



# cnBNG Installation and Configuration

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## 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 |
| Introduced Maintenance Operation Procedure (MOP) for cnBNG Node Scaling. | 2024.03.0 |

| Revision Details                                                        | Release   |
|-------------------------------------------------------------------------|-----------|
| Introduced support for cnBNG Cluster Deployment Using Inception Server. | 2023.04.0 |

## 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

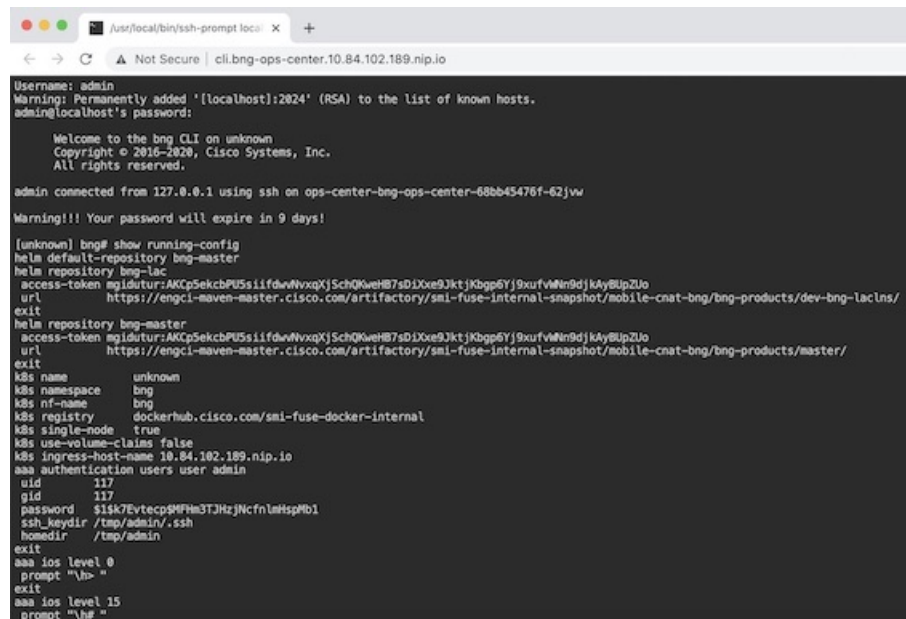
To access the offline or online repository, contact your Cisco Account Manager or representative to get access to the offline or online repository.

## 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.



```

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
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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:AKCp5ekcbPU5siifdwWvxqXj5chQKweH7sdIXe9JktjKbpg6Yj9xufvWn9djkay8lp2Uo
url https://engcl-maven-master.cisco.com/artifactory/smi-fuse-internal-snapshot/mobile-cnat-bng/bng-products/dev-bng-lac/lac/
exit
helm repository bng-master
access-token mgidutur:AKCp5ekcbPU5siifdwWvxqXj5chQKweH7sdIXe9JktjKbpg6Yj9xufvWn9djkay8lp2Uo
url https://engcl-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 $1sk7Ertcp9MFM3TJHzjNcfnlMispMb1
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.

## 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.



**Note** The cnBNG installation is tested and qualified on the VMware vCenter 6.7 environment.

## 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               | <ul style="list-style-type: none"> <li>• High-performance x86 64-bit chipset</li> <li>• CPU performance Passmark benchmark of 13K rating per chip and 1,365 rating per thread, or better</li> <li>• VMware ESXi-compatible</li> </ul> <p><b>Note</b><br/>The following is recommended:</p> <ul style="list-style-type: none"> <li>• Cisco UCSM5 series blade servers to achieve the best performance.</li> <li>• All the host servers should be UCSC-C240-M5SX or UCSC-C220-M5SX.</li> <li>• All the UCS systems should have SSD storage type.</li> <li>• UCS C240M5 servers for better performance and to avoid infrastructure issues.</li> </ul> |
| Platform               | <p>VMware ESXi and VMware vCenter versions 6.5 and 6.7</p> <p><b>Note</b><br/>SMI Cluster Manager support is qualified on the preceding platforms.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Memory                 | <ul style="list-style-type: none"> <li>• At least DDR3-1600 or better than 1600 MT/s</li> <li>• ECC</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 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
```

**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 or the web-based CLI console.

1. SSH:

```
ssh admin@ops_center_pod_ip -p 2024
```

2. Web-based console:

- a. Log in to the Kubernetes master node.

- b. Run the following command:

```
kubectl get ingress <namespace>
```

The available ingress connections get listed.

- c. Select the appropriate ingress and access the BNG Ops Center.

- d. Access the following URL from your web browser:

```
cli.<namespace>-ops-center.<ip_address>.nip.io
```

By default, the Day 0 configuration is loaded into the cnBNG.

### Day 0 Configuration

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

```
show running-config
```

The following is a sample Day 0 configuration:

## 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
  http-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
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 contains the Day 1 configuration for cnBNG. For a sample day1 configuration, see [Configuring the CP, on page 8](#).

## 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                                           |
|---------------------------------|-------------------------------------------------------|
| <b>Virtual Drive Name</b> field | The name of the new virtual drive you want to create. |

| Name                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Read Policy</b> drop-down list       | The read-ahead cache mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Cache Policy</b> drop-down list      | The cache policy used for buffering reads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Strip Size</b> drop-down list        | The size of each strip, in MB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Write Policy</b> drop-down list      | <p>This can be one of the following</p> <ul style="list-style-type: none"> <li>• <b>Write Through</b>— 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.</li> <li>• <b>Write Back</b>— 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 <b>Write Through</b> caching when the BBU cannot guarantee the safety of the cache in the event of a power failure.</li> <li>• <b>Write Back Bad BBU</b>—With this policy, write caching remains <b>Write Back</b> even if the battery backup unit is defective or discharged.</li> </ul> |
| <b>Disk Cache Policy</b> drop-down list | <p>This can be one of the following</p> <ul style="list-style-type: none"> <li>• <b>Unchanged</b>— The disk cache policy is unchanged.</li> <li>• <b>Enabled</b>— Allows IO caching on the disk.</li> <li>• <b>Disabled</b>— Disallows disk caching.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Access Policy</b> drop-down list     | <p>This can be one of the following</p> <ul style="list-style-type: none"> <li>• <b>Read Write</b>— Enables host to perform read-write on the VD.</li> <li>• <b>Read Only</b>— Host can only read from the VD.</li> <li>• <b>Blocked</b>— Host can neither read nor write to the VD.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Size</b> field                       | <p>The size of the virtual drive (VD) you want to create. Enter a value and select one of the following units:</p> <ul style="list-style-type: none"> <li>• MB</li> <li>• GB</li> <li>• TB</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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:YQ3OfuEinrurnkkF1LW/vBDu5Zkti8zMt8dfIxpYIE 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@inception-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 © 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<br>Wiring up the new servers<br>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-cnbngr-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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre> clusters svi-cnbnng-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 </pre> | <pre> clusters svi-cnbnng-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 </pre> |

### Node Scaling for CDL Only

| Cluster1 Node5 Deployer Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Cluster2 Node5 Deployer Configuration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>clusters svi-cnbngr-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> | <pre>clusters svi-cnbngr-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> |

**Node Scaling for both CDL and Services**

| Cluster1 Node5 Deployer configuration | Cluster2 Node5 Deployer configuration |
|---------------------------------------|---------------------------------------|
|---------------------------------------|---------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre> clusters svi-cnbngr-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 </pre> | <pre> clusters svi-cnbngr-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 </pre> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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

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

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                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre> instance instance-id 1   endpoint dhcp     replicas 4     nodes   2   <b>exit</b> <b>exit</b>   endpoint sm     replicas 6     nodes   2   <b>exit</b> <b>exit</b> </pre> <pre> instance instance-id 2   endpoint dhcp     replicas 4     nodes   2   <b>exit</b> <b>exit</b>   endpoint sm     replicas 6     nodes   2   <b>exit</b> <b>exit</b> </pre> | <pre> instance instance-id 1   endpoint dhcp     replicas 4     <b>nodes   3</b>   <b>exit</b> <b>exit</b>   endpoint sm     replicas 6     <b>nodes   3</b>   <b>exit</b> <b>exit</b> </pre> <pre> instance instance-id 2   endpoint dhcp     replicas 4     <b>nodes   3</b>   <b>exit</b> <b>exit</b>   endpoint sm     replicas 6     <b>nodes   3</b>   <b>exit</b> <b>exit</b> </pre> |

