluster Manager(config-clusters-test2)# secrets docker-registry sec1
SMI Cluster Manager(config-docker-registry-sec1)# docker-server serv1
SMI Cluster Manager(config-docker-registry-sec1)# docker-username user1
SMI Cluster Manager(config-docker-registry-sec1)# docker-password Cisco@123
SMI Cluster Manager(config-docker-registry-sec1)# docker-email reg@cisco.com
SMI Cluster Manager(config-docker-registry-sec1)# bng bng
SMI Cluster Manager(config-docker-registry-sec1)# exit
SMI Cluster Manager(config-clusters-test2)# exit
SMI Cluster Manager(config)#
```

5. Run the cluster synchronization.

```
clusters cluster_name actions sync run
```

Example:

```
SMI Cluster Manager# clusters cnbng-smi-cluster-01 actions sync run
```

Notes:

- **software-packages download** *url*–Specifies the software packages to be downloaded through HTTP/HTTPS.
- **software-packages list**–Specifies the list of available software packages.
- **ops-centers** *app_name instance_name*–Specifies the BNG Ops Center and instance. *app_name* is the application name. *instance_name* is the name of the instance.
- **repository** *url*-Specifies the local registry URL for downloading the charts.
- **netconf-ip** *ipv4_address*–Specifies the BNG Ops Center netconf IPv4 address.
- **netconf-port** *port*–Specifies the BNG Ops Center netconf port number.
- **ssh-ip** *ipv4_address*–Specifies the SSH IPv4 address for the BNG Ops Center.
- **ssh-port** *port*–Specifies the SSH port number for the BNG Ops Center.
- **ingress-hostname** *<ipv4_address>.<customer_specific_domain_name>*–Specifies the ingress hostname to be set to the BNG Ops Center. *<customer_specific_domain_name>* specifies the domain name of the customer.
- **initial-boot-parameters**–Specifies the initial boot parameters for deploying the helm charts.
    - **use-volume-claims** *true/false*–Specifies the usage of persistent volumes. Set this option to True to use persistent volumes. The default value is true.
    - **first-boot-password** *password*–Specifies the first boot password for the product's Ops Center.
    - **auto-deploy** *true/false*–Auto deploys all the services of the product. Set this option to false to deploy only the product's Ops Center.

  - **single-node** *true/false*– Specifies the product deployment on a single node. Set this option to false for multi node deployments.
  - **image-pull-secrets**–Specifies the docker registry secret name to be used.

- **secrets docker-registry** *secret_name*–Specifies the secret name for your docker registry.
  - **docker-server** *server_name*–Specifies the docker server name.
  - **docker-username** *username*–Specifies the docker registry user name.
  - **docker-password** *password*–Specifies the docker registry password.
  - **docker-email** *email*–Specifies the docker registry email.
  - **namespace** *namespace*–Specifies the docker registry namespace.

Verifying the cnBNG Installation

Verify the status of the cnBNG installation deployment through the cnBNG CLI. To verify, use the following commands:

1. Log in to the cnBNG product CLI.
2. Verify whether the charts are loaded in the specific instance (verify the namespace).

   show helm charts

   Example:

   ```
   bng# show helm charts
   CHART    INSTANCE  STATUS    VERSION  REVISION  RELEASE   NAMESPACE
   ---------------------------------------------------------------------------
   infra-charts - DEPLOYED 0.0.6-rel-2021-01-0073-210208130850-fac5207 1 bng-bng-infra-charts
    bng-bng
   oam-pod - DEPLOYED 0.1.2-rel-2021-01-0144-210122165946-fcb74ed 1 bng-bng-oam-pod bng-bng
   bng-dashboard - DEPLOYED 0.0.1-rel-2021-01-0039-210122165311-0d542be 1
   bng-bng-bng-dashboard bng-bng
   etcd-cluster - DEPLOYED 0.7.0-0-7-0060-210203074532-f118407 1 bng-bng-etcd-cluster bng-bng
   ngn-datastore - DEPLOYED 1.3.0-1-3-0782-210125161812-f50a892 1 bng-bng-ngn-datastore
   bng-bng
   ```

3. Verify the status of the system.

   show system status

   Example:

   ```
   bng# show system status
   system status deployed true
   system status percent-ready 100.0
   ```

Notes:

- **show helm charts**–Displays the helm release details.
- **show system status**–Displays the status of the system.

Accessing BNG Ops Center

You can connect to the BNG Ops Center through SSH.

ssh admin@ops_center_pod_ip **-p 2024**

Day 0 Configuration

To view the Day 0 configuration, run the following command.

show running-config

The following is a sample Day 0 configuration:

```
luser@cnbng-smi-cluster-master1:~$ kubectl get svc -n bng-bng | grep
ops-center-bng-bng-ops-center
NAME                                  TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)
                                      AGE
ops-center-bng-bng-ops-center         ClusterIP   10.96.151.115    <none>
8008/TCP,8080/TCP,2024/TCP,2022/TCP,7681/TCP   7m37s
luser@cnbng-smi-cluster-master1:~$ ssh admin@10.96.151.115 -p 2024
Warning: Permanently added '[10.96.151.115]:2024' (RSA) to the list of known hosts.
admin@10.96.151.115's password:

      Welcome to the bng CLI on cnbng-smi-cluster/bng
      Copyright © 2016-2020, Cisco Systems, Inc.
      All rights reserved.

admin connected from 192.202.0.1 using ssh on ops-center-bng-bng-ops-center-7bddd4cc48-fmb6l
[cnbng-smi-cluster/bng] bng# show running-config
system mode running
helm default-repository base-repos
helm repository base-repos
url
https://engci-maven-master.cisco.com/artifactory/smi-fuse-internal-snapshot/mobile-cnat-bng/bng-products/master/
username <username>
password <password>
exit
k8s name          cnbng-smi-cluster
k8s namespace     bng-bng
k8s nf-name       bng
k8s registry      dockerhub.cisco.com/smi-fuse-docker-internal
k8s single-node   false
k8s use-volume-claims true
k8s ingress-host-name 192.0.2.2.nip.io
aaa authentication users user admin
uid        1117
gid        1117
password   $1$EmkQjvc0$o8K5tXmUzN1.drQgCL0A2/
ssh_keydir /tmp/admin/.ssh
homedir    /tmp/admin
exit
aaa ios level 0
prompt "\h> "
exit
aaa ios level 15
prompt "\h# "
exit
aaa ios privilege exec
level 0
  command action
  exit
  command autowizard
  exit
  command enable
  exit
  command exit
  exit
  command help
  exit
  command startup
  exit
exit
level 15
  command configure
  exit
exit
exit
nacm write-default deny
nacm groups group admin
user-name [ admin ]
exit
nacm rule-list admin
group [ admin ]
rule any-access
  action permit
exit
exit
nacm rule-list confd-api-manager
group [ confd-api-manager ]
rule any-access
  action permit
exit
exit
nacm rule-list ops-center-security
group [ * ]
rule change-self-password
  module-name       ops-center-security
  path              /smiuser/change-self-password
  access-operations exec
  action            permit
exit
rule smiuser
  module-name       ops-center-security
  path              /smiuser
  access-operations exec
  action            deny
exit
exit

deployment
 app-name     BNG
 cluster-name Local
 dc-name      DC
exit
k8 bng
 etcd-endpoint      etcd:2379
 datastore-endpoint datastore-ep-session:8882
 tracing
  enable
  enable-trace-percent 30
  append-messages      true
  endpoint             jaeger-collector:9411
 exit
exit
k8 label protocol-layer key smi.cisco.com/node-type value protocol
exit
k8 label service-layer key smi.cisco.com/node-type value service
```

```
exit
k8 label cdl-layer key smi.cisco.com/node-type value session
exit
k8 label oam-layer key smi.cisco.com/node-type value oam
exit
instances instance 1
 system-id  DC
 cluster-id Local
 slice-name 1
exit
local-instance instance 1
system mode shutdown
helm default-repository base-repos
helm repository base-repos
 url
https://engci-maven-master.cisco.com/artifactory/smi-fuse-internal-snapshot/mobile-cnat-bng/bng-products/master/

 username smf-deployer.gen
 password ***
exit
k8s name          svi-cn-bng-tb3
k8s namespace     bng-bng
k8s nf-name       bng
k8s registry      dockerhub.cisco.com/smi-fuse-docker-internal
k8s single-node   false
k8s use-volume-claims true
k8s ingress-host-name 10.81.103.86.nip.io
aaa authentication users user admin
 uid        1117
 gid        1117
 password   $1$vDWeJvJm$v46wiBWqdOj7eWgoPoZZE/
 ssh_keydir /tmp/admin/.ssh
 homedir    /tmp/admin
exit
aaa ios level 0
 prompt "\h> "
exit
aaa ios level 15
 prompt "\h# "
exit
aaa ios privilege exec
 level 0
  command action
  exit
  command autowizard
  exit
  command enable
  exit
  command exit
  exit
  command help
  exit
  command startup
  exit
 exit
 level 15
  command configure
  exit
 exit
exit
nacm write-default deny
nacm groups group admin
 user-name [ admin ]
exit
```

```
nacm rule-list admin
 group [ admin ]
 rule any-access
  action permit
 exit
exit
nacm rule-list confd-api-manager
 group [ confd-api-manager ]
 rule any-access
  action permit
 exit
exit
nacm rule-list ops-center-security
 group [ * ]
 rule change-self-password
  module-name       ops-center-security
  path              /smiuser/change-self-password
  access-operations exec
  action            permit
 exit
 rule smiuser
  module-name       ops-center-security
  path              /smiuser
  access-operations exec
  action            deny
 exit
exit
```

CP and UP Service Configuration

The CP service requires the basic configuration to process the API calls.

Note For information about the User Plane service configuration, refer to the *Cloud Native BNG User Plane Configuration Guide for Cisco ASR 9000 Series Routers, IOS XR Release 7.3.x*

Configuring the CP

The CP configuration is provided using the Ops Center infrastructure.

The following is a sample CP configuration:

```
ipam
 instance 1
  source local
  address-pool <dummy-pool-1>
   vrf-name default
   ipv4
    split-size
     per-cache 8192
     per-dp    8192
    exit
    address-range 10.0.0.1 10.10.255.255
   exit
   ipv6
    address-ranges
     split-size
      per-cache 8192
      per-dp    8192
     exit
     address-range 2001:DB8::1 2001:DB8::ff00
    exit
    prefix-ranges
     split-size
      per-cache 8192
      per-dp    1024
     exit
     prefix-length 56
     prefix-range 2001:db0:: length 40
    exit
   exit
  exit
  address-pool dummy-pool2
   vrf-name default
   ipv6
    prefix-ranges
     split-size
      per-cache 8192
      per-dp    1024
     exit
     prefix-range 2001:DB8:: length 48
    exit
   exit
  exit
  address-pool slaac-radius
   vrf-name default
   ipv6
    prefix-ranges
     split-size
      per-cache 8192
      per-dp    1024
     exit
     prefix-range 2001:DB8:: length 48
    exit
   exit
  exit
  address-pool static-dummy-pool2
   vrf-name default
   static enable user-plane dummy-asr9k-1
   ipv6
    prefix-ranges
     split-size
      no-split
     exit
     prefix-range 2001:DB8:: length 48
    exit
   exit
  exit
 exit
exit
cdl node-type session
cdl logging default-log-level error
cdl datastore session
 slice-names [ 1 ]
 endpoint replica 2
 endpoint settings slot-timeout-ms 750
 index replica 2
 index map 1
 slot replica 2
 slot map 2
 slot notification limit 300
exit
cdl kafka replica 1
```

```
!
profile dhcp dummy-dhcp-server1
 ipv4
  mode server
  server
   pool-name   dummy-pool-1
   dns-servers [ network-dns ]
   lease days 1
   lease hours 2
   lease minutes 3
  exit
 exit
 ipv6
  mode server
  server
   iana-pool-name dummy-pool-1
   iapd-pool-name dummy-pool-1
   lease days 10
   lease hours 0
   lease minutes 4
  exit
 exit
exit
profile pppoe pppoe-prof
 mtu                       1500
 ctrl-pkt-priority         7
 service-selection-disable true
 max-payload minimum 1492 maximum 1540
 session-limit max 64000 threshold 60000
exit
profile pppoe ppp1
 mtu 1492
exit
profile aaa dummy-aaa-prof
 authentication
  method-order [ dummy-ser-grp ]
 exit
 authorization
  type subscriber method-order [ dummy-ser-grp ]
  username identifier client-mac-address
  password <any-password>
 exit
 accounting
  method-order [ dummy-ser-grp ]
 exit
exit
profile server-group dummy-ser-grp
 radius-group dummy-ser-grp
exit
profile attribute-format attr1
 format-order [ client-mac-address ]
exit
profile attribute-format attr2
 format-order [ addr ]
exit
profile attribute-format attr3
 format-order [ username ]
exit
profile subscriber dummy-subs-prof
 dhcp-profile               dummy-dhcp-server1
 pppoe-profile              ppp1
 session-type               ipv4v6
 activate-feature-templates [ svc1 VOICE TV ]
 aaa authorize dummy-aaa-prof
```

```
exit
profile feature-template VOICE
 qos
  in-policy   VOICE_INGRESS
  out-policy  VOICE_EGRESS
  merge-level 40
 exit
exit
profile feature-template APPS
 httpr-policy ACCESS-PBR
exit
profile feature-template TV
 qos
  in-policy   TV_INGRESS
  out-policy  TV_EGRESS
  merge-level 50
 exit
exit
profile feature-template svc1
 vrf-name default
 ipv4
  mtu                   1492
  disable-unreachables
  verify-unicast-source reachable-via-rx
 exit
 ipv6
  mtu                   1492
  ingress-acl           ipv6-acl-in-1
  egress-acl            ipv6-acl-out-1
  disable-unreachables
  verify-unicast-source reachable-via-rx
 exit
 session-accounting
  enable
  aaa-profile       dummy-aaa-prof
  periodic-interval 1800
 exit
exit
!
profile feature-template HSI_100M_5MQ
 qos
  in-policy   HSI_UPLOAD_RATE_100MB_IN
  out-policy  HSI_DOWNLOAD_RATE_100MB_OUT
  merge-level 30
 exit
 service-accounting
  enable
  aaa-profile       aaa-prof1
  periodic-interval 120
 exit
exit
profile feature-template HSI_100M_30MQ
 qos
  in-policy   HSI_UPLOAD_RATE_100MB_IN
  out-policy  HSI_DOWNLOAD_RATE_100MB_OUT
  merge-level 30
 exit
 service-accounting
  enable
  aaa-profile       dummy-aaa-prof
  periodic-interval 1800
 exit
exit
profile radius
```

```
 algorithm first-server
 deadtime  2
 detect-dead-server response-timeout 30
 max-retry 3
 timeout   5
 server 10.1.2.3 1812
  type     auth
  secret   <password>
  priority 1
 exit

 server 2001::10:1:36:121 1812
   type     auth
   secret   cisco
   priority 1
 exit
 server 10.1.2.3 1813
  type     acct
  secret   <password>
  priority 1
 exit
 server 2001::10:1:36:121 1813
   type     acct
   secret   cisco
   priority 1
 exit
attribute
  nas-identifier CISCO-BNG
  nas-ip        <209.165.201.1>
  nas-ipv6 2001::250:56ff:fe95:658
  nas-ip user-plane-ip
  instance 1
  exit
 exit
 accounting
  attribute
   nas-ip <209.165.201.1>
   nas-ipv6 2001::10:1:7:95
  exit
 exit
 server-group dummy-ser-grp
  server auth 10.1.2.3 1812
  exit
  server acct 10.1.2.3 1813
  exit
  server auth 2001::10:1:36:121 1812
  exit
  server acct 2001::10:1:36:121 1813
  exit
 exit
exit
profile coa
 client 10.1.2.3
  server-key <password>
 exit
 client 2001::10:1:36:111
  server-key cisco
 exit
user-plane
 instance 1
  user-plane dummy-asr9k-1
   peer-address ipv4 209.165.201.3
   subscriber-profile dummy-subs-prof
  exit
  user-plane dummy-asr9k-2
   peer-address ipv4 209.165.201.2
   subscriber-profile dummy-subs-prof
  exit
 exit
exit
instance instance-id 1
 endpoint sm
  replicas 1
 exit
 endpoint l2tp-tunnel
  replicas 1
 exit
 endpoint nodemgr
  replicas 1
 exit
 endpoint n4-protocol
  replicas 1
  retransmission max-retry 1
 exit
 endpoint dhcp
  replicas 1
 exit
 endpoint pppoe
  replicas 1
 exit
 endpoint radius
  interface coa-nas
   vip-ip <209.165.201.1> vip-port 2000
   vip-ipv6 2001::10:1:39:191 vip-ipv6-port 2000
  exit
 exit
 endpoint udp-proxy
  vip-ip <209.165.201.1>
  vip-ipv6 2001::10:1:39.192
  interface n4
   sla response 180000
  exit
  interface gtpu
   sla response 180000
  exit
 exit
exit
logging level application error
logging level transaction error
logging level tracing error
logging name infra.affinity_cache.core level application off
logging name infra.application.core level application off
logging name infra.bgipcstream.core level application off
logging name infra.cache_client.core level application off
logging name infra.cdl_update_queue.core level application off
logging name infra.config.core level application off
logging name infra.diagnostic.core level application off
logging name infra.diagnostics.core level application off
logging name infra.dpd.core level application off
logging name infra.ds_client.core level application off
logging name infra.edr.core level application off
logging name infra.heap_dump.core level application off
logging name infra.ipc_action.core level application off
logging name infra.ipcstream.core level application off
logging name infra.memory_cache.core level application off
logging name infra.message_trace.core level application off
logging name infra.resource_monitor.core level application off
logging name infra.resource_monitor_load_factor.core level application off
logging name infra.rest_server.core level application off
logging name infra.session_cache.core level application off
logging name infra.topology.core level application off
logging name infra.topology_lease.core level application off
logging name infra.transaction.core level application off
logging name infra.virtual_msg_queue.core level application off
logging name infra.vrf_etcd_update.core level application off
deployment
 app-name     BNG
 cluster-name Local
 dc-name      DC
exit
k8 bng
 etcd-endpoint      etcd:2379
 datastore-endpoint datastore-ep-session:8882
 tracing
  enable
  enable-trace-percent 30
  append-messages      true
  endpoint             jaeger-collector:9411
 exit
exit
k8 label protocol-layer key smi.cisco.com/proto-type value protocol
exit
k8 label service-layer key smi.cisco.com/svc-type value service
exit
k8 label cdl-layer key smi.cisco.com/sess-type value cdl-node
exit
k8 label oam-layer key smi.cisco.com/node-type value oam
exit
resource cache-pod
 gomaxproc 8
exit
instances instance 1
 system-id  DC
 cluster-id Local
 slice-name 1
exit
local-instance instance 1
system mode <shutdown or running>
commit
end
```

Configuring the UP

The following is a sample UP configuration:

```
user-plane
 instance 1
  user-plane dummy-asr9k-1
   peer-address ipv4 209.165.201.3
   subscriber-profile dummy-subs-prof
  exit
  user-plane dummy-asr9k-2
   peer-address ipv4 209.165.201.2
   subscriber-profile dummy-subs-prof
  exit
 exit
exit
```

Loading Day1 Configuration

To load the Day 1 configuration for cnBNG, run the following command:

```
ssh admin@ops_center_pod_ip -p 2024  < Day1config.cli
```

Note: The **day1config.cli file** contains the necessary parameters required for the Day 1 configuration.

Alternatively, you can copy the configuration and paste it in the BNG Ops Center CLI to load the Day 1 configuration.

```
config
  <Paste the Day 1 configuration here>
  commit
  exit
```

Day1config.cli

The **day1config.cli file** file contains the Day 1 configuration for cnBNG. For a sample day1 configuration, see Configuring the CP, on page 11.

Mapping Pods with Node Labels

Prerequisites

- Ensure that the node labels are according to the pod deployment layout.
- Ensure that the external VIPs are according to the requirement of NF.
- Enable Istio for pod to pod traffic load balancing.

Node Labels are key and value pairs that are attached to nodes at cluster synchronization. Each node can have a set of key and value labels defined. Each key must be unique for a node. With labels, users can map their NF pods onto nodes in a loosely coupled manner.

Important:

- The pod-level labeling configuration is applicable only when the cnBNG CP is deployed on a bare metal server.
- Ensure to configure the node label on the SMI cluster deployer before mapping the pods. Following is the sample command for master-1 labeling:

```
[cndp-clpnc-cm-cm-primary] SMI Cluster Deployer (config-nodes-master-1)# k8s node-labels
smi.cisco.com/svc-type bng-node
```

To map the pods with node labels, use the following sample configuration:

```
config
   k8 label protocol-layer key label_key value label_value
   k8 label service-layer key label_key value label_value
   k8 label cdl-layer key label_key value label_value
   k8 label oam-layer key label_key value label_value
   end
```

Following is an example configuration of pod to node-label mapping:

```
k8 label protocol-layer key smi.cisco.com/node-type value bng-proto
exit
k8 label service-layer key vm-type value bng-svc
exit
k8 label cdl-layer key smi.cisco.com/node-type value bng-cdl
exit
k8 label oam-layer key smi.cisco.com/node-type value oam
exit
```

High Availability Support on BareMetal Server

High Availablity on cnBNG CP is validated on BareMetal server deployment. For more informaton about High Availablity, see High Availability and CP Reconciliation.

cnBNG CNF Deployment on AIO BareMetal Server

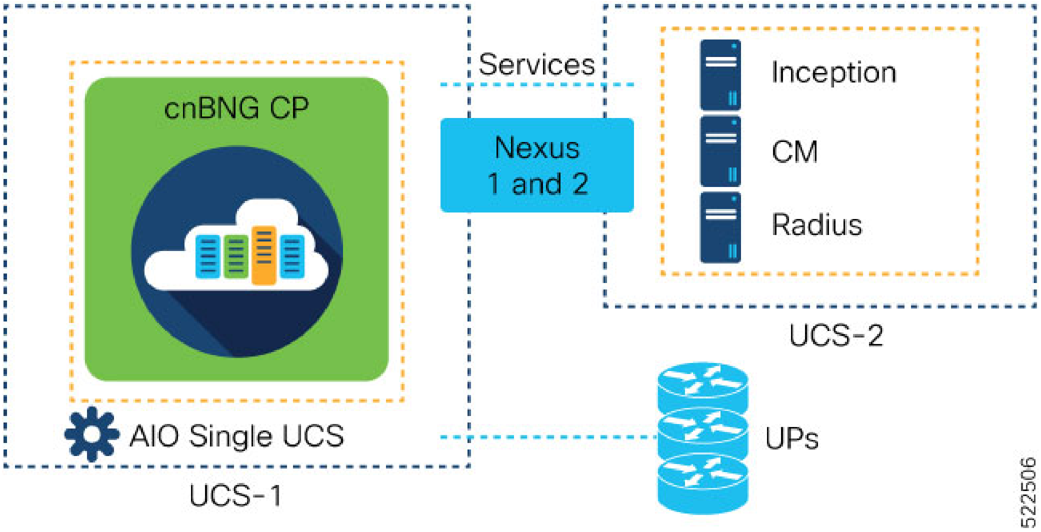
The cnBNG CNF Deployment on AIO BareMetal Server explains the process of onboarding a cnBNG Cloud Native Function (CNF) on the Cloud Native Deployment Platform (CNDP) on the BareMetal all-in-one (AIO) Kubernetes (K8s) cluster.

In the AIO deployment, all the management VMs are hosted on a different UCS server, however, this depends on the deployment strategy.

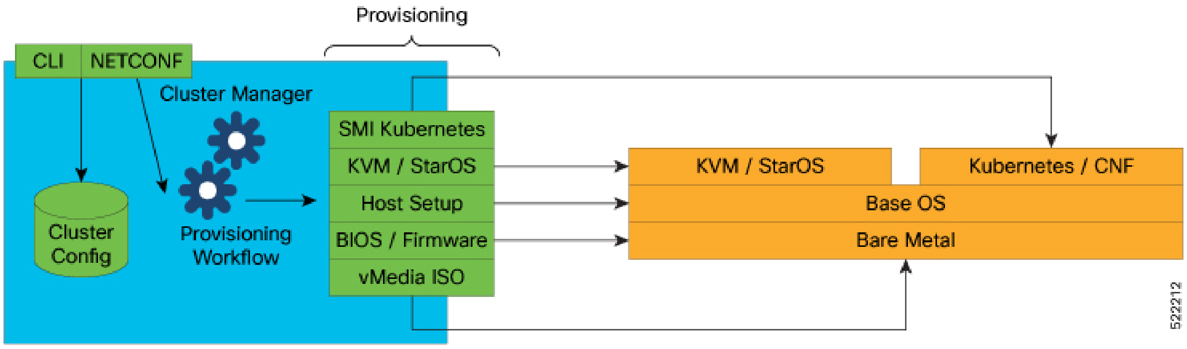
The cnBNG CNF is hosted on another UCS server referred as AIO server. During installation, the Cluster Manager (CM) accesses the AIO via the Cisco Integrated Management Controller (IMC) interface and adds the respective image and SMI packages to complete the installation.

Note The management VMs are the Inception, Cluster Manager, and RADIUS servers.

Figure 1: Logical Topology for cnBNG CNF Deployment on AIO BareMetal Server



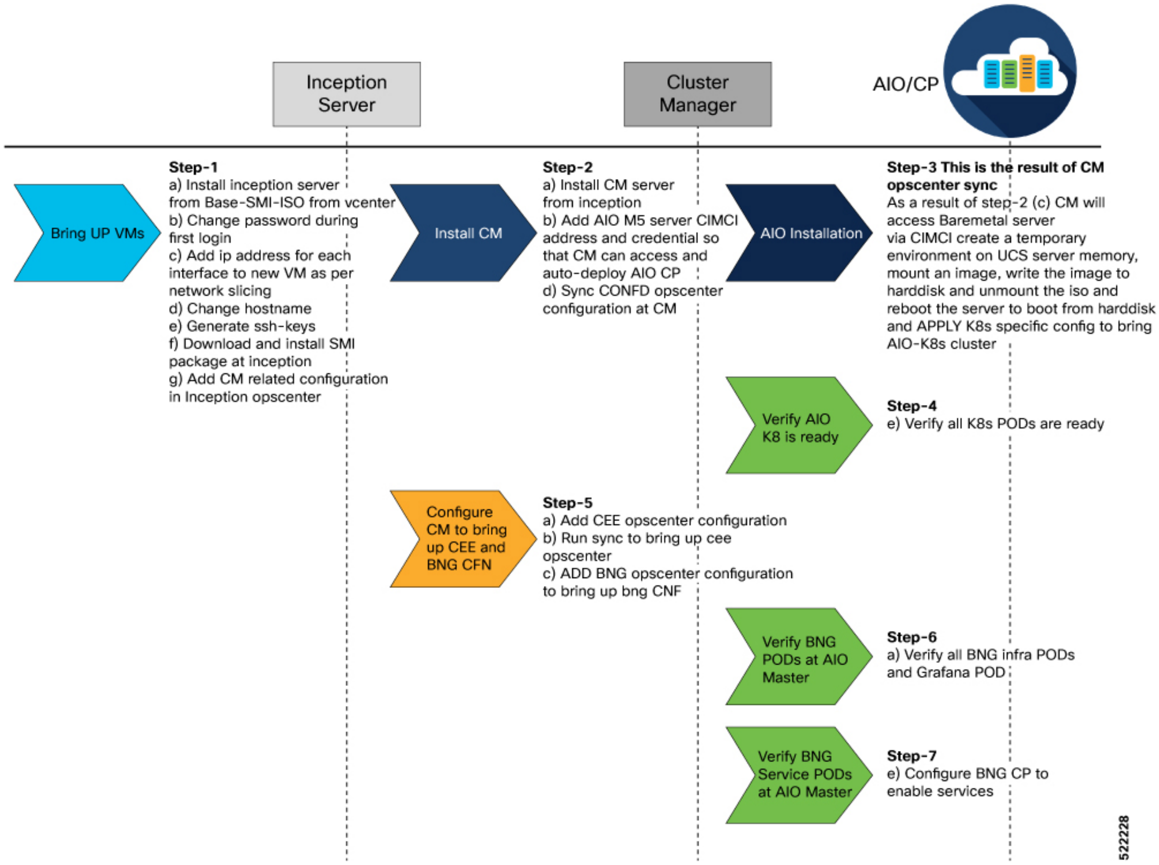
The CNDP is a 'SMI Bare-Metal'. The Cluster Manager uses REST APIs (instead of VIM APIs) of the management cards, which are on the servers, to create a set of Linux servers and then loads the K8s software.



Before installing network functions (NF) on the Cluster Manager, the common containerized software from SMI is installed. For example, monitoring and logging. The SMI NFs include their own common containerized software.

BareMetal CNDP AIO Bring-Up Procedure

The following figure illustrates the step-by-step process that is required to bring up the cnBNG CNF on K8s AIO server.


Inception Server
Cluster Manager
AIO/CP
Bring UP VMs
Install CM
AIO Installation
Verify AIO K8 is ready
Configure CM to bring up CEE and BNG CFN
Verify BNG PODs at AIO Master
Verify BNG Service PODs at AIO Master
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Step-1
a) Install inception server from Base-SMI-ISO from vcenter
b) Change password during first login
c) Add ip address for each interface to new VM as per network slicing
d) Change hostname
e) Generate ssh-keys
f) Download and install SMI package at inception
g) Add CM related configuration in Inception opscenter

Step-2
a) Install CM server from inception
b) Add AIO M5 server CIMCI address and credential so that CM can access and auto-deploy AIO CP
d) Sync CONFD opscenter configuration at CM

Step-3 This is the result of CM opscenter sync
As a result of step-2 (c) CM will access Baremetal server via CIMCI create a temporary environment on UCS server memory, mount an image, write the image to harddisk and unmount the iso and reboot the server to boot from harddisk and APPLY K8s specific config to bring AIO-K8s cluster

Step-4
e) Verify all K8s PODs are ready

Step-5
a) Add CEE opscenter configuration
b) Run sync to bring up cee opscenter
c) ADD BNG opscenter configuration to bring up bng CNF

Step-6
a) Verify all BNG infra PODs and Grafana POD

Step-7
e) Configure BNG CP to enable services

For more information about the Inception, Cluster Manager, and All-in-One server installation, see the "SMI Cluster Manager - Deployment" chapter of the *Ultra Cloud Core Subscriber Microservices Infrastructure - Deployment Guide*.

Limitations and Restrictions

The cnBNG CNF Deployment on AIO BareMetal Server has the following limitations and restrictions:

- Simulated User Planes (UPs) are used in the characterisation activity.
- ASR 9000 routers will be used in the topology based on availability in future releases.
- Actual customer profile must be validated before deployment.

Implementing cnBNG CP Validation with CNDP

Implementing cnBNG CP Validation with CNDP involves the following procedures.

- Prerequisites
- Instantiating and Provisioning Inception Server Instance
- Installing the Cluster Manager Node
- Deploying the All-in-One Cluster
- Integrating RADIUS and UP with the AIO BareMetal Server

Prerequisites

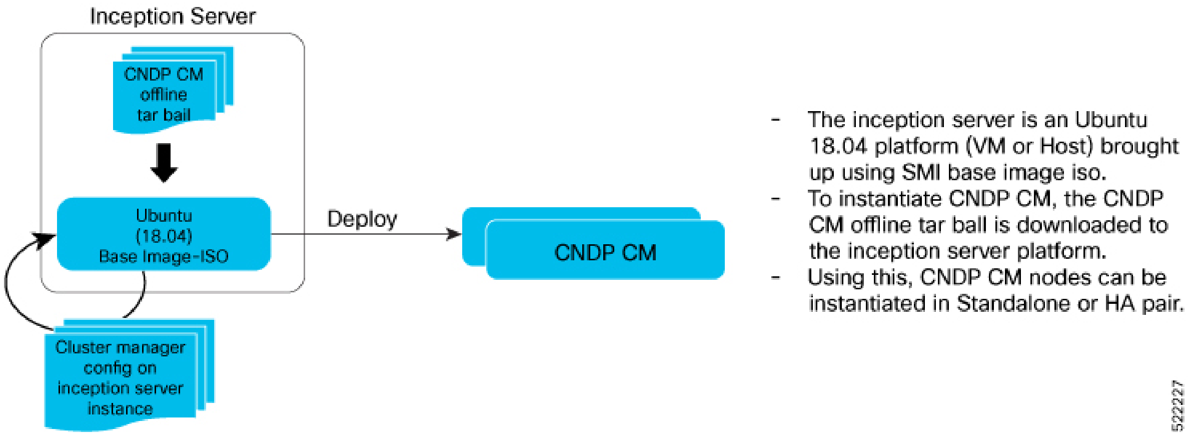
The following sections detail the prerequisites for deploying the cnBNG CNF on the AIO BareMetal Server.

Instantiating and Provisioning Inception Server Instance

The Inception server is used to deploy the CM for CNDP deployment. It is an Ubuntu 18.04 based VM installed with additional packages such as, docker, docker-compose, and its dependencies. The offline tar ball for the CNDP CM is installed on this instance and configured to deploy the CNDP CM nodes.

The following section presents the procedure on how to bring up an Inception server instance on a VM.

Figure 2: CNDP Inception VM


Inception Server
CNDP CM offline tar ball
Ubuntu (18.04) Base Image-ISO
Cluster manager config on inception server instance
Deploy
CNDP CM
- The inception server is an Ubuntu 18.04 platform (VM or Host) brought up using SMI base image iso.
- To instantiate CNDP CM, the CNDP CM offline tar ball is downloaded to the inception server platform.
- Using this, CNDP CM nodes can be instantiated in Standalone or HA pair.
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Before beginning the configuration of the Inception server, verify that all the dependent packages such as docker, docker-compose are installed on the VM. This is a prerequisite before loading the tar ball to configure and deploy the CM. If the SMI Base-ISO is used for installing Inception server, the packages are preinstalled.

Installing Cluster Manager Node

The Cluster Manager (CM) handles the installation and upgrade of the Kubernetes (K8s) cluster and associated infrastructure. In this deployment, the Inception server launches two machines that use DRBD to replicate the state to provide High Availability (HA) of the CM. This section covers the bring up procedure of the CM in standalone mode.

For High Availability CM deployment, see the "SMI Cluster Manager - Deployment" chapter of the *Ultra Cloud Core Subscriber Microservices Infrastructure - Deployment Guide*.

Configuring the Cluster Manager - Single Instance

Configure the single instance of the CM:

1. Login to the Ops Center CLI of the Inception server. Use the following steps to install and configure the CM.

   Use the IP address of the Inception server to login.

   ```
    ssh admin@<ip_address> -p 2022   (or)
   https://cli.smi-deployer.<ip_address>.nip.io
   ```

2. Configure the Inception server cluster deployer to install the CM.

Note Ensure the following before configuring the CM.

- All the passwords must be typed manually because copying and pasting the encrypted passwords from the configuration throws an error during validation
- Private key and public key must be generated in the Inception VM and copied. Both the keys must match the keys present in the Inception VM. Use the **ssh-keygen** command in the Inception VM and follow the prompts to generate the keys.
- Private key and public key are multiline commands. For instance, after typing **node-defaults ssh-connection- private-key**, press Enter to paste the keys.

For the Inception configuration, see the "SMI Cluster Manager - Deployment" chapter of the *Ultra Cloud Core Subscriber Microservices Infrastructure - Deployment Guide*.

Note Modify IPs, password, keys , username , cluster-name, and CNF name based on the specified configurations.

Installing the All-in-One Cluster

This section provides the detailed steps to deploy the CNDP AIO (K8s) cluster from the CM node. It also specifies the CLI that is used on the CM to configure and perform a cluster synchronization operation.

Configuring the AIO Cluster

This section describes the procedure to configure and deploy the CNDP AIO cluster from the CM using the CLI method.

1. Login to the CM Ops Center and load the SMI cluster, cnBNG, CEE, and Ops Center node configurations. Multiline configuration for private key must be pasted separately.

```
ssh admin@<ip_address> -p 2022
```

2. Update the Sha256 value, which was generated for the software from the previous step, in the configuration for the respective software under the sha256 section.

Note

- All the passwords must be typed manually because copying and pasting the encrypted passwords from the configuration throws an error during validation
- Private key and public key must be generated in the CM and copied in. Both the keys must match the keys present in the CM. Use the **ssh-keygen** command in the Inception VM and follow the prompts to generate the keys.

3. Before running cluster synchronization, enable detail logging using the following configuration.

```
clusters <cluster_name>
 configuration restrict-logging false exit
```

4. From the SMI cluster configuration, configure the Software CNF repository to use the cnBNG image, CEE, and include the sha256 checksum as generated previously and provide the path of the image.

   For more information, see the "SMI Cluster Manager - Deployment" chapter of the *Ultra Cloud Core Subscriber Microservices Infrastructure - Deployment Guide*.

   ```
   [inception] SMI Cluster Deployer# show running-config
   software cnf <cnf_software_version>c
    url      <repo_url>
    user     <user_name>
    password <password>
    sha256   <SHA256_hash_key>
   exit
   ```

   Example:

   ```
   Cluster Manager# config
   Cluster Manager(config)# software cnf <example=cm-2020-02-0-i06>
   Cluster Manager(config)# url <repo_url>
   Cluster Manager(config)#user <username>
   Cluster Manager(config)#password "<password>"
   Cluster Manager(config)#sha256 <sha256_key>
   Cluster Manager(config)#exit
   ```

   In this deployment model, a single AIO node is deployed.

   From a CM configuration perspective, the AIO node definition, corresponding Ops Center CEE and cnBNG instances are defined as part of a single AIO cluster.

   The following configuration snippet shows the sample configuration for a cluster from the cluster manager

   ```
   config
     software cnf <cnf_software_version>
     url <repo_url>
     user <user_name>
     password <password>
     sha256 <SHA256_hash_key>
     exit
   environments bare-metal
    ucs-server
   exit
   clusters <cluster_name> #For example, cndp-testbed
    environment bare-metal
    addons ingress bind-ip-address <IPv4address>
    addons cpu-partitioner enabled
    configuration allow-insecure-registry true
    node-defaults ssh-username <username>
    node-defaults ssh-connection-private-key
     "-----BEGIN OPENSSH PRIVATE KEY-----\n
    <SSH_private_key>
     -----END OPENSSH PRIVATE KEY-----\n"
     node-defaults initial-boot default-user <username>
     node-defaults initial-boot default-user-ssh-public-key
      "<SSH_Public_Key>"
     node-defaults initial-boot default-user-password #For example, Csco123#
     node-defaults os proxy https-proxy <proxy_server_url>
     node-defaults os proxy no-proxy <proxy_server_url/IPv4address>
     node-defaults os ntp enabled
     node-defaults os ntp servers <ntp_server>
     exit
    node-defaults initial-boot netplan ethernets <interface_name> #For example, eno1
     dhcp4 false
     dhcp6 false
     gateway4 <IPv4address>
     nameservers search <nameserver>
   ```

```
  nameservers addresses <IPv4addresses>
 exit
 node-defaults initial-boot netplan ethernets eno2 # same like eno1 other interfaces to
 be configured
  dhcp4 false                                      # without any ip address
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets eno5
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets eno6
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets enp216s0f0
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets enp216s0f1
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets enp94s0f0
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan ethernets enp94s0f1
  dhcp4 false
  dhcp6 false
 exit
 node-defaults initial-boot netplan vlans <vlan_name> #For example, vlan309
  dhcp4 false
  dhcp6 false
  id    <vlan_id> #For example, 309
  link  eno6
 exit
 node-defaults initial-boot netplan vlans <vlan_name> #For example, vlan310
  dhcp4 false
  dhcp6 false
  id    <vlan_id> #For example, 310
  link  eno6
 exit
 node-defaults initial-boot netplan vlans <vlan_name> #For example, vlan311
  dhcp4 false
  dhcp6 false
  id    <vlan_id> #For example, 311
  link  enp94s0f0
 exit
 node-defaults ucs-server cimc user admin
node-defaults ucs-server cimc storage-adaptor create-virtual-drive true
node-defaults ucs-server cimc remote-management sol enabled
node-defaults ucs-server cimc remote-management sol baud-rate 115200
node-defaults ucs-server cimc remote-management sol comport com0
node-defaults ucs-server cimc remote-management sol ssh-port 2400
node-defaults ucs-server cimc networking ntp enabled
node-defaults ucs-server cimc networking ntp servers <example: ntp.server1.com>
exit
node-defaults ucs-server cimc networking ntp servers <example: ntp.server2.com>
exit
node-defaults os ntp enabled
node-defaults os ntp servers <example: ntp.server1.com>
exit
node-defaults os ntp servers <example: ntp.server1.com>
```

```
exit

 nodes <aio>  #For example it can be master or aio
 k8s node-type master
 k8s ssh-ip <IPv4address>
 k8s node-ip <IPv4address>
 k8s node-labels disktype ssd
 exit
 k8s node-labels smi.cisco.com/node-type oam
 exit
 ucs-server cimc user admin
 ucs-server cimc password <IPv4address> #this CIMCI address of the AIO UCS SERVER
 ucs-server cimc ip-address 10.81.103.117
 initial-boot netplan ethernets eno1
 addresses [ <IPv4address-mgmt>/24 ]
 gateway4    <gateway-address>
 exit
 initial-boot netplan vlans vlan309
 addresses [ <IPv4address-k8s>/24 ]
 exit
 initial-boot netplan vlans vlan310
 addresses [ <IPv4address-SMI>/24 ]
 exit
 initial-boot netplan vlans vlan311
 addresses [ <IPv4address-services>/24 ]
 exit
exit
```

Each CNF provides a ConfD based Ops Center CLI to configure and manage the CNF pods. There is a separate Ops Center required for each CNF deployed on the AIO node.

The following is the Ops Center configuration for the AIO node, which has the Ops Center configuration for CEE and CNF.

```
ops-centers bng bng
  repository       <url> or offline-tarball
  username         <username>
  password         <password>
  ingress-hostname <ip-address>.nip.io
  initial-boot-parameters use-volume-claims false
  initial-boot-parameters first-boot-password <password>
  initial-boot-parameters auto-deploy false
  initial-boot-parameters single-node true
 exit
  ops-centers cee cee
  repository-local        cee-release-build
  sync-default-repository true
  netconf-ip            <ip-address>
  netconf-port            2024
  ssh-ip                   <ip-address>
  ssh-port                2022
  ingress-hostname        <ip-address>.nip.io
  initial-boot-parameters use-volume-claims true
  initial-boot-parameters first-boot-password <password>
  initial-boot-parameters auto-deploy true
  initial-boot-parameters single-node true
 exit
exit
```

Note To bring the network function NF at the AIO K8 cluster, always use the “initial-boot-parameters single-node true" option.

5. Run the cluster synchronization to deploy the cluster, cnBNG, and CEE Ops Centers

   ```
   clusters cndp-cm actions sync run debug true
   ```

   The cluster synchronization operation takes approximately 45 minutes to complete.

6. Monitor the cluster synchronization operation using the following command.

   ```
   monitor sync-logs cndp-cm
   ```

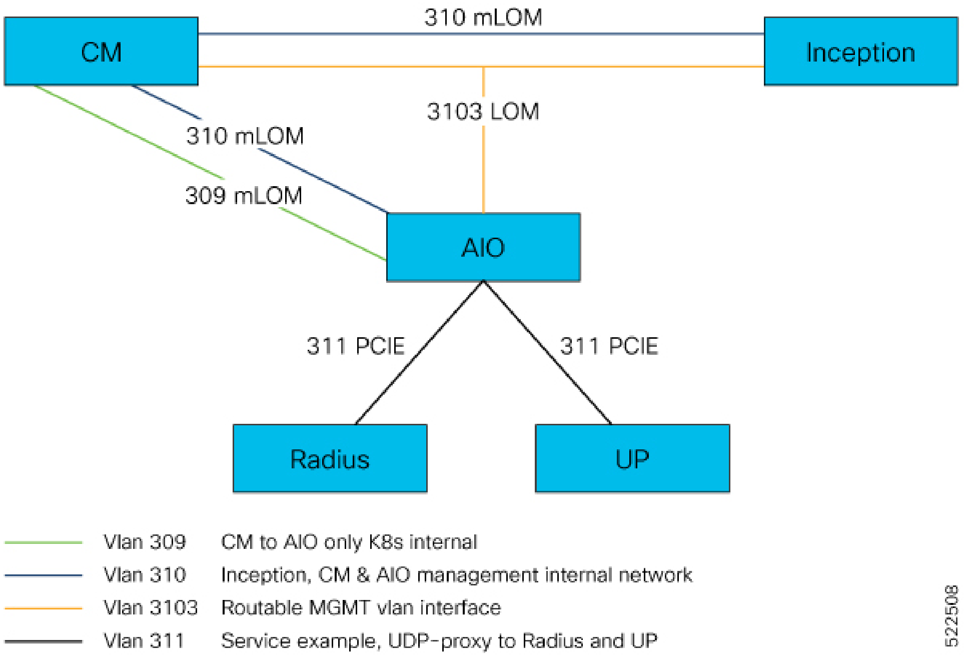
   After cluster synchronization is completed, a message is shown indicating a successful cluster synchronization.

Integrating RADIUS and UP with the AIO BareMetal Server

The RADIUS and UP are part of the services network and therefore should be part of the same network. If they are not in the same VLAN, then the necessary routing should be available to have reachability between them.

The AIO services interface is also part of the services VLAN, which has routable reachability between AIO UDP proxy interface, RADIUS, and the User Plane function (UPF).

Figure 3: Logical Network Connectivity


310 mLOM
CM
Inception
3103 LOM
310 mLOM
309 mLOM
AIO
311 PCIE
311 PCIE
Radius
UP
Vlan 309 CM to AIO only K8s internal
Vlan 310 Inception, CM & AIO management internal network
Vlan 3103 Routable MGMT vlan interface
Vlan 311 Service example, UDP-proxy to Radius and UP
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cnBNG Cluster Deployment Using Inception Server

You can now deploy the cnBNG cluster using the Inception server alone. You do not require the SMI Cluster Manager, which was previously used along with the Inception server to deploy the cnBNG cluster. This enhancement can help you save on hardware resources (servers).

Installing Inception Server on Baremetal

The procedure to install the the Inception server on baremetal is as follows:

1. Clear a Boot drive.
2. Create a virtual drive from unused physical drives.
3. Install Base ISO image.
4. Configure User and Network Parameters.
5. Install Inception Server.
6. Deploy SMI Cluster.
7. Add images to Inception Server.
8. Create SSH keys.
9. Add SMI Cluster Deployer configuration.

Clear a Boot Drive

You must clean up the server storage before installing the Base ISO image. To clear the boot drive configurations on the Cisco Integrated Management Controller (CIMC) server, perform the following steps:

1. Log in to the CIMC Web UI using admin privileges.
2. In the **Navigation** pane, click the **Storage** menu.
3. On the **Storage** menu, click the appropriate LSI MegaRAID or Host Bus Adapter (HBA) controller.

   In the **RAID Controller** area, the **Controller Info** tab is displayed by default.
4. In the **Actions** area, click **Clear Boot Drive**.

Note The **Clear Boot Drive** option is enabled only if the server was used previously. If the server is new, this option is disabled.

5. Click **OK** to confirm.

Create Virtual Drive from Unused Physical Drives

1. Log in to the CIMC Web UI using admin privileges.
2. On the **Storage** menu, click the appropriate LSI MegaRAID or HBA controller.
3. In the **Actions** area, click **Create Virtual Drive from Unused Physical Drives**.

   The **Create Virtual Drive from Unused Physical Drives** dialog box appears.
4. In the **Create Virtual Drive from Unused Physical Drives** dialog box, select **1** from the **RAID Level** drop-down list.
5. In the **Create Drive Groups** area, choose one or more physical drives to include in the group.

Use the >> button to add the drives to the **Drive Groups** table. Use the << button to remove physical drives from the drive group.

Note

- The size of the smallest physical drive in the drive group defines the maximum size used for all the physical drives. To ensure maximum use of space for all physical drives, it is recommended that the size of all the drives in the drive group are similar.
- CIMC manages only RAID controllers and not Host Bus Adapters (HBAs) attached to the server.
- You must have multiple drive groups available to create virtual drives (VDs) for certain RAID levels. While creating drives for these RAID levels, the create drive option is available only if the required number of drives are selected.

6. In the **Virtual Drive Properties** area, update the following properties:

Name	Description
Virtual Drive Name field	The name of the new virtual drive you want to create.
Read Policy drop-down list	The read-ahead cache mode.
Cache Policy drop-down list	The cache policy used for buffering reads.
Strip Size drop-down list	The size of each strip, in MB.
Write Policy drop-down list	This can be one of the following • **Write Through**— Data is written through the cache and to the physical drives. Performance is improved, because subsequent reads of that data can be satisfied from the cache. • **Write Back**— Data is stored in the cache, and is only written to the physical drives when space in the cache is needed. Virtual drives requesting this policy fall back to **Write Through** caching when the BBU cannot guarantee the safety of the cache in the event of a power failure. • **Write Back Bad BBU**—With this policy, write caching remains **Write Back** even if the battery backup unit is defective or discharged.
Disk Cache Policy drop-down list	This can be one of the following • **Unchanged**— The disk cache policy is unchanged. • **Enabled**— Allows IO caching on the disk. • **Disabled**— Disallows disk caching.
Access Policy drop-down list	This can be one of the following • **Read Write**— Enables host to perform read-write on the VD. • **Read Only**— Host can only read from the VD. • **Blocked**— Host can neither read nor write to the VD.

Name	Description
Size field	The size of the virtual drive (VD) you want to create. Enter a value and select one of the following units: • MB • GB • TB

7. Click **Create Virtual Drive**.
8. After the virtual drive is created, click the **Virtual Drive Info** tab.

   In the **Virtual Drives** area, choose the drive from which the controller must boot, and then click **Set as Boot Drive**.
9. Click **OK** to confirm.

Install Base ISO image

Perform the following steps to install the Base ISO image.

1. Log in to the CIMC Web UI using admin privileges.
2. Click the **Virtual KVM** tab.
3. In the **Actions** area, click **Launch KVM Console**.
4. Click the **Virtual Media** menu, and click **Activate Virtual Devices**. A virtual media session is activated, and that allows you to attach a drive or image file from your local computer or network.
5. Click the **Virtual Media** menu again, and select **Map CD/DVD**. You can map a CD or a DVD image from your local machine and map the drive to the image.
6. Browse, and select the Base ISO image from the image folder.
7. From the tool bar, click the **Host Power** link. Select **Power Cycle** from the drop-down list. The chosen server is powered on with the mapped Base ISO image.
8. From the tool bar, click **Launch KVM**. The **KVM Console** opens in a separate window.
9. Once you see the login prompt and other options, press the **F6** function key.
10. On the boot menu, select the CIMC based vKVM-Mapped option to which the Base ISO image is mapped.

    The server boots with the required ISO image.
11. Using CIMC, you can also configure the order in which the server attempts to boot from the available boot device types.
    a. Click the **Compute** menu.
    b. In the **BIOS** tab, click the **Configure Boot Order** tab. **Configure Boot Order** dialog box appears.
    c. In the **Configure Boot Order** dialog box, you can select the order of boot, and click **Save Changes**.

12. Power cycle the server to trigger the Base ISO installation. You can view the installation status in the KVM console.

Configure User and Network Parameters

Before installing the Inception server you must configure the user and network parameters.

To configure the network and static IP addressing:

1. Login with the default *cloud-init* credentials.

   Note You must change the password immediately after logging in.

2. Update the network configuration in `/etc/netplan/50-cloud-init.yaml` file.

   The following is a sample network configuration:

```
network:
   ethernets:
     eno1:
       addresses:
      - 10.0.0.20/8
      dhcp4: false
      gateway4: 10.197.209.193
      nameservers:
         addresses:
        - 10.104.128.236
        - 10.163.128.140
        - 10.37.142.73
version: 2
```

3. Run the following command to apply the configuration:

```
sudo netplan apply
```

4. To preserve hostname or make the hostname persistent after reboot, you must edit the cloud configuration file:

```
sudo vi /etc/cloud/cloud.cfg
```

   Set **preserve_hostname: true**

5. Modify the hostname.

```
sudo hostnamectl set-hostname hostname
sudo vi /etc/hosts
127.0.0.1 hostname
```

Install Inception Server

Perform the following steps to install the Inception server:

1. Copy the SMI offline package to the images folder.

   Example:

```
cloud-user@cnbng4-cxbgl:/data/software/images$ pwd /data/software/images
cloud-user@cnbng4-cxbgl:/data/software/images$
```

2. Untar the the downloaded file.

   Example:

   ```
   cloud-user@cnbng4-cxbgl:/data/software/images$ tar -xvf
   cluster-deployer-2023.01.1.i18.tar
   ```

3. Navigate to the `deployer-inception` folder which has the required charts and docker files.

   Example:

   ```
   cd /data/deployer-inception/
   ```

4. Run the following command to install the Inception server.

   Example:

   ```
   sudo ./deploy --external-ip external_ipaddress --first-boot-password
   first_boot_password
   ```

Note The *external_ipaddress* is the management IP address of the inception server.

Deploy SMI Cluster

Perform the following steps to deploy the SMI cluster:

1. Log in to the cluster using the following:

   ```
   ssh admin@<ip_address> -p 2022
   ```

2. Add the cluster level configurations for one or more K8s clusters.

Add Images to Inception Server

1. Fetch the offline tarball for SMI, cnBNG, & CEE and save it to the `/data/software/images` folder. You can fetch the tarball either from the artifactory or copy it securely through the **scp** or **winscp** command.

2. Untar the offline tarball, and copy the tar file to the respective path.

   Example:

   ```
   root@cnbng-inception:/data/downloads# tar -xvzf bng.2020.04.m0.i37.SSA.tgz ./
   ./bng.2020.04.m0.i37.tar.SSA.README
   ./CNBNG_DEV_KEY-CCO_DEV.cer
   ./trca.cer
   ./Innerspace_DEV.cer ./cisco_x509_verify_dev.py ./bng.2020.04.m0.i37.tar.signature.SSA
   ./bng.2020.04.m0.i37.tar
   ```

3. Generate **sha256** checksum for the images and verify them with artifactory checksum.

   Example:

   ```
   cloud-user@cnbng4-cxbgl:/data/software/images$ sudo sha256sum bng.2020.04.m0.i37.tar
   2e4fe956daf4afa13909d6fa89be5e727b9e4c03619436ecd04805045b780c0b bng.2020.04.m0.i37.tar
   cloud-user@cnbng4-cxbgl:/data/software/images$ sudo sha256sum cee-2023.01.1.i18.tar
   320e61f56976a2c107fa489a2a12d16301671f28212ec5b7d902b608d2e6ab80 cee-2023.01.1.i18.tar
   ```

```
cloud-user@cnbng4-cxbgl:/data/software/images$ sudo sha256sum cluster-deployer-
2023.01.1.i18.tar
929dd80a840483f65a9f4afa314144f0f544e3bee23703214c03c831465ae707 cluster-deployer-
2023.01.1.i18.tar
```

4. Add the images to Inception deployer cluster configuration. The inception deployer uses cnBNG & CEE images from the provided file path to bring up cnBNG control plane & CEE ops-center.

   Example:

```
software cnf cnbng
url file:///data/software/images/bng.2020.04.m0.i37.tar
sha256 2e4fe956daf4afa13909d6fa89be5e727b9e4c03619436ecd04805045b780c0b
exit
software cnf cee-2023.01.1.i18
url file:///data/software/images/cee-2023.01.1.i18.tar
sha256 320e61f56976a2c107fa489a2a12d16301671f28212ec5b7d902b608d2e6ab80
exit
software host-profile bios-ht-25
url file:///data/software/images/ht.tgz
sha256 aa7e240f2b785a8c8d6b7cd6f79fe162584dc01b7e9d32a068be7f6e5055f664
exit
environments bare-metal
ucs-server
exit
!
```

Generate SSH Keys

Generate SSH public and private keys.

Example:

```
cloud-user@inception-28:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
Created directory '/root/.ssh'.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa.
Your public key has been saved in /root/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:YQ3OfuEinrurnkkFlLW/vBDu5Zkti8zMt8dfIxpgYIE ubuntu@nfs-server-cn-svi
The key's randomart image is:
+---[RSA 2048]----+
| .+o . |
| .E = o |
| . + = o |
| o = o . |
| + S o |
| + * = |
| . = +.. . o |
| . O *o=oo o . |
| .=.@+B=o.. |
+----[SHA256]-----+
cloud-user@inception-28:~/.ssh$ ls -ltr ~/.ssh/*id*
-rw------- 1 cloud-user cloud-user 577 Jan 19 2023 /home/cloud-user/.ssh/id_rsa.pub
-rw------- 1 cloud-user cloud-user 2484 Jan 19 2023 /home/cloud-user/.ssh/id_rsa
```

Add SMI Cluster Deployer Configuration

Perform the following steps to add the SMI Cluster Deployer configurations:

1. **Log in to the SMI cluster deployer.**

   Example:

   ```
   cloud-user@incep.on-28:~$ ssh admin@127.0.0.1 -p 2022
   admin@127.0.0.1's password:
   Welcome to the Cisco SMI Cluster Deployer on inception-28
   Copyright Â© 2016-2020, Cisco Systems, Inc.
   All rights reserved.
   admin connected from 10.0.1.1 using ssh on c0993db6451a
   ```

2. Add SSH-keys to the Inception Manager.

   Example:

   ```
   clusters <cluster_name>
   environment bare-metal
   node-defaults initial-boot default-user-ssh-public-key
   "<SSH_Public_key>"
   node-defaults ssh-connection-private-key
   "-----BEGIN OPENSSH PRIVATE KEY-----
   <SSH_Private_Key>
   -----END OPENSSH PRIVATE KEY-----\n"
   CNTRL+D
   ```

3. Add CNF to clusters.

   You can either download CNF images from online repositories, web servers, or local servers, or copy the tarball images to the Inception server folder and configure the folder path.

4. You can verify the configuration using the following command:

   ```
   SMI Cluster Deployer# show running-config
   software cnf cee-2023.01.1.i18
   url file:///data/software/images/cee-2023.01.1.i18.tar
   sha256 320e61f56976a2c107fa489a2a12d16301671f28212ec5b7d902b608d2e6ab80
   exit
   software cnf cnbng
   url file:///data/software/images/bng-dev-private.tar
   sha256 2e4fe956daf4afa13909d6fa89be5e727b9e4c03619436ecd04805045b780c0b
   exit
   software host-profile bios-ht-25
   url file:///data/software/images/ht.tgz
   sha256 aa7e240f2b785a8c8d6b7cd6f79fe162584dc01b7e9d32a068be7f6e5055f664
   exit
   ```

cnBNG Cluster Deployment Support on Red Hat OpenShift

Starting with Release 2025.01, the cnBNG control-plane can also be deployed on a Red Hat OpenShift cluster.

Supported Functionalities:

The following functionalities are supported:

- OpenShift Container Platform (OCP) versions 4.16 and 4.17 are supported.
- Single Node OpenShift (SNO) is supported.
- Both cnBNG Standalone and CP-GR are supported.
- Only IPOE is supported.

- Compatible with IPv4-only and dual-stack configurations.

Requirements:

The following software versions are required:

- CEE version: 2025.01 or above
- cnBNG-CP version: 2025.01.0 or above

Monitoring and Management:

The following monitoring and management functionalities are available:

- Monitoring dashboards are available via CEE.
- Local storage support is provided through CEE.
- Cisco TAC debug support is available through CEE.
- Log and metric forwarding capabilities are provided via CEE.

ISTIO:

ISTIO is not supported.

Note This guide does not cover the installation of the OpenShift cluster or the setup of Helm and the Docker registry.

Set Up the cnBNG Application on an OCP Cluster

After installing the OpenShift Container Platform (OCP) cluster, follow these steps to set up the cnBNG application:

1. Add the hostname to the `/etc/hosts` file.
2. Assign the necessary node labels.
3. Execute the following command to enable support for external IP addresses:

   ```
   oc patch network cluster --type merge -p '{ "spec": { "externalIP": { "policy":
   {"allowedCIDRs": ["0.0.0.0/0", "::/0"]}}}}'
   ```

4. Add Helm and Docker repositories for the BNG and CEE charts.
5. Install the **cee-ops-center** and **bng-ops-center** charts using the specified inputs.

   Ensure that your configuration includes the following global settings:

   ```
   global:
     registry: <docker-registry>
     istio: false
     singleNode: true
     useVolumeClaims: true
     caasModel: "openshift"
     pathBasedIngress: false
     smiNfMonitoring: true
     smiPlatformMonitoring: true
     ingressHostname: <ingress>
     imagePullPolicy: IfNotPresent
   ```

```
imagePullSecrets:
  - name: <secret-name>
networkPolicy:
  enabled: false
```

The CLI commands for `bng-ops-center` and `cee-ops-center` are consistent with CNDP, allowing you to enable additional functionalities using the same setup.

Maintenance Operation Procedure (MOP) for cnBNG Node Scaling

The current solution for a cnBNG Control Plane consists of two racks working together to provide high availability. Each rack contains four Kubernetes (K8s) clusters and is in the process of scaling up to a fifth Kubernetes cluster.

This MOP outlines the steps to scale a cnBNG Control Plane deployment from Half-Rack to Full-Rack.

The procedure includes

- adding new servers
- scaling up Kubernetes (K8s) clusters
- scaling up CDL, and
- scaling up services.

Before you begin

Perform these steps prior to the actual maintenance window.

- Generate configuration files for K8s node scale up.
  - Prepare and review the config change payload for scaling up each cluster.
  - Verify that label configuration is in line with the current pod.
  - Load and merge change payload files into the Deployer configuration and perform a commit dry-run.
  - Verify that all changes are as per the expectation.
  - Exit Deployer config mode without issuing a commit.

Note Actual commits are done during the maintenance window.

Estimated Time for Procedure

Time for	Time taken
Adding new servers Wiring up the new servers Configure the switches	1 day
Scale up – Rack1 – CDL+Service	90m
Scale up – Rack2 – CDL+Service	90m
Scale up – CDL	60 ~ 90m

Software Used

Software For	Software Version
cnBNG	CNBNG-2024.03.0

Adding and Wiring New Servers

1. Update the firmware.

   Ensure that new servers have the same firmware version as existing nodes.

Note This step should be done prior to the actual maintenance window before racking the servers in the pod.

2. Install and wire servers.
   - Install new servers in the same rack as existing servers.
   - Wire servers using available ports in current switches.
3. Power up servers.
4. Verify that there are no existing boot or virtual disks on these new servers.
5. Ensure that disks appear as Unconfigured-good.
6. Check the CIMC IP addresses of these new servers for connectivity.
7. Configure switch ports.
   - Configure leaf switch ports for new servers.

     Use the same configuration as other leaf ports connected to existing worker nodes.
   - Verify from the ClusterManager Linux shell that you can ping CIMC IP addresses of new nodes.

Scale Up Kubernetes Cluster

You must scale up the Kubernetes cluster in each rack of the pod.

Follow these steps to scale up the Kubernetes cluster:

1. Perform a planned GR switchover to move all cnBNG instances to the RackInService as primary.

Note RackInService refers to the rack hosting all primary GR instances of all cnBNGs in the pod.

2. Reset states of cnBNG GR instances in STANDBY_ERROR state to STANDBY state in RackBeingScaled.

Note RackBeingScaled refers to the rack undergoing K8s node scaling.

3. Verify that all GR instances in RackInService are in PRIMARY state and those in RackBeingScaled are in STANDBY state.
4. Set geo-maintenance mode in all cnBNGs in both RackBeingScaled and RackInService.
5. Shut down all cnBNGs in RackBeingScaled.
6. Add the configuration in Deployer via CLI or NSO load merge config change payload files to scale up RackBeingScaled.

   See the section "K8s Cluster scale-up config example" for example configuration.
7. Manually add networks in the netplan on the new server.
   - Command: **sudo vi /etc/netplan/50-cloud-init.yaml**
   - Apply: **sudo netplan apply**

Note If the server is new, you don't have to add netplan manually. If you are reusing a server, write a netplan manually.

8. [**Optional**] If you are reusing an existing server, reset it using the CLI command:
   - **kubeadm reset --force**
   - Clean up (delete) the virtual drive by logging into the CIMC of that server.
9. Issue a cluster sync to scale up RackBeingScaled.
   - Command: **clusters svi-cnbng-gr-tb1 actions sync run debug true**
10. Monitor the cluster sync progress by logging into the Cluster Manager.
11. Verify if all nodes in the K8s cluster in RackBeingScaled are in ready state.
12. Verify if all pods in the K8s cluster in RackBeingScaled are in good running state.
13. Start up all cnBNGs in RackBeingScaled.
14. Verify if the added nodes appear in the cnBNG Ops Center configurations.

15. Verify if both GR instances of all cnBNGs in RackBeingScaled are in STANDBY state.

16. Unset geo-maintenance mode in all cnBNGs in both RackBeingScaled and RackInService

Post-Requirements:

Repeat this procedure to scale up K8s cluster in each rack of the Pod.

Scale Up CDL

Follow these steps to scale up the CDL:

1. Verify that all cnBNGs in the pod are in good state.

2. Update CDL Grafana dashboard to monitor the total number of index keys that have been rebalanced.

   - **Query**: sum(index_rebalanced_keys_total{namespace="$namespace"}) by (cdl_slice, shardId, pod)

   - **Legend**: irkt-{{cdl_slice}}-{{shardId}}-{{pod}}

Note CDL rebalancing happens once the CDL rebalance query is issued.

3. Make rack-1 as ACTIVE and rack-2 as STANDBY.

   a. Unset geo maintenance mode in all cnBNGs in both racks (if previously set).

   b. Make both GR instances of all cnBNGs in Rack1 PRIMARY.

   c. Make both GR instances of all cnBNGs in Rack2 STANDBY.

   d. Set geo maintenance mode in all cnBNGs in both racks.

4. Add configuration changes to Rack2 (STANDBY)

   a. Shut down all cnBNGs in Rack2.

   b. Add configuration changes to all cnBNGs in Rack2 (see "*CDL Configuration changes*" section).

   c. Start up all cnBNGs in Rack2.

5. Verify the cnBNG State

   - Ensure that all cnBNGs are in good state.

   - Both GR instances in all cnBNGs in Rack2 should be in STANDBY state.

   - Both GR instances in all cnBNGs in Rack1 should be in PRIMARY state.

6. Verify CDL indices and slots sync

   a. Verify if CDL indices and slots in Rack2 can sync with remote peers (may take ~15 mins).

7. Switch rack states

   - Unset geo maintenance mode in all cnBNGs in both racks.

- Make both GR instances of all cnBNGs in Rack2 PRIMARY.
- Make both GR instances of all cnBNGs in Rack1 STANDBY.
- Set geo maintenance mode in all cnBNGs in both racks.

8. Add configuration changes to Rack1 (STANDBY)

a. Shut down all cnBNGs in Rack1.

b. Add configuration changes to all cnBNGs in Rack1 (see "*CDL Configuration changes*" section).

c. Start up all cnBNGs in Rack1.

9. Verify the state of all cnBNGs.

- Ensure that all cnBNGs are in good state.
- Both GR instances in all cnBNGs in Rack1 should be in STANDBY state.
- Both GR instances in all cnBNGs in Rack2 should be in PRIMARY state.

10. Verify if CDL indices and slots in Rack1 can sync with remote peers (may take ~15 mins).

11. Trigger CDL index rebalancing.

- Issue the following command in all cnBNGs in the current STANDBY rack:

  cdl rebalance-index run

12. Verify CDL index rebalancing completion.

a. Monitor progress with the following command in the STANDBY rack cnBNG:

cdl rebalance-index status

b. Validate rebalancing with the following command in the STANDBY rack cnBNG:

cdl rebalance-index validate

13. Remove CDL scale up mode configuration:

```
config
  cdl datastore session
  no mode
  commit
  end
```

14. Unset Geo maintenance mode in all cnBNGs in both racks.

15. Initiate GR switchovers

Switch all cnBNGs in the pod to ACTIVE-ACTIVE mode.

16. Verify that all cnBNGs are operating in sunny day mode.

Scale Up Services

You can now scale up cnBNG Services.

Note There is no restriction to always scale up Cluster1 before Cluster2. You can scale up any cluster first, depending on the existing role set on the cluster.

Follow these steps to scale up cnBNG services:

1. Make Rack-1 Active and Rack-2 Standby
    - Unset geo maintenance mode in all cnBNGs in both racks (if previously set).
    - Make both GR instances of all cnBNGs in Rack1 PRIMARY.
    - Make both GR instances of all cnBNGs in Rack2 STANDBY.
    - Set geo maintenance mode in all cnBNGs in both racks.
2. Add configuration changes in Rack-2 (STANDBY).
    a. Shut down all cnBNGs in Rack2.
    b. Add the configuration changes to all cnBNGs in Rack2 (see the "Service scaleup config changes" section).
    c. Start up all cnBNGs in Rack2.
3. Verify the cnBNG state.
    - Ensure that all cnBNGs are in good state.
    - Both GR instances in all cnBNGs in Rack2 should be in STANDBY state.
    - Both GR instances in all cnBNGs in Rack1 should be in PRIMARY state.
4. Verify that the scale-up configuration changes are applied (may take approximately 15 mins).
5. Make Rack-2 active and Rack-1 standby
    a. Unset geo maintenance mode in all cnBNGs in both racks.
    b. Make both GR instances of all cnBNGs in Rack2 PRIMARY.
    c. Make both GR instances of all cnBNGs in Rack1 STANDBY.
    d. Set Geo maintenance mode in all cnBNGs in both racks.
6. Add configuration changes in Rack-1 (STANDBY)
    a. Shutdown all cnBNGs in Rack1.
    b. Add the configuration changes to all cnBNGs in Rack1 (see *"Service Scale up Configuration"* section).
    c. Start up all cnBNGs in Rack1.
7. Verify the cnBNG State.
    - Ensure that all cnBNGs are in good state.

- Both GR instances in all cnBNGs in Rack1 should be in STANDBY state.
- Both GR instances in all cnBNGs in Rack2 should be in PRIMARY state.

8. Verify that the scale-up configuration changes are applied (may take ~15 mins).
9. Remove the geo maintenance mode in both clusters.
10. Move both CP-GR clusters to their original state.

Configuration Examples

K8s Cluster Scale Up:

Scale up configurations for both the servers are available in the following combinations:

- Node Scaling for Service only
- Node Scaling for CDL only
- Node Scaling for both CDL and Service

Node Scaling for Service Only

Cluster1 Node5 Deployer Configuration	Cluster2 Node5 Deployer Configuration

clusters svi-cnbng-gr-tb1
 nodes server-5
  host-profile bng-ht-sysctl-enable
  k8s node-type worker
  k8s ssh-ip 1.1.111.15
  k8s ssh-ipv6 2002:4888:1:1::111:15
  k8s node-ip 1.1.111.15
  k8s node-ipv6 2002:4888:1:1::111:15
  k8s node-labels smi.cisco.com/svc-type service
  exit
  ucs-server cimc ip-address 10.81.103.78
  initial-boot netplan vlans bd0.mgmt.3103
   addresses [10.81.103.119/24]
   gateway4 10.81.103.1
  exit
  initial-boot netplan vlans bd1.k8s.111
   addresses [1.1.111.15/24 2002:4888:1:1::111:15/112]
   routes 203.203.203.50/32 1.1.111.1
   exit
   routes 2002:4888:203:203::203:50/128 2002:4888:1:1::111:1
   exit
  exit
  initial-boot netplan vlans bd1.inttcp.104
   dhcp4   false
   dhcp6   false
   addresses [1.1.104.15/24 2002:4888:1:1::104:15/112]
   id   104
   link   bd1
   routes 2.2.104.0/24 1.1.104.1
   exit
   routes 2002:4888:2:2::104:0/112 2002:4888:1:1::104:1
   exit
  exit
  os tuned enabled
 exit
exit
	clusters svi-cnbng-gr-tb2
	 nodes server-5
	  host-profile bng-ht-sysctl-enable
	  k8s node-type worker
	  k8s ssh-ip 2.2.112.15
	  k8s ssh-ipv6 2002:4888:2:2::112:15
	  k8s node-ip 2.2.112.15
	  k8s node-ipv6 2002:4888:2:2::112:15
	  k8s node-labels smi.cisco.com/svc-type service
	  exit
	  ucs-server cimc ip-address 10.81.103.58
	  initial-boot netplan vlans bd0.mgmt.3103
	   addresses [10.81.103.68/24]
	   gateway4 10.81.103.1
	  exit
	  initial-boot netplan vlans bd1.inttcp.104
	   dhcp4 false
	   dhcp6 false
	   addresses [2.2.104.15/24 2002:4888:2:2::104:15/112]
	   id 104
	   link bd1
	   routes 1.1.104.0/24 2.2.104.1
	   exit
	   routes 2002:4888:1:1::104:0/112 2002:4888:2:2::104:1
	   exit
	  exit
	  initial-boot netplan vlans bd1.k8s.112
	   addresses [2.2.112.15/24 2002:4888:2:2::112:15/112]
	   routes 203.203.203.50/32 2.2.112.1
	   exit
	   routes 2002:4888:203:203::203:50/112 2002:4888:2:2::112:1
	   exit
	  exit
	  os tuned enabled
	 exit
	exit

Node Scaling for CDL Only

<table>
<tr><th>Cluster1 Node5 Deployer Configuration</th><th>Cluster2 Node5 Deployer Configuration</th></tr>
<tr><td><pre>
clusters svi-cnbng-gr-tb1
 nodes server-5
  host-profile bng-ht-sysctl-enable
  k8s node-type worker
  k8s ssh-ip 1.1.111.15
  k8s ssh-ipv6 2002:4888:1:1::111:15
  k8s node-ip 1.1.111.15
  k8s node-ipv6 2002:4888:1:1::111:15
  k8s node-labels smi.cisco.com/sess-type
cdl-node
  exit
  ucs-server cimc ip-address 10.81.103.78
  initial-boot netplan vlans bd0.mgmt.3103
   addresses [10.81.103.119/24]
   gateway4 10.81.103.1
  exit
  initial-boot netplan vlans bd1.cdl.103
   dhcp4   false
   dhcp6   false
   addresses [1.1.103.15/24
2002:4888:1:1::103:15/112]
   id   103
   link   bd1
   routes 2.2.103.0/24 1.1.103.1
   exit
   routes 2002:4888:2:2::103:0/112
2002:4888:1:1::103:1
   exit
  exit
  initial-boot netplan vlans bd1.k8s.111
   addresses [1.1.111.15/24
2002:4888:1:1::111:15/112]
   routes 203.203.203.50/32 1.1.111.1
   exit
   routes 2002:4888:203:203::203:50/128
2002:4888:1:1::111:1
   exit
  exit
  os tuned enabled
 exit
exit
</pre></td><td><pre>
clusters svi-cnbng-gr-tb2
 nodes server-5
  host-profile bng-ht-sysctl-enable
  k8s node-type worker
  k8s ssh-ip 2.2.112.15
  k8s ssh-ipv6 2002:4888:2:2::112:15
  k8s node-ip 2.2.112.15
  k8s node-ipv6 2002:4888:2:2::112:15
  k8s node-labels smi.cisco.com/sess-type
cdl-node
  exit
  ucs-server cimc ip-address 10.81.103.58
  initial-boot netplan vlans bd0.mgmt.3103
   addresses [10.81.103.85/24]
   gateway4 10.81.103.1
  exit
  initial-boot netplan vlans bd1.cdl.103
   dhcp4   false
   dhcp6   false
   addresses [2.2.103.15/24
2002:4888:2:2::103:15/112]
   id   103
   link   bd1
   routes 1.1.103.0/24 2.2.103.1
   exit
   routes 2002:4888:1:1::103:0/112
2002:4888:2:2::103:1
   exit
  exit
  initial-boot netplan vlans bd1.k8s.112
   addresses [2.2.112.15/24
2002:4888:2:2::112:15/112]
   routes 203.203.203.50/32 2.2.112.1
   exit
   routes 2002:4888:203:203::203:50/112
2002:4888:2:2::112:1
   exit
  exit
  os tuned enabled
 exit
exit
</pre></td></tr>
</table>

Node Scaling for both CDL and Services

Cluster1 Node5 Deployer configuration	Cluster2 Node5 Deployer configuration

```
clusters svi-cnbng-gr-tb1
 nodes server-5
  host-profile bng-ht-enable
  k8s node-type worker
  k8s ssh-ip 1.1.111.15
  k8s ssh-ipv6 2002:4888:1:1::111:15
  k8s node-ip 1.1.111.15
  k8s node-ipv6 2002:4888:1:1::111:15
  k8s node-labels smi.cisco.com/sess-type
cdl-node
  exit
  k8s node-labels smi.cisco.com/svc-type
service
  exit
  ucs-server cimc ip-address 10.81.103.78
  initial-boot netplan vlans bd0.mgmt.3103
   addresses [ 10.81.103.119/24 ]
   gateway4  10.81.103.1
  exit
  initial-boot netplan vlans bd1.inttcp.104
   dhcp4     false
   dhcp6     false
   addresses [ 1.1.104.15/24
2002:4888:1:1::104:15/112 ]
   id        104
   link      bd1
   routes 2.2.104.0/24 1.1.104.1
   exit
   routes 2002:4888:2:2::104:0/112
2002:4888:1:1::104:1
   exit
  exit
  initial-boot netplan vlans bd1.cdl.103
   dhcp4     false
   dhcp6     false
   addresses [ 1.1.103.15/24
2002:4888:1:1::103:15/112 ]
   id        103
   link      bd1
   routes 2.2.103.0/24 1.1.103.1
   exit
   routes 2002:4888:2:2::103:0/112
2002:4888:1:1::103:1
   exit
  exit
  initial-boot netplan vlans bd1.k8s.111
   addresses [ 1.1.111.15/24
2002:4888:1:1::111:15/112 ]
   routes 203.203.203.50/32 1.1.111.1
   exit
   routes 2002:4888:203:203::203:50/128
2002:4888:1:1::111:1
   exit
  exit
  os tuned enabled
 exit
exit
```

```
clusters svi-cnbng-gr-tb2
 nodes server-5
  host-profile bng-ht-enable
  k8s node-type worker
  k8s ssh-ip 2.2.112.15
  k8s ssh-ipv6 2002:4888:2:2::112:15
  k8s node-ip 2.2.112.15
  k8s node-ipv6 2002:4888:2:2::112:15
  k8s node-labels smi.cisco.com/sess-type
cdl-node
  exit
  k8s node-labels smi.cisco.com/svc-type
service
  exit
  ucs-server cimc ip-address 10.81.103.58
  initial-boot netplan vlans bd0.mgmt.3103
   addresses [ 10.81.103.85/24 ]
   gateway4  10.81.103.1
  exit
  initial-boot netplan vlans bd1.inttcp.104
   dhcp4     false
   dhcp6     false
   addresses [ 2.2.104.15/24
2002:4888:2:2::104:15/112 ]
   id        104
   link      bd1
   routes 1.1.104.0/24 2.2.104.1
   exit
   routes 2002:4888:1:1::104:0/112
2002:4888:2:2::104:1
   exit
  exit
  initial-boot netplan vlans bd1.cdl.103
   dhcp4     false
   dhcp6     false
   addresses [ 2.2.103.15/24
2002:4888:2:2::103:15/112 ]
   id        103
   link      bd1
   routes 1.1.103.0/24 2.2.103.1
   exit
   routes 2002:4888:1:1::103:0/112
2002:4888:2:2::103:1
   exit
  exit
  initial-boot netplan vlans bd1.k8s.112
   addresses [ 2.2.112.15/24
2002:4888:2:2::112:15/112 ]
   routes 203.203.203.50/32 2.2.112.1
   exit
   routes 2002:4888:203:203::203:50/112
2002:4888:2:2::112:1
   exit
  exit
  os tuned enabled
 exit
exit
```

CDL Configuration Changes

CDL Scale-up Configuration on Cluster1	CDL Scale-up Configuration on Cluster2

CDL Scale-up Configuration on Cluster1	CDL Scale-up Configuration on Cluster2
cdl datastore session	cdl datastore session
label-config session	label-config session
geo-remote-site [2]	geo-remote-site [1]
mode scale-up	**mode scale-up**
slice-names [1 2]	slice-names [1 2]
overload-protection disable true	overload-protection disable true
endpoint go-max-procs 16	endpoint go-max-procs 16
endpoint replica 3	**endpoint replica 3**
endpoint copies-per-node 2	endpoint copies-per-node 2
endpoint settings slot-timeout-ms 750	endpoint settings slot-timeout-ms 750
endpoint external-ip 1.1.103.100	endpoint external-ip 2.2.103.100
endpoint external-ipv6 2002:4888:1:1::103:100	endpoint external-ipv6 2002:4888:2:2::103:100
endpoint external-port 8882	endpoint external-port 8882
index go-max-procs 8	index go-max-procs 8
index replica 2	index replica 2
index prev-map-count 2	**index prev-map-count 2**
index map 3	**index map 3**
features instance-aware-notification enable true	features instance-aware-notification enable true
features instance-aware-notification system-id 1	features instance-aware-notification system-id 1
slice-names [1]	slice-names [1]
exit	exit
features instance-aware-notification system-id 2	features instance-aware-notification system-id 2
slice-names [2]	slice-names [2]
exit	exit
slot go-max-procs 8	slot go-max-procs 8
slot replica 2	slot replica 2
slot map 6	**slot map 6**
slot notification limit 1500	slot notification limit 1500
slot notification max-concurrent-bulk-notifications 20	slot notification max-concurrent-bulk-notifications 20
exit	exit
cdl label-config session	cdl label-config session
endpoint key smi.cisco.com/sess-type	endpoint key smi.cisco.com/sess-type
endpoint value cdl-node	endpoint value cdl-node
slot map 1	slot map 1
key smi.cisco.com/sess-type	key smi.cisco.com/sess-type
value cdl-node	value cdl-node
exit	exit
slot map 2	slot map 2
key smi.cisco.com/sess-type	key smi.cisco.com/sess-type
value cdl-node	value cdl-node
exit	exit
slot map 3	slot map 3
key smi.cisco.com/sess-type	key smi.cisco.com/sess-type
value cdl-node	value cdl-node
exit	exit
slot map 4	slot map 4
key smi.cisco.com/sess-type	key smi.cisco.com/sess-type
value cdl-node	value cdl-node
exit	exit
slot map 5	**slot map 5**
key smi.cisco.com/sess-type	**key smi.cisco.com/sess-type**
value cdl-node	**value cdl-node**
exit	**exit**
slot map 6	**slot map 6**
key smi.cisco.com/sess-type	**key smi.cisco.com/sess-type**

CDL Scale-up Configuration on Cluster1	CDL Scale-up Configuration on Cluster2
value cdl-node	**value cdl-node**
exit	**exit**
index map 1	index map 1
key smi.cisco.com/sess-type	key smi.cisco.com/sess-type
value cdl-node	value cdl-node
exit	exit
index map 2	index map 2
key smi.cisco.com/sess-type	key smi.cisco.com/sess-type
value cdl-node	value cdl-node
exit	exit
index map 3	**index map 3**
key smi.cisco.com/sess-type	**key smi.cisco.com/sess-type**
value cdl-node	**value cdl-node**
exit	**exit**
exit	exit

The commands that are required for node scaling are highlighted.

Service Scale up Configuration

Scaling up services by increasing replica counts and nodes is supported. Reducing replicas and nodes is not supported and it will impact the system.

Existing Configuration	Service Scale Up Configuration in Both Clusters
instance instance-id 1	instance instance-id 1
endpoint dhcp	endpoint dhcp
replicas 4	replicas 4
nodes 2	**nodes 3**
exit	exit
exit	exit
endpoint sm	endpoint sm
replicas 6	replicas 6
nodes 2	**nodes 3**
exit	exit
exit	exit
instance instance-id 2	instance instance-id 2
endpoint dhcp	endpoint dhcp
replicas 4	replicas 4
nodes 2	**nodes 3**
exit	exit
exit	exit
endpoint sm	endpoint sm
replicas 6	replicas 6
nodes 2	**nodes 3**
exit	exit
exit	exit