NVIDIA DGX SuperPOD

Deployment Guide

Featuring NVIDIA DGX A100 Systems

Document History

DG-11251-001

Version	Date	Authors	Description of Change
0.5	2022-12-22	Alex James, Davinder Singh, Greg Zynda, Mark Troyer, Rangam Addepalli, Robert Sohigian, Robert Strober, Scott Ellis, and Yang Yang	Early access
0.7	2023-01-18	Alex James, Charles Kim, Craig Tierney, and Robert Sohigian	Minor updates
1	2023-02-08	Rangam Addepalli and Robert Sohigian	Base Command Manager (BCM) 3.23.01
2	2023-03-01	Harmandeep Singh, Lawrence Hu, Rangam Addepalli, and Robert Sohigian	BCM 3.23.02
3	2023-04-11	Mihir Mehta, Rangam Addepalli, and Robert Sohigian	BCM 3.23.03 (network automation)

Contents

Chapter 1. Initial Cluster Setup

This document details how to deploy NVIDIA Base Command™ Manager (BCM) on NVIDIA DGX SuperPOD™ configurations.

Deployment of a DGX SuperPOD involves pre-setup, deployment, and use of BCM to provision the Slurm cluster.

Physical installation and network switch configuration should be completed before deploying BCM. In addition, information about the intended deployment should be recorded in a site survey.

The deployment stage of a DGX SuperPOD consists of using BCM to provision and manage the Slurm cluster.

1. Configure the NFS server.

   User home directories (`home/`) and shared data (`cm_shared/`) directories must be shared between head nodes (such as the DGX OS image) must be stored on an NFS filesystem for HA availability. Because DGX SuperPOD does not mandate the nature of the NFS storage, the configuration is outside the scope of this document.

   This DGX SuperPOD deployment uses the NFS export path provided in the site survey: `/var/nfs/general`.

   Following parameters are recommended for the NFS server export file `/etc/exports`.

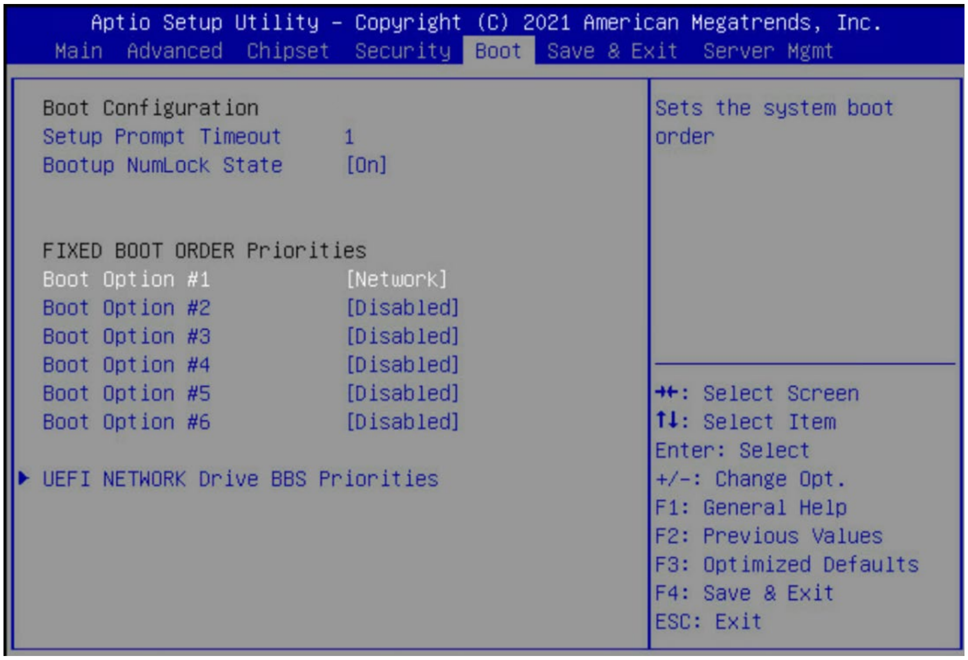
   ```
   /var/nfs/general *(rw,sync,no_root_squash,no_subtree_check)
   ```

2. On the DGX A100 compute nodes, configure the SBIOS so that the nodes PXE boot by default.

   BCM requires DGX systems to PXE boot.

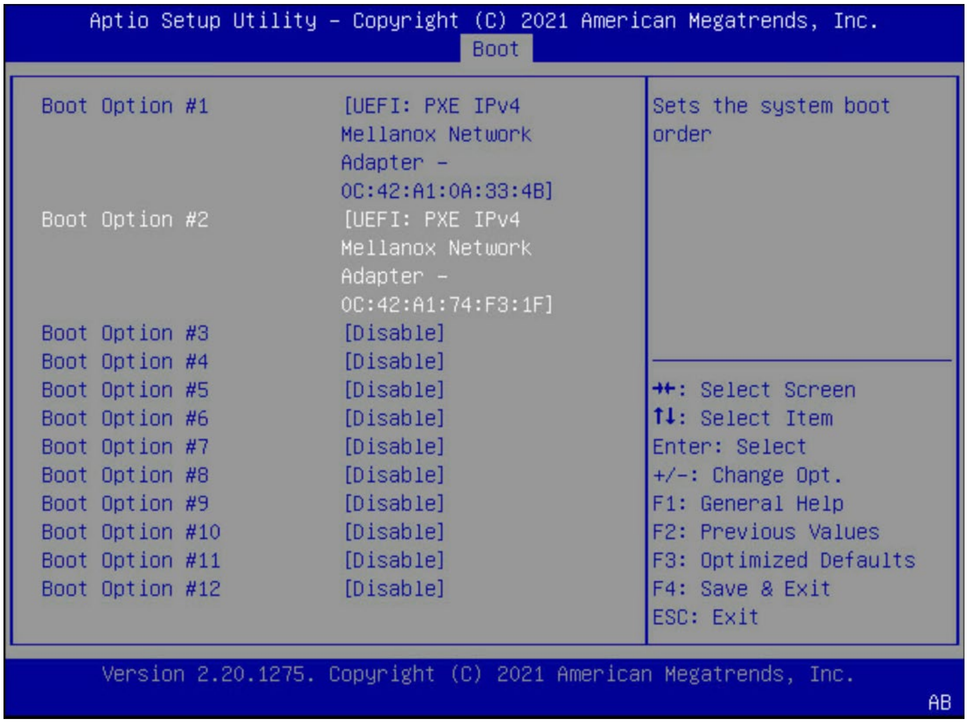
   a. Using either KVM or a crash cart, connect to the DGX A100 system and enter the BIOS menu, and configure `Boot Option #1` to be `[NETWORK]`.

b. Set other Boot devices to `[DISABLED]`.



```
      Aptio Setup Utility - Copyright (C) 2021 American Megatrends, Inc.
  Main  Advanced  Chipset  Security  Boot  Save & Exit  Server Mgmt

  Boot Configuration                                 Sets the system boot
  Setup Prompt Timeout        1                      order
  Bootup NumLock State        [On]


  FIXED BOOT ORDER Priorities
  Boot Option #1              [Network]
  Boot Option #2              [Disabled]
  Boot Option #3              [Disabled]
  Boot Option #4              [Disabled]
  Boot Option #5              [Disabled]             →←: Select Screen
  Boot Option #6              [Disabled]             ↑↓: Select Item
                                                     Enter: Select
▶ UEFI NETWORK Drive BBS Priorities                  +/-: Change Opt.
                                                     F1: General Help
                                                     F2: Previous Values
                                                     F3: Optimized Defaults
                                                     F4: Save & Exit
                                                     ESC: Exit
```

c. Disable PXE boot devices except for `Storage 4-2` and `Storage 5-2`. Set them to use IPv4.

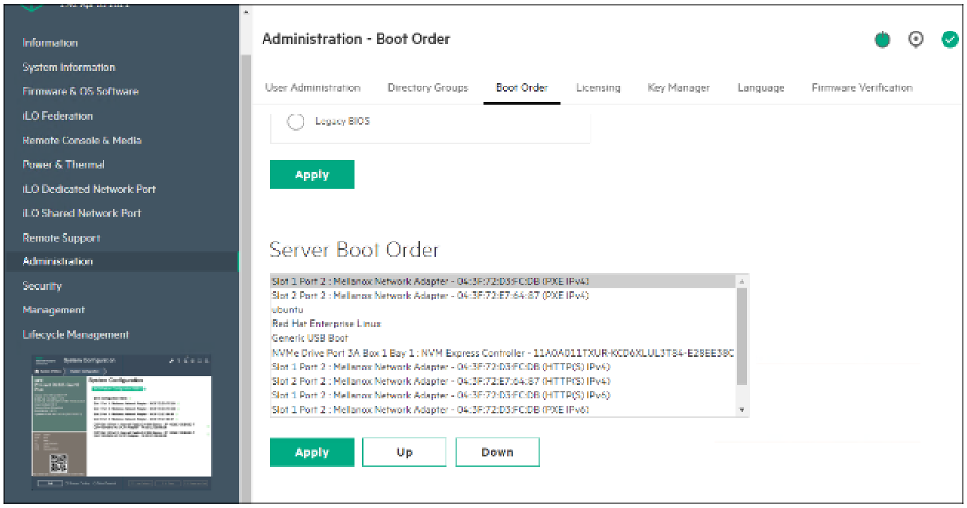


```
      Aptio Setup Utility - Copyright (C) 2021 American Megatrends, Inc.
                                   Boot

  Boot Option #1              [UEFI: PXE IPv4        Sets the system boot
                              Mellanox Network       order
                              Adapter -
                              0C:42:A1:0A:33:4B]
  Boot Option #2              [UEFI: PXE IPv4
                              Mellanox Network
                              Adapter -
                              0C:42:A1:74:F3:1F]
  Boot Option #3              [Disable]
  Boot Option #4              [Disable]
  Boot Option #5              [Disable]              →←: Select Screen
  Boot Option #6              [Disable]              ↑↓: Select Item
  Boot Option #7              [Disable]              Enter: Select
  Boot Option #8              [Disable]              +/-: Change Opt.
  Boot Option #9              [Disable]              F1: General Help
  Boot Option #10             [Disable]              F2: Previous Values
  Boot Option #11             [Disable]              F3: Optimized Defaults
  Boot Option #12             [Disable]              F4: Save & Exit
                                                     ESC: Exit

       Version 2.20.1275. Copyright (C) 2021 American Megatrends, Inc.
                                                                        AB
```

d. Select `Save & Exit` the BIOS.

3. On the failover head node and the CPU nodes, ensure that Network boot is configured as the primary option. Ensure that the Mellanox ports connected on the network on the head and CPU nodes are set to Ethernet mode as well.

   This is an example of a system that will boot from the network with `Slot 1 Port 2` and `Slot 2 Port 2`.



Administration - Boot Order

Server Boot Order

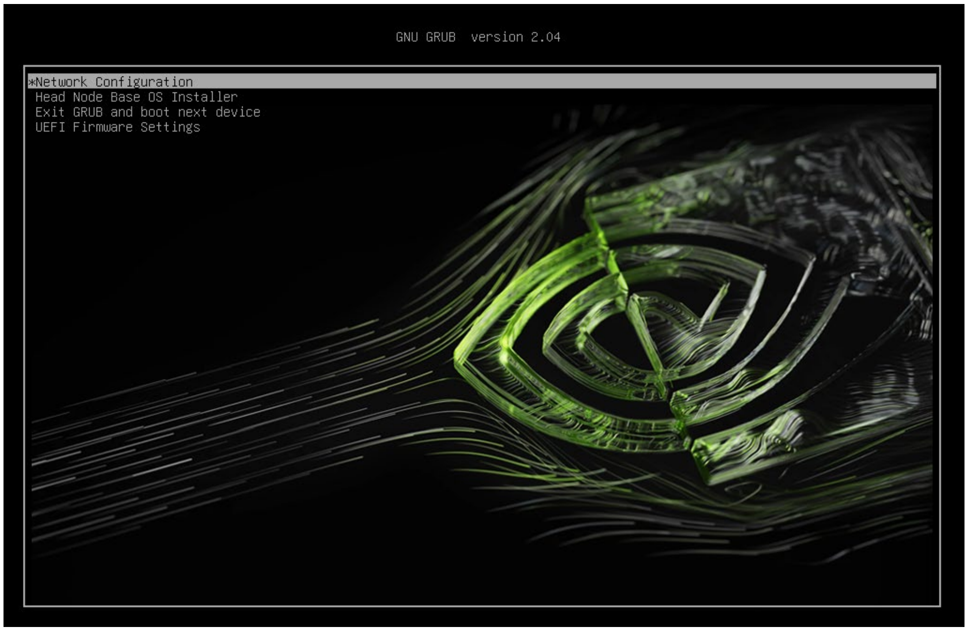
```
Slot 1 Port 2 : Mellanox Network Adapter - 04:3F:72:D3:FC:DB (PXE IPv4)
Slot 2 Port 2 : Mellanox Network Adapter - 04:3F:72:E7:64:87 (PXE IPv4)
ubuntu
Red Hat Enterprise Linux
Generic USB Boot
NVMe Drive Port 3A Box 1 Bay 1 : NVM Express Controller - 11A0A011TXUR-KCD6XLUL3T84-E28EE38C
Slot 1 Port 2 : Mellanox Network Adapter - 04:3F:72:D3:FC:DB (HTTP(S) IPv4)
Slot 2 Port 2 : Mellanox Network Adapter - 04:3F:72:E7:64:87 (HTTP(S) IPv4)
Slot 1 Port 2 : Mellanox Network Adapter - 04:3F:72:D3:FC:DB (HTTP(S) IPv6)
Slot 1 Port 2 : Mellanox Network Adapter - 04:3F:72:D3:FC:DB (PXE IPv6)
```

4. Download the BCM installer ISO from Cloud Storage.
5. Burn the ISO to a DVD or to a bootable USB device.

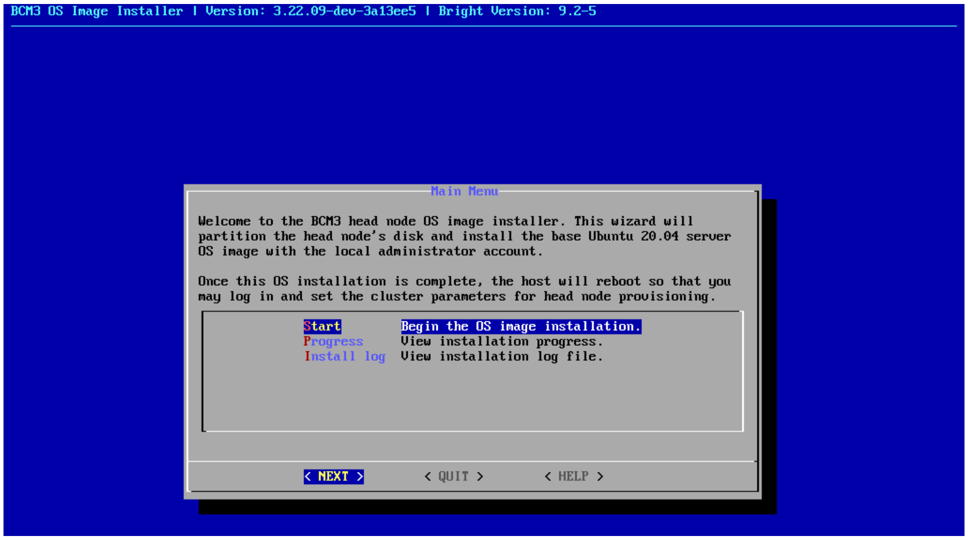
   It can also be mounted as virtual media and installed using the BMC. The specific mechanism for the latter will vary by vendor.
6. Ensure that the BIOS of the target head node is configured in UEFI mode and that its boot order is configured to boot the media containing the Bright installer image.
7. Boot the installation media.
8. Follow the Generated Network Configuration (BCM_v3.23.03) section of the *BCM 3.0 Network Provisioning Guide*.

   After the network switches are provisioned, reboot the ISO and continue.

9. At the grub menu, choose `Head Node Base OS Installer`.



10. After booting and at the Welcome screen, choose `Start` and then select `NEXT` to begin installation.


BCM3 OS Image Installer | Version: 3.22.09-dev-3a13ee5 | Bright Version: 9.2-5

Main Menu

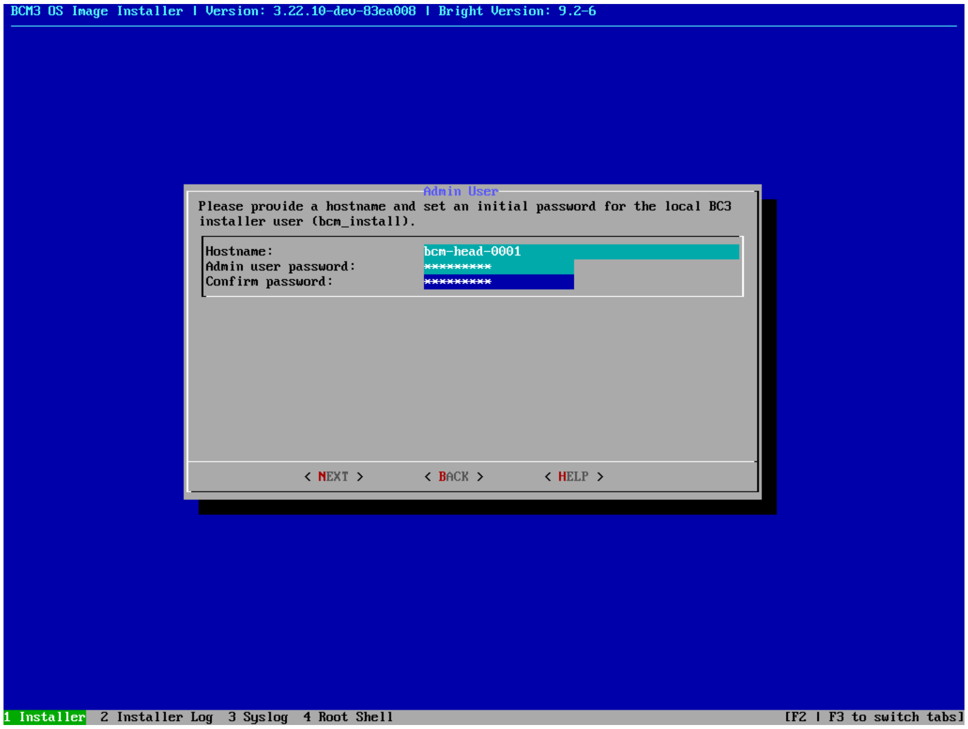
Welcome to the BCM3 head node OS image installer. This wizard will partition the head node's disk and install the base Ubuntu 20.04 server OS image with the local administrator account.

Once this OS installation is complete, the host will reboot so that you may log in and set the cluster parameters for head node provisioning.

Start   Begin the OS image installation.
Progress   View installation progress.
Install log View installation log file.
< NEXT >
< QUIT >
< HELP >

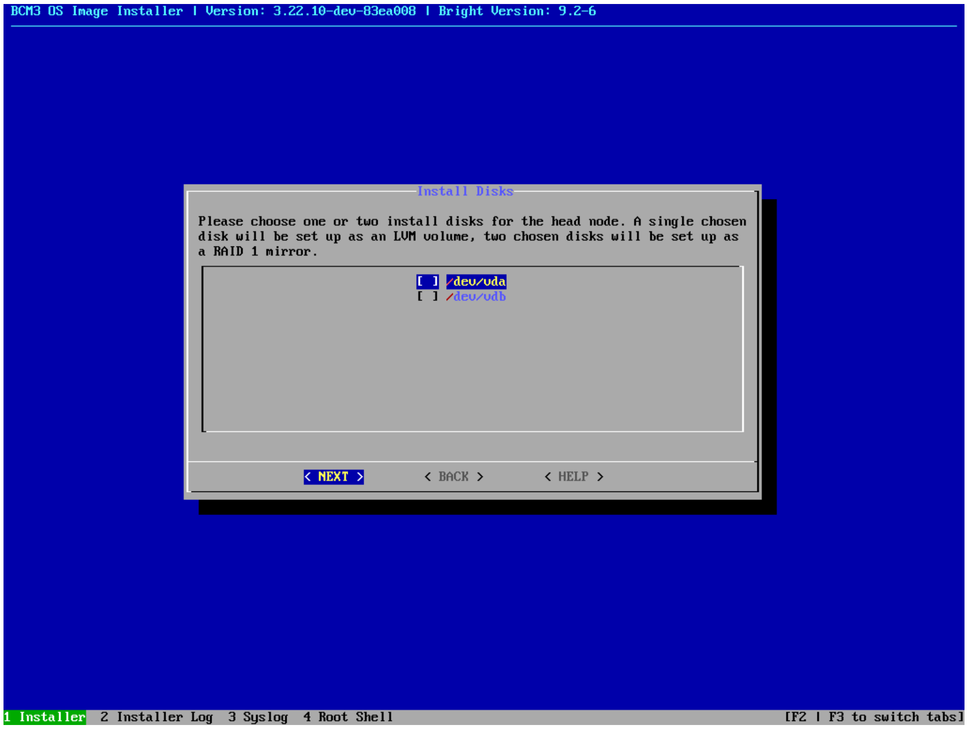
11. Provide a hostname and initial password, and then select `NEXT`.

    Confirm or update the hostname of the primary head node and enter a password for the `bcm_install` user. This information will be used to login to the head node after the OS is installed and to complete configuring BCM.



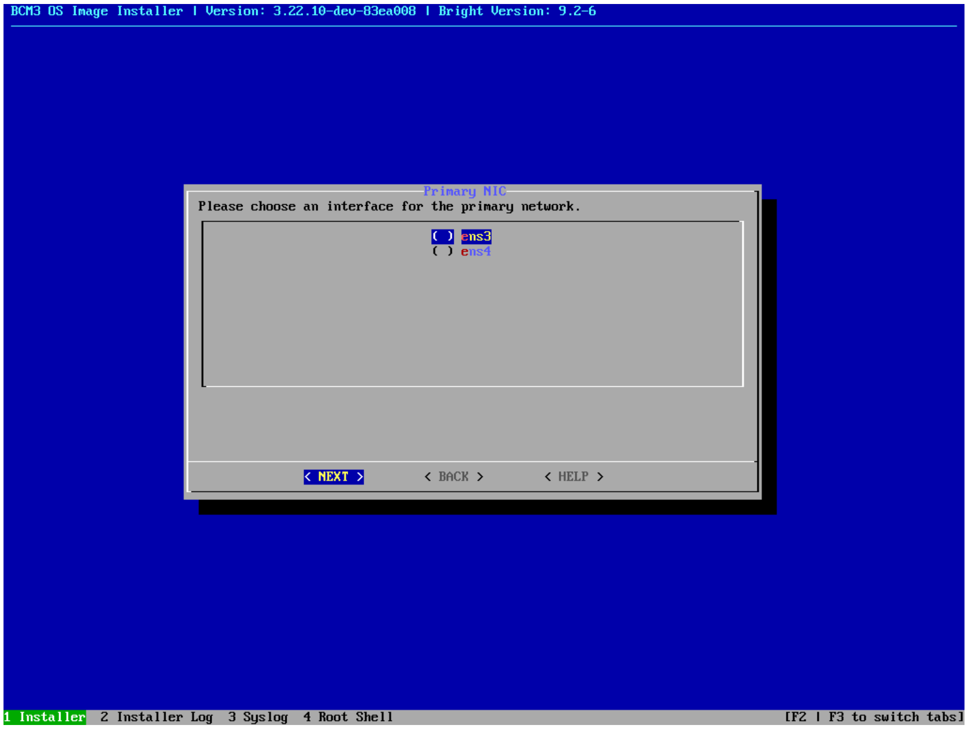
```
BCM3 OS Image Installer | Version: 3.22.10-dev-83ea008 | Bright Version: 9.2-6

Admin User
Please provide a hostname and set an initial password for the local BC3
installer user (bcm_install).

Hostname:                     bcm-head-0001
Admin user password:          *********
Confirm password:             *********
```

12. Choose one or more install disks and then select `NEXT`.



```
BCM3 OS Image Installer | Version: 3.22.10-dev-83ea008 | Bright Version: 9.2-6

Install Disks
Please choose one or two install disks for the head node. A single chosen
disk will be set up as an LVM volume, two chosen disks will be set up as
a RAID 1 mirror.

[ ] /dev/vda
[ ] /dev/vdb
```

13. Choose the primary network interface for the head node and then select NEXT. This is the internalnet interface and should have Internet access.



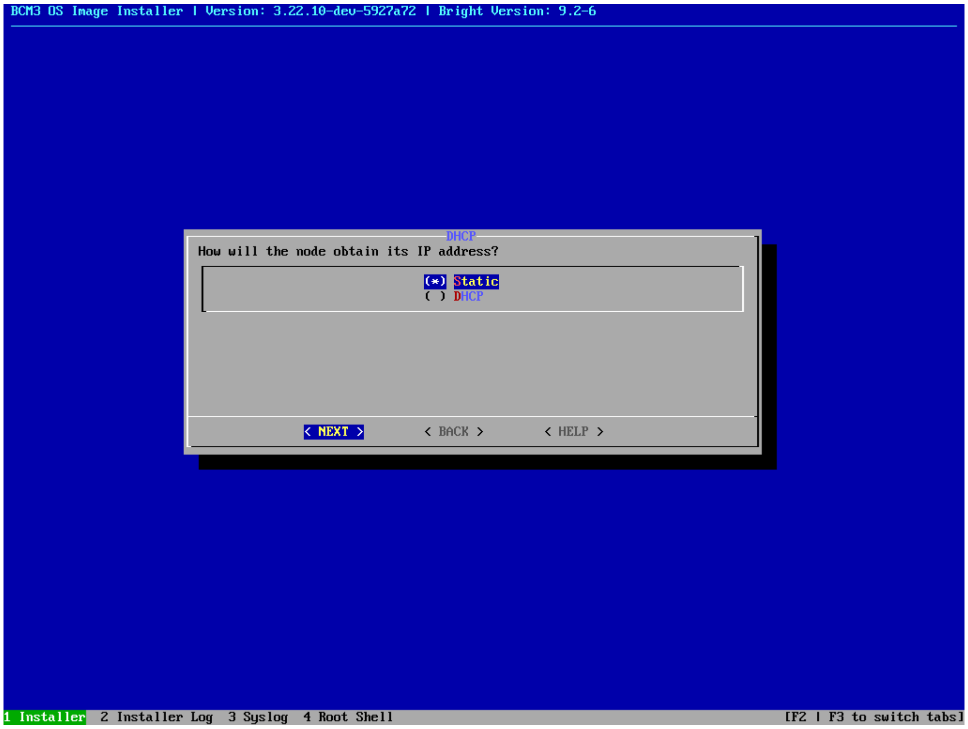
BCM3 OS Image Installer | Version: 3.22.10-dev-83ea008 | Bright Version: 9.2-6

Primary NIC

Please choose an interface for the primary network.

( ) ens3
( ) ens4

14. Choose Static or DHCP for IP address assignment and then select NEXT.



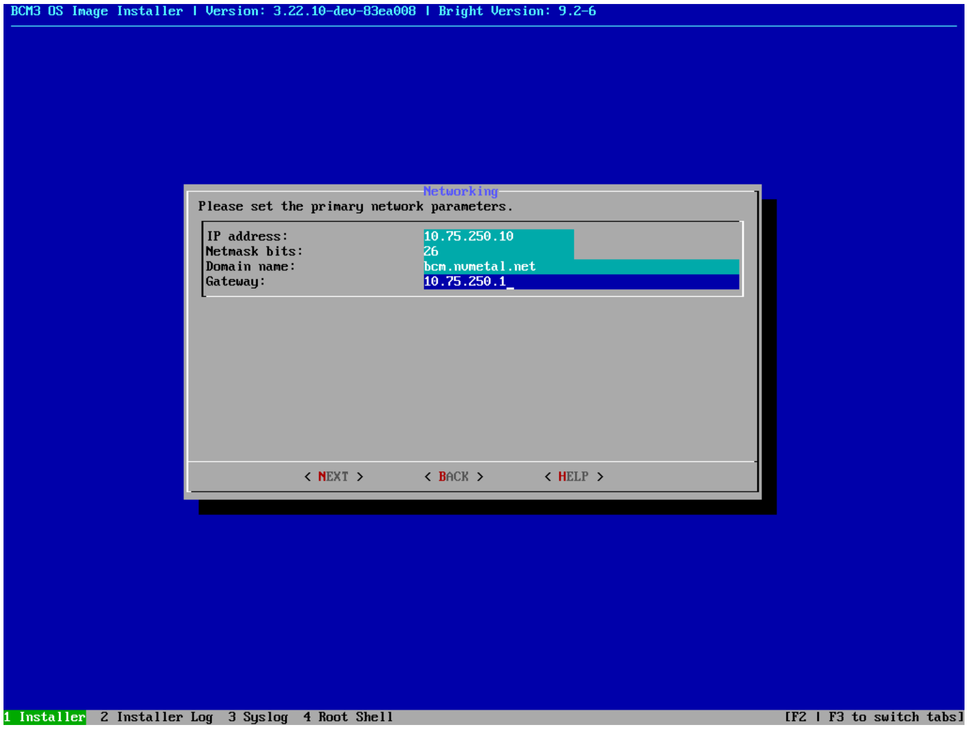
BCM3 OS Image Installer | Version: 3.22.10-dev-5927a72 | Bright Version: 9.2-6

DHCP

How will the node obtain its IP address?

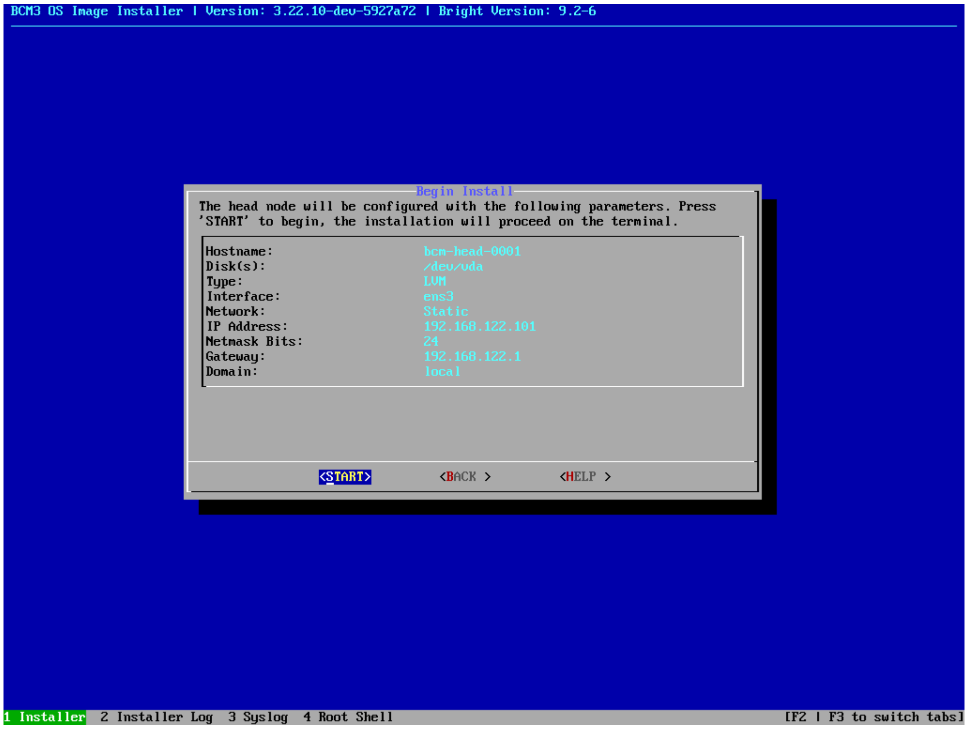
(*) Static
( ) DHCP

15. If the network is to be statically configured, enter the parameters and then select `NEXT`.



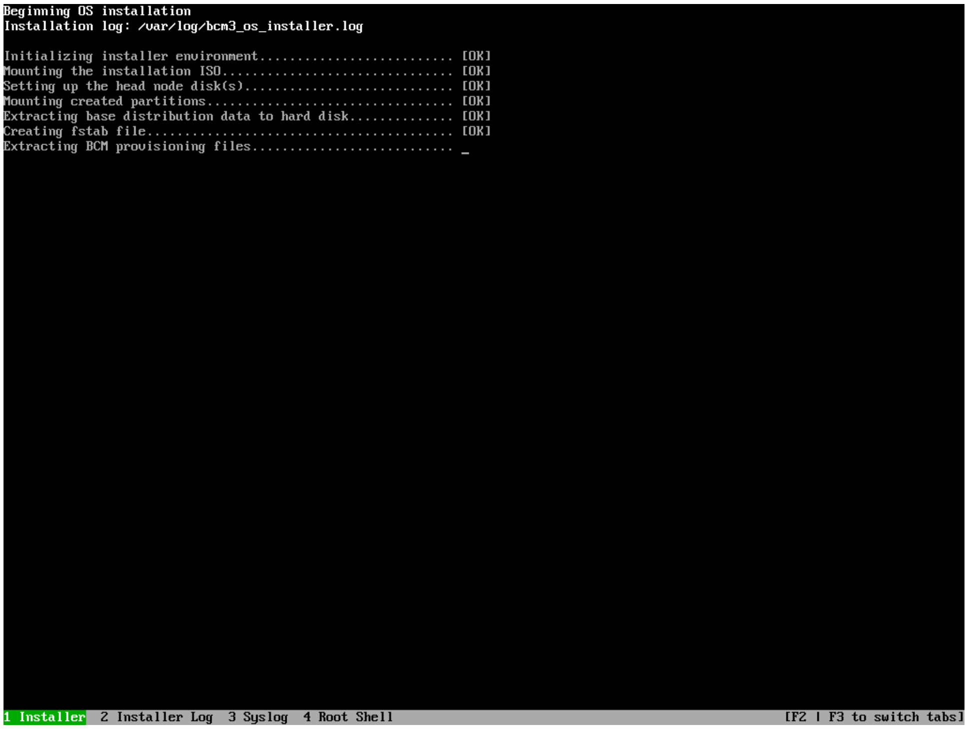
```
BCM3 OS Image Installer | Version: 3.22.10-dev-83ea008 | Bright Version: 9.2-6

Networking
Please set the primary network parameters.

IP address:                   10.75.250.10
Netmask bits:                 26
Domain name:                  bcm.nvmetal.net
Gateway:                      10.75.250.1_
```

16. Confirm the settings at the summary screen and then select `START` to install the OS.



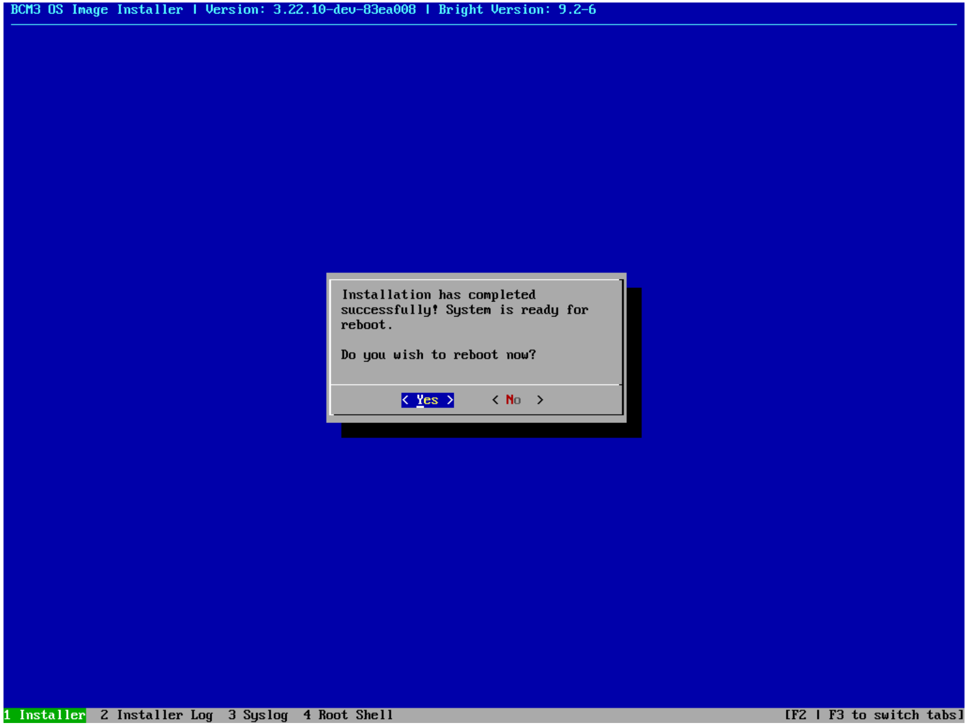
```
BCM3 OS Image Installer | Version: 3.22.10-dev-5927a72 | Bright Version: 9.2-6

Begin Install
The head node will be configured with the following parameters. Press
'START' to begin, the installation will proceed on the terminal.

Hostname:                     bcm-head-0001
Disk(s):                      /dev/vda
Type:                         LVM
Interface:                    ens3
Network:                      Static
IP Address:                   192.168.122.101
Netmask Bits:                 24
Gateway:                      192.168.122.1
Domain:                       local
```

17. Track the installation on the resulting screen.



```
Beginning OS installation
Installation log: /var/log/bcm3_os_installer.log

Initializing installer environment.......................... [OK]
Mounting the installation ISO............................... [OK]
Setting up the head node disk(s)............................ [OK]
Mounting created partitions................................. [OK]
Extracting base distribution data to hard disk.............. [OK]
Creating fstab file......................................... [OK]
Extracting BCM provisioning files........................... _
```

18. When the OS installation completes, select `Yes` to reboot.



```
BCM3 OS Image Installer | Version: 3.22.10-dev-83ea008 | Bright Version: 9.2-6

Installation has completed
successfully! System is ready for
reboot.

Do you wish to reboot now?
```

19. After the host reboots, login as the `bcm_install` user using the password provided to the OS installer. ssh can be used instead of the out-of-band console at this point.
20. Run the `configure_install` command.

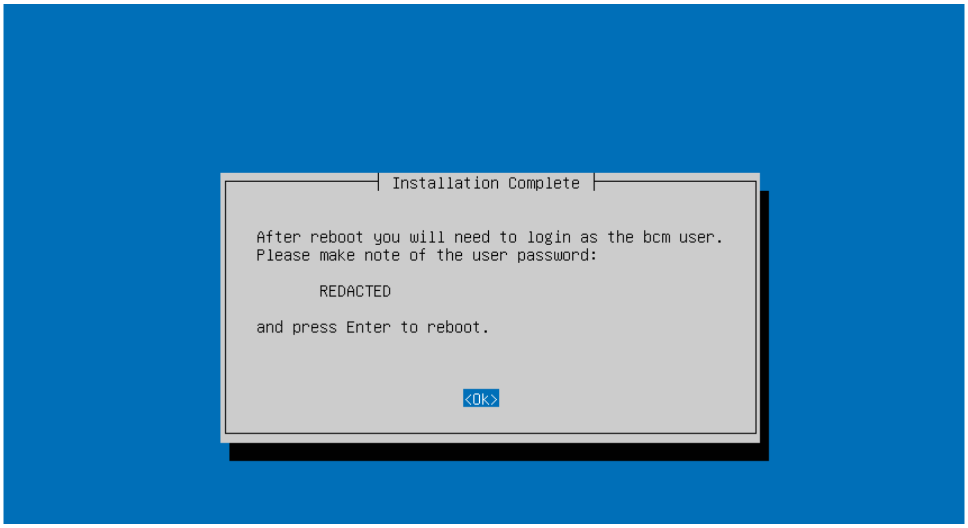
```
sudo /opt/bcm/configure_install
```

21. After the configuration completes, run the `install` command.

```
sudo /opt/bcm/installer/install
```

22. When installation completes, make note of the randomly generated password for the bcm admin user, and select `Ok` to reboot.

> **Note:** The root password was saved to /root/.root and the MySQL password was saved to /root/.mysql. Both files will be available after the system reboots.



```
Installation Complete

After reboot you will need to login as the bcm user.
Please make note of the user password:

        REDACTED

and press Enter to reboot.
```

> **Note:** At this step there will be one DGX node and one CPU node in the device list. These hosts will not have MAC and IP assignments.
>
> Before proceeding, configure interfaces and IP addresses in each node category.

23. Clone the DGX nodes.

    `dgx01` was created during head node installation. Clone it to create the DGX nodes.

```
% device
% foreach --clone dgx01 -n dgx02..[dgxXX] ()
% commit
```

24. Check the nodes and their categories.

    Extra options are used for `device list` to make the format more readable.

```
% device list -f hostname:20,category:10,ip:20,status:15
hostname (key)       category       ip                    status
-------------------- ----------     -------------------- ---------------
bcm-head-01                        10.130.122.254       [    UP    ]
dgx01                dgxnodes      10.130.122.5         [   DOWN   ]
dgx02                dgxnodes      10.130.122.6         [   DOWN   ]
dgx03                dgxnodes      10.130.122.7         [   DOWN   ]
dgx04                dgxnodes      10.130.122.8         [   DOWN   ]
```

25. License cluster by running the request-license and providing product key.

```
request-license
Product Key (XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX):
```

Chapter 2. Head Node Configuration

This section address configuration steps to be performed on BCM head nodes.

2.1 Configure BCM to Allow MAC Addresses to PXE Boot

1. Use the root (not `cmsh`) shell.
2. In `/cm/local/apps/cmd/etc/cmd.conf`, uncomment the `AdvancedConfig` parameter.
   ```
   AdvancedConfig = { "DeviceResolveAnyMAC=1" } # modified value
   ```
3. Restart the `CMDaemon` to enable reliable PXE booting from bonded interfaces.
   ```
   # systemctl restart cmd
   ```

The `cmsh` session will be disconnected because of restarting the `CMDaemon`. Type `connect` to reconnect after the `CMDaemon` has restarted. Or enter `exit` and then restart `cmsh`.

2.2 Setup Networking on DGX Systems

The steps that follow are performed on the head node and should be run on all DGX systems.

> **Note:** Double check the MAC address for each interface and the IP number for the `bond0` interface. Mistakes here will be difficult to diagnose.

1. Set the MAC addresses on the physical interfaces.
   ```
   # cmsh
   % device
   % use dgx01
   % interfaces
   % use ipmi0
   % set ip 10.130.111.68
   % set gateway 10.130.111.65
   % use enp225s0f1np1
   % set mac B8:CE:F6:2F:08:69
   % use enp97s0f1np1
   % set mac B8:CE:F6:2D:0E:A7..
   % % commit
   ```

2. Verify the configuration.

```
% get provisioninginterface
bond0
% interfaces
% list
Type         Network device name  IP               Network          Start if
------------ -------------------- ---------------- ---------------- --------
bmc          ipmi0                10.130.111.68    ipminet          always
bond         bond0 [prov]         10.130.122.5     internalnet      always
physical     enp225s0f1np1 (bond0)   0.0.0.0                        always
physical     enp97s0f1np1 (bond0)    0.0.0.0                        always
```

3. Configure InfiniBand interfaces on DGX nodes

   The following procedure adds four physical InfiniBand interfaces for a single DGX system (`dgx01`).

```
% /      # go to top level of CMSH
% device
% use dgx01
% interfaces
% add physical ibp12s0
% set ip 10.149.0.5
% set network ibnet
% add physical ibp75s0
% set ip 10.149.1.5
% set network ibnet
% add physical ibp141s0
% set ip 10.149.2.5
% set network ibnet
% add physical ibp186s0
% set network ibnet
% set ip 10.149.3.5

% list
Type         Network device name  IP               Network          Start if
------------ -------------------- ---------------- ---------------- --------
bmc          ipmi0                10.130.111.69    ipminet          always
bond         bond0 [prov]         10.130.122.5     internalnet      always
physical     enp225s0f1np1 (bond0)   0.0.0.0                        always
physical     enp97s0f1np1 (bond0)    0.0.0.0                        always
physical     ibp12s0              10.149.0.5       ibnet            always
physical     ibp141s0             10.149.2.5       ibnet            always
physical     ibp186s0             10.149.3.5       ibnet            always
physical     ibp75s0              10.149.1.5       ibnet            always

% device commit
```

2.3 Identify the DGX Cluster Nodes

1. Identify the nodes by setting the MAC address for the provisioning interface for each node to the MAC address listed in the site survey.

```
% device
% use dgx01
% set mac b8:ce:f6:2f:08:69
% use dgx02
% set mac 0c:42:a1:54:32:a7
% use dgx03
% set mac 0c:42:a1:0a:7a:51
% use dgx04
% set mac 1c:34:da:29:17:6e
% foreach -c dgx (get mac)
B8:CE:F6:2F:08:69
0C:42:A1:54:32:A7
0C:42:A1:0A:7A:51
1C:34:DA:29:17:6E
```

2. If all the MAC addresses are set properly, commit the changes.

```
% device commit
% quit
```

2.4 Identify the First CPU Node

1. Set the IP address for the IPMI interface.

```
% device
% use bcm-cpu-01
% interfaces
% use ipmi0
% set ip 10.127.1.15
% set gateway 10.127.1.1
% commit
```

2. Set the MAC addresses for the Ethernet interfaces.

```
% device
% use bcm-cpu-01
% interfaces
% use ens2f0np0
% set mac 88:e9:a4:92:26:ba
% use ens2f1np1
% set mac 88:e9:a4:92:26:bb
% commit
```

3. Set the IP address for the `bond0` interface.

```
% device
% use bcm-cpu-01
% interfaces
% use bond0
% set ip 10.127.3.15
% commit
```

2.5 Disable GPU Information Collection

In BCM 2.23.03, GPU information collection must be disabled.

On the head node, run the following command:

```
sudo /cm/local/apps/cmd/sbin/cm-manipulate-advanced-config.py -i '*'
"SysInfoCollectGPU=0"
```

2.6 Power On and Provision the Cluster Nodes

Now that the required post-installation configuration has been completed, it is time to power on and provision the cluster nodes. After the initial provisioning, power control will be available from within Bright using the `cmsh` or Bright View. But for this initial provisioning it is necessary to power them on outside of Bright (that is, using the power button or a KVM).

It will take several minutes for the nodes to go through their BIOS. After that, you should see the node status progress as the nodes are being provisioned. Watching the `/var/log/messages` and `/var/log/node-installer` log files to verify that everything is proceeding smoothly.

Chapter 3. High Availability

This section covers how to configure high availability (HA) using `cmha-setup` CLI wizard.

1. Ensure that both head nodes are licensed.

   The MAC address for the secondary head was provided when the cluster license was installed.

   ```
   % main licenseinfo  | grep ^MAC
   MAC address / Cloud ID               04:3F:72:E7:67:07|14:02:EC:DA:AF:18
   ```

2. Configure the shared storage (NFS).

   Mounts configured in `fsmounts` will be automatically mounted by the `CMDaemon`.

   ```
   % device
   % use master
   % fsmounts
   % add /nfs/general
   % set device 10.130.122.252:/var/nfs/general
   % set filesystem nfs
   % commit
   % show
   Parameter                        Value
   ---------------------------- ------------------------------------------------
   Device                           10.130.122.252:/var/nfs/general
   Revision
   Filesystem                       nfs
   Mountpoint                       /nfs/general
   Dump                             no
   RDMA                             no
   Filesystem Check                 NONE
   Mount options                    defaults
   ```

3. Verify that the shared storage is mounted.

   ```
   # mount | grep '/nfs/general'
   10.130.122.252:/var/nfs/general on /nfs/general type nfs4
   (rw,relatime,vers=4.2,rsize=1048576,wsize=1048576,namlen=255,hard,proto=tcp,timeo
   =600,retrans=2,sec=sys,clientaddr=10.130.122.254,local_lock=none,addr=10.130.122.
   252)
   ```

4. Verify that head node has power control over the cluster nodes.

```
% device
% power -c dgx status
[-head1->device]% power -c dgx status
ipmi0 .................... [   ON    ] dgx01
ipmi0 .................... [   ON    ] dgx02
ipmi0 .................... [   ON    ] dgx03
ipmi0 .................... [   ON    ] dgx04
[bcm-head-01->device]%
```

5. Power off the cluster nodes.

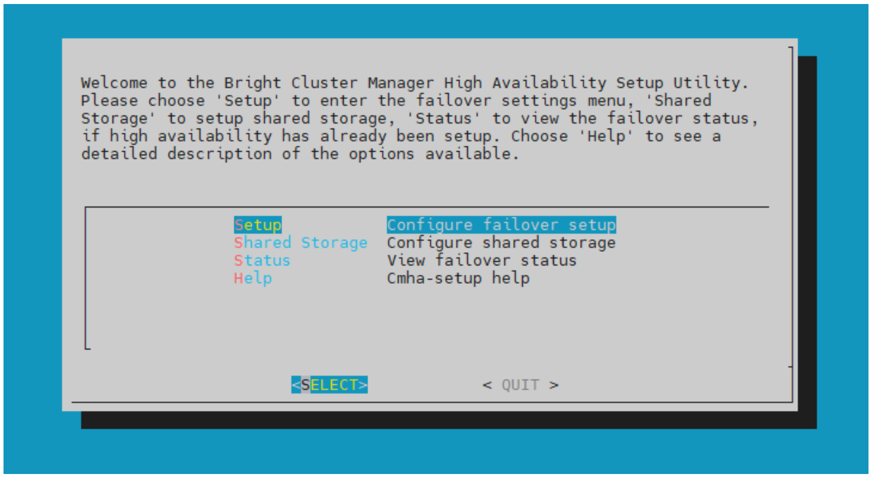
   The cluster nodes must be powered off before configuring HA.

```
% power -c dgx off
ipmi0 .................... [   OFF   ] dgx01
ipmi0 .................... [   OFF   ] dgx02
ipmi0 .................... [   OFF   ] dgx03
ipmi0 .................... [   OFF   ] dgx04
```

6. Start the `cmha-setup` CLI wizard as the root user on the primary head node.

```
# cmha-setup
```

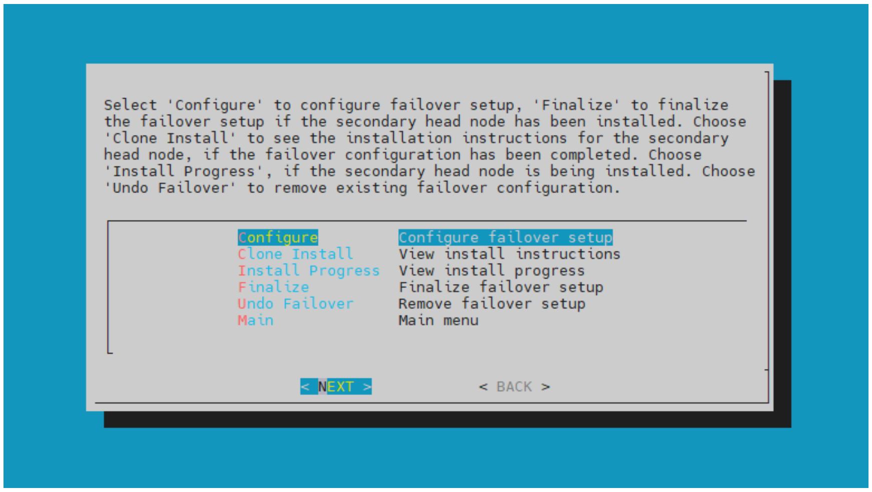
7. Choose `Setup` and then select `SELECT`.



Welcome to the Bright Cluster Manager High Availability Setup Utility. Please choose 'Setup' to enter the failover settings menu, 'Shared Storage' to setup shared storage, 'Status' to view the failover status, if high availability has already been setup. Choose 'Help' to see a detailed description of the options available.

Setup Configure failover setup
Shared Storage Configure shared storage
Status View failover status
Help Cmha-setup help
<SELECT>
< QUIT >

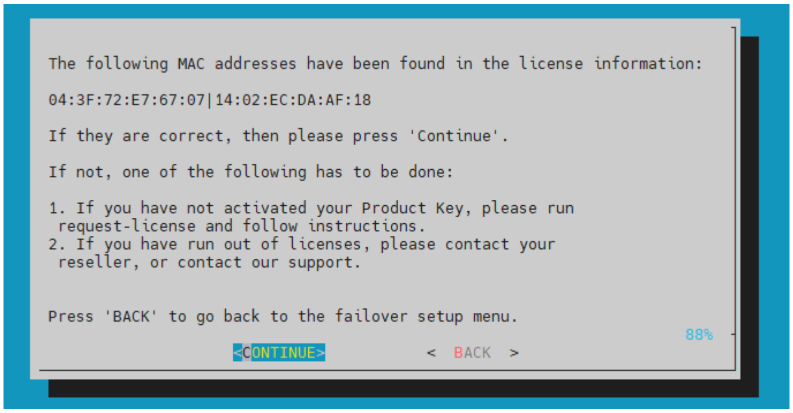
8. Choose `Configure` and then select `NEXT`.



Select 'Configure' to configure failover setup, 'Finalize' to finalize the failover setup if the secondary head node has been installed. Choose 'Clone Install' to see the installation instructions for the secondary head node, if the failover configuration has been completed. Choose 'Install Progress', if the secondary head node is being installed. Choose 'Undo Failover' to remove existing failover configuration.

Configure Configure failover setup
Clone Install View install instructions
Install Progress View install progress
Finalize Finalize failover setup
Undo Failover Remove failover setup
Main Main menu
< NEXT >
< BACK >

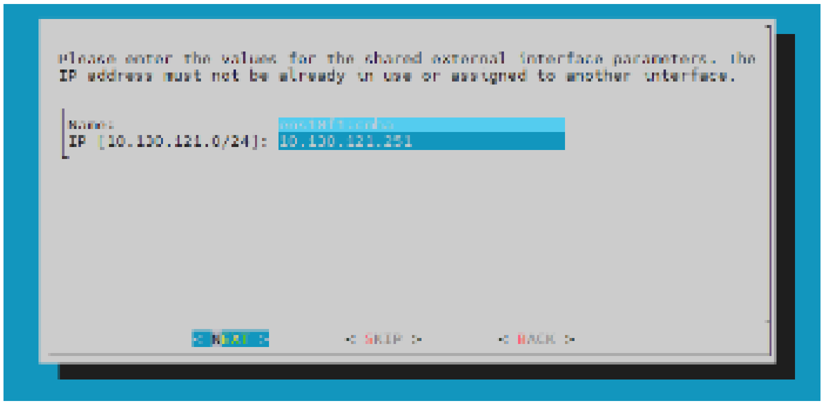
9. Verify that the cluster license information found `cmha-setup` is correct and then select `CONTINUE`.



```
The following MAC addresses have been found in the license information:

04:3F:72:E7:67:07|14:02:EC:DA:AF:18

If they are correct, then please press 'Continue'.

If not, one of the following has to be done:

1. If you have not activated your Product Key, please run
 request-license and follow instructions.
2. If you have run out of licenses, please contact your
 reseller, or contact our support.

Press 'BACK' to go back to the failover setup menu.
```

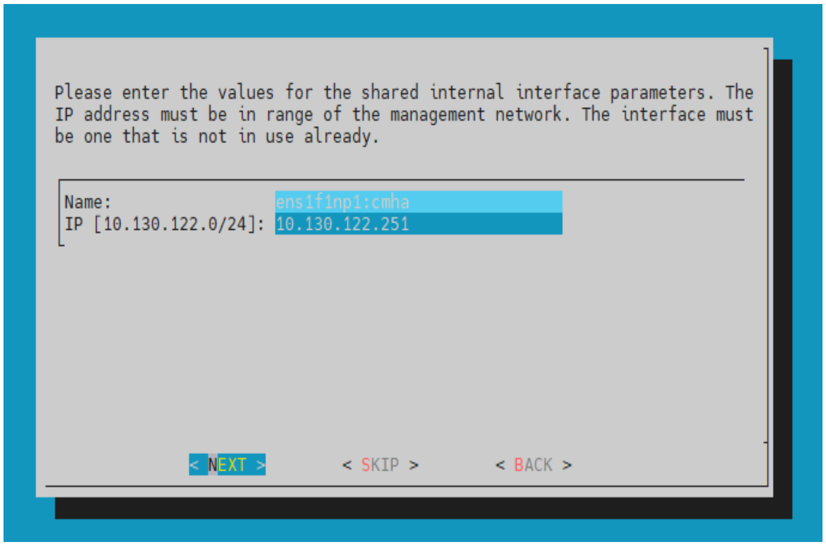
10. Configure an external Virtual IP address that will be used by the active head node in the HA configuration and then select `NEXT`.

    This will be the IP that should always be used for accessing the active head nodes.



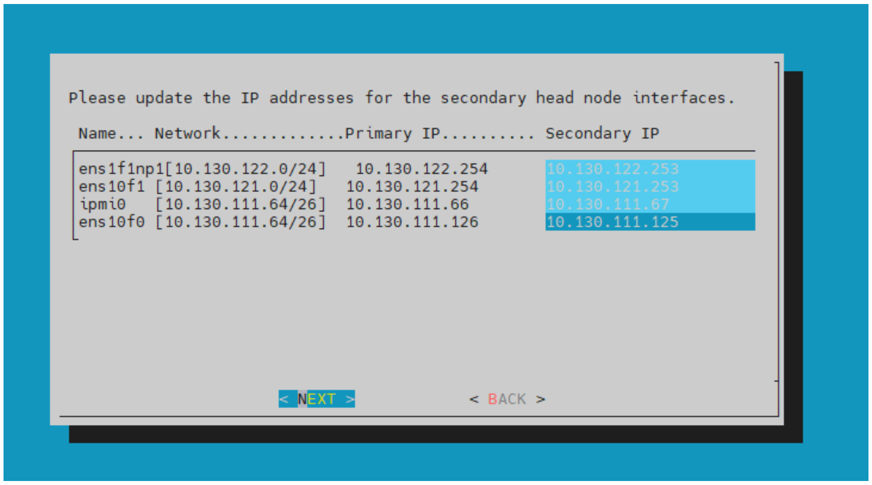
```
Please enter the values for the shared external interface parameters. The
IP address must not be already in use or assigned to another interface.

Name:                  [illegible]
IP [10.130.121.0/24]:  10.130.121.251
```

11. Provide an internal Virtual IP address that will be used by the active head node in the HA configuration.



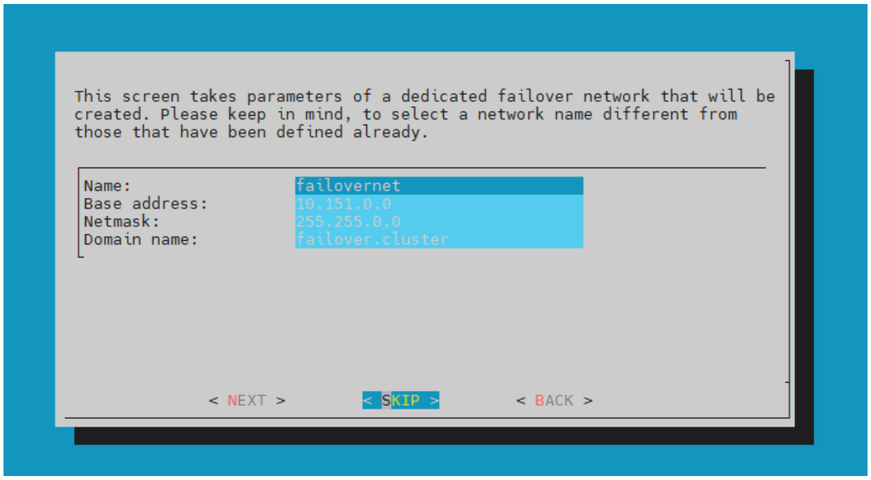
```
Please enter the values for the shared internal interface parameters. The
IP address must be in range of the management network. The interface must
be one that is not in use already.

Name:                  ens1f1np1:cmha
IP [10.130.122.0/24]:  10.130.122.251
```

12. Provide the name of the secondary head node.



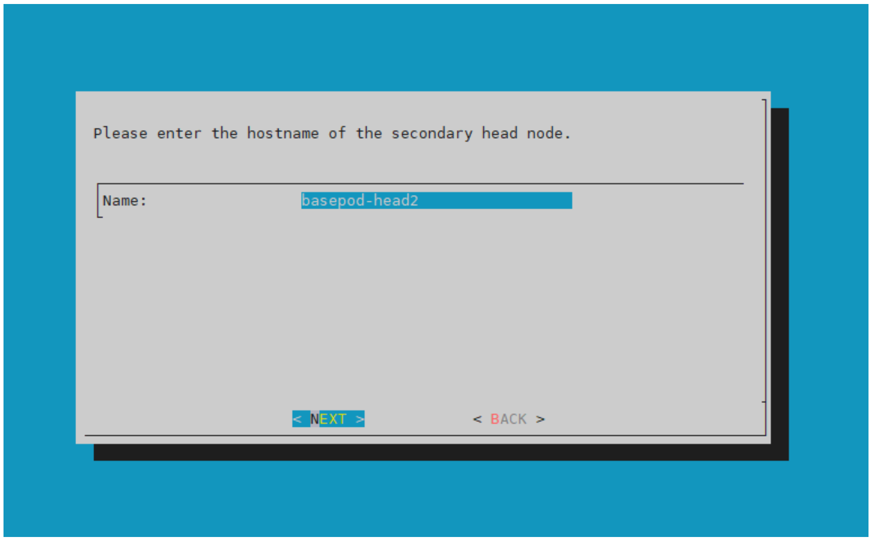
```
Please update the IP addresses for the secondary head node interfaces.

 Name... Network............Primary IP.......... Secondary IP

 ens1f1np1[10.130.122.0/24]   10.130.122.254       10.130.122.253
 ens10f1 [10.130.121.0/24]   10.130.121.254       10.130.121.253
 ipmi0   [10.130.111.64/26]  10.130.111.66        10.130.111.67
 ens10f0 [10.130.111.64/26]  10.130.111.126       10.130.111.125
```

13. Since DGX SuperPOD uses the internal network as the failover network, select `SKIP`.



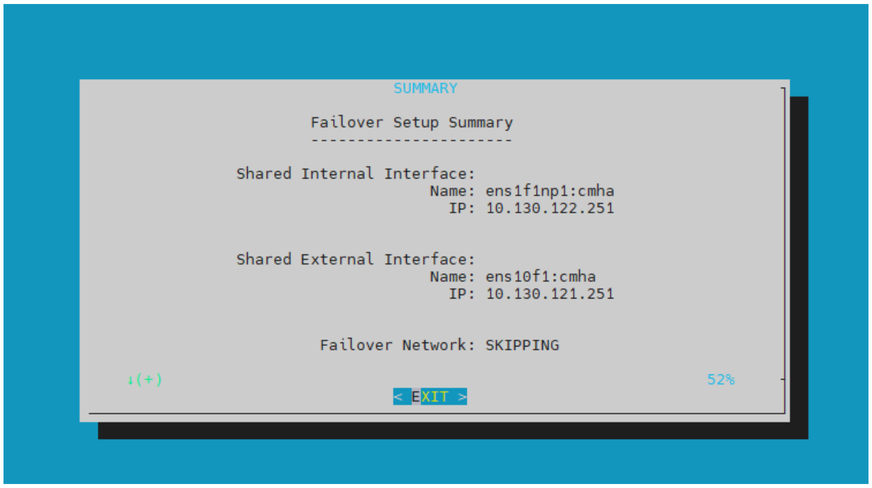
```
This screen takes parameters of a dedicated failover network that will be
created. Please keep in mind, to select a network name different from
those that have been defined already.

 Name:                    failovernet
 Base address:            10.151.0.0
 Netmask:                 255.255.0.0
 Domain name:             failover.cluster
```

14. Configure the IP addresses for the secondary head node that the wizard is about to create.



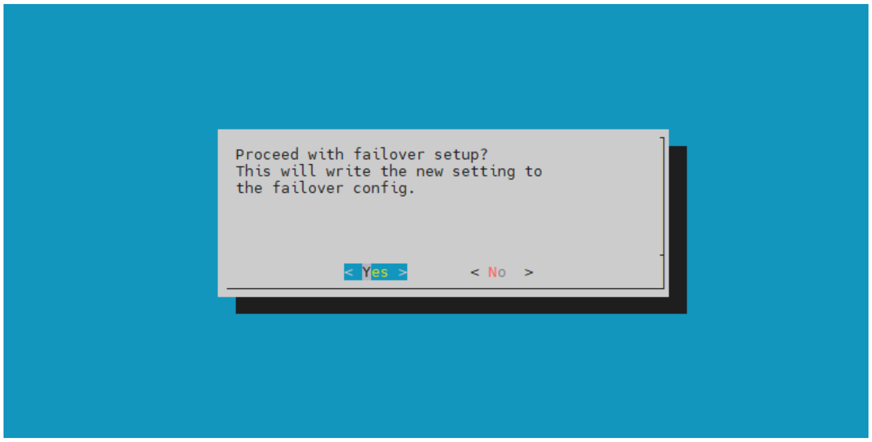
```
Please enter the hostname of the secondary head node.

 Name:                    basepod-head2
```

15. The wizard shows a summary of the information that it has collected. The VIP that will be assigned to the internal and external interfaces, respectively.



```
                         SUMMARY

                  Failover Setup Summary
                  ----------------------

        Shared Internal Interface:
                             Name: ens1f1np1:cmha
                               IP: 10.130.122.251


        Shared External Interface:
                             Name: ens10f1:cmha
                               IP: 10.130.121.251


                 Failover Network: SKIPPING
```

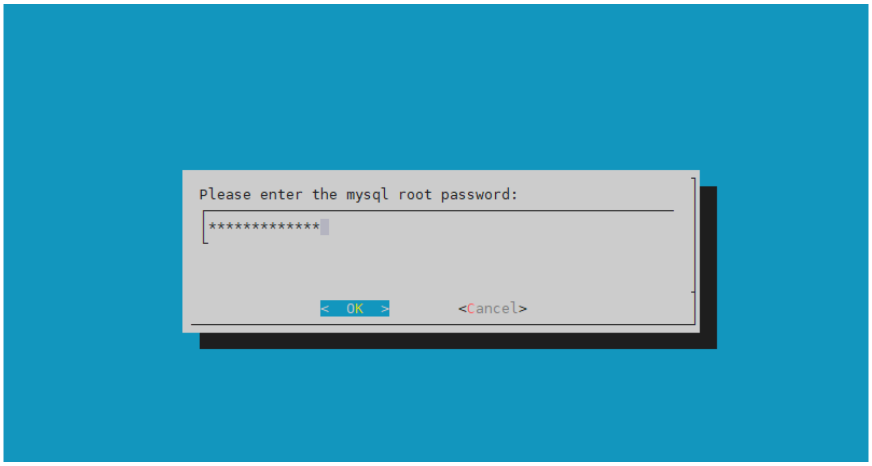
16. Select `Yes` to proceed with the failover configuration.



```
Proceed with failover setup?
This will write the new setting to
the failover config.
```

17. Enter the MySQL root password.

The auto-generated password is in `/root/.mysql`.



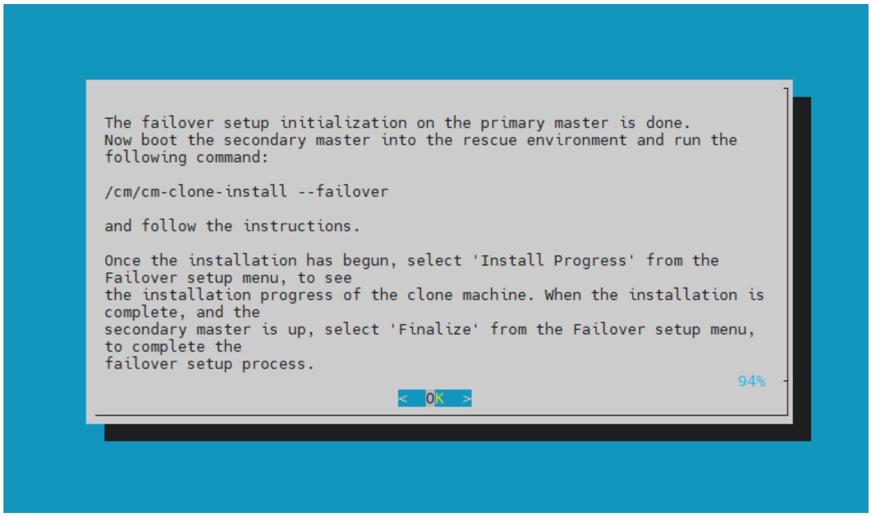
```
Please enter the mysql root password:
*************
```

18. The wizard implements the first steps in the HA configuration. If all the steps show `OK`, press `ENTER` to continue. The progress is shown below.

```
Initializing failover setup on master............. [  OK  ]
Updating shared internal interface................ [  OK  ]
Updating shared external interface................ [  OK  ]
Updating extra shared internal interfaces......... [  OK  ]
Cloning head node................................. [  OK  ]
Updating secondary master interfaces.............. [  OK  ]
Updating Failover Object.......................... [  OK  ]
Restarting cmdaemon............................... [  OK  ]
Press any key to continue
```

19. Run the `/cm/cm-clone-install –failover` command on the secondary head node.

    This should be a one-time network boot.

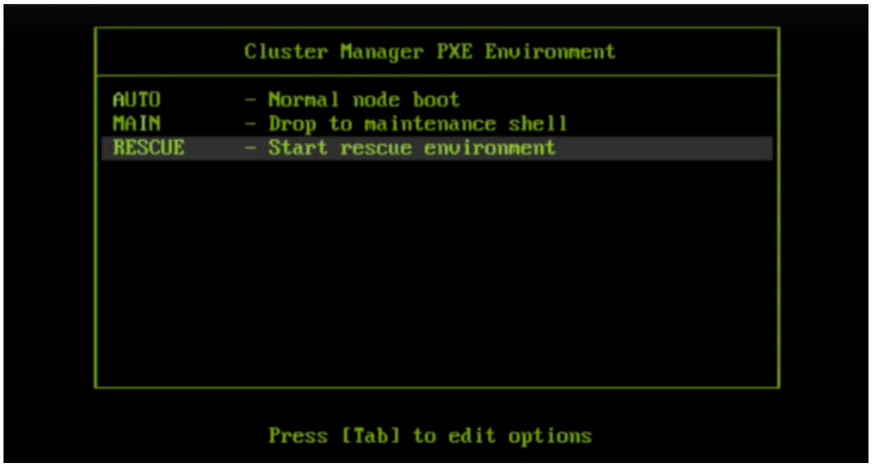


```
The failover setup initialization on the primary master is done.
Now boot the secondary master into the rescue environment and run the
following command:

/cm/cm-clone-install --failover

and follow the instructions.

Once the installation has begun, select 'Install Progress' from the
Failover setup menu, to see
the installation progress of the clone machine. When the installation is
complete, and the
secondary master is up, select 'Finalize' from the Failover setup menu,
to complete the
failover setup process.
```

20. PXE boot the secondary head node.

    Because this is the initial boot of this node, it must be done using BMC or physical power button

21. Select `RESCUE` from the grub menu.

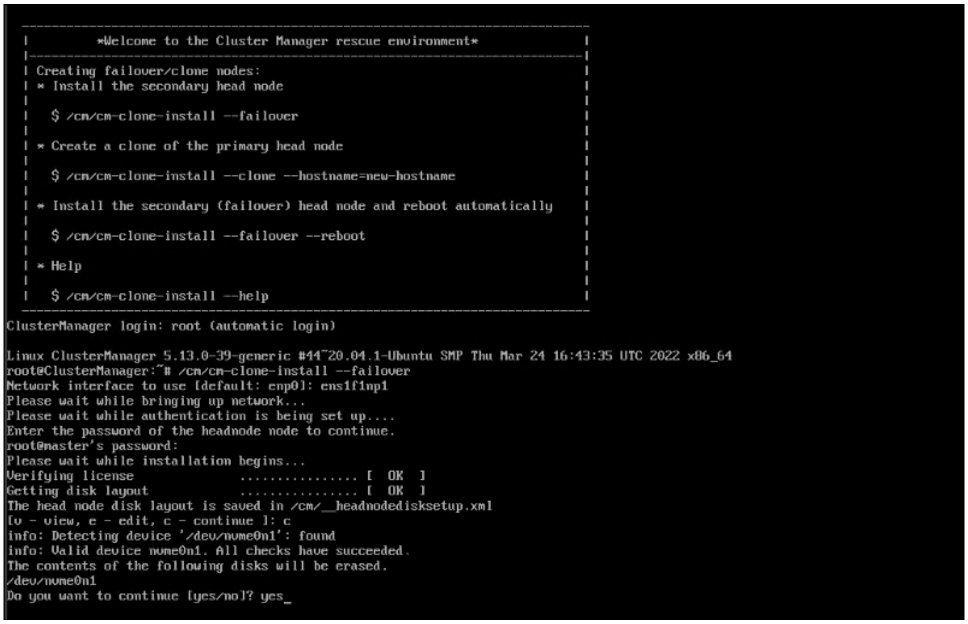


Cluster Manager PXE Environment
AUTO - Normal node boot
MAIN - Drop to maintenance shell
RESCUE - Start rescue environment
Press [Tab] to edit options

.

22. After the secondary head node has booted into the rescue environment, run the `/cm/cm--clone-install --failover` command, then enter yes when prompted.

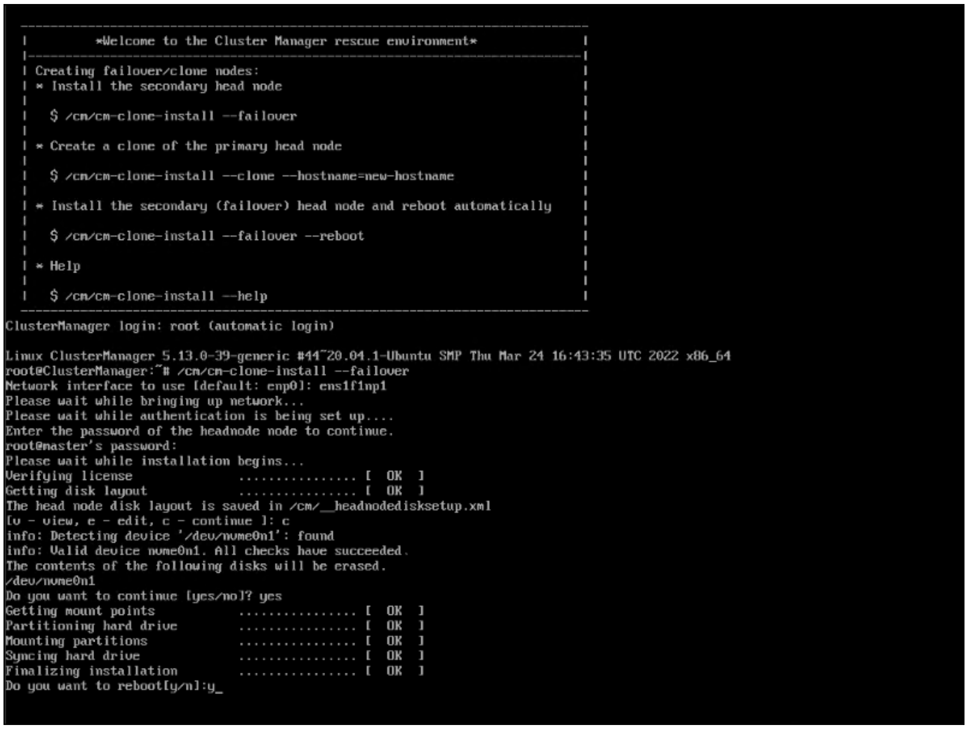
    The secondary head node will be cloned from the primary.



```
 ---------------------------------------------------------------------------
 |          *Welcome to the Cluster Manager rescue environment*            |
 |-------------------------------------------------------------------------|
 | Creating failover/clone nodes:                                          |
 | * Install the secondary head node                                       |
 |                                                                         |
 |   $ /cm/cm-clone-install --failover                                     |
 |                                                                         |
 | * Create a clone of the primary head node                               |
 |                                                                         |
 |   $ /cm/cm-clone-install --clone --hostname=new-hostname                |
 |                                                                         |
 | * Install the secondary (failover) head node and reboot automatically   |
 |                                                                         |
 |   $ /cm/cm-clone-install --failover --reboot                            |
 |                                                                         |
 | * Help                                                                  |
 |                                                                         |
 |   $ /cm/cm-clone-install --help                                         |
 ---------------------------------------------------------------------------
ClusterManager login: root (automatic login)

Linux ClusterManager 5.13.0-39-generic #44~20.04.1-Ubuntu SMP Thu Mar 24 16:43:35 UTC 2022 x86_64
root@ClusterManager:~# /cm/cm-clone-install --failover
Network interface to use [default: enp0]: ens1f1np1
Please wait while bringing up network...
Please wait while authentication is being set up....
Enter the password of the headnode node to continue.
root@master's password:
Please wait while installation begins...
Verifying license              ................ [  OK  ]
Getting disk layout            ................ [  OK  ]
The head node disk layout is saved in /cm/__headnodedisksetup.xml
[v - view, e - edit, c - continue ]: c
info: Detecting device '/dev/nvme0n1': found
info: Valid device nvme0n1. All checks have succeeded.
The contents of the following disks will be erased.
/dev/nvme0n1
Do you want to continue [yes/no]? yes_
```

23. When cloning is completed, enter `y` to reboot the secondary head node.

    The secondary must be set to boot from its hard drive. PXE boot should not be enabled.

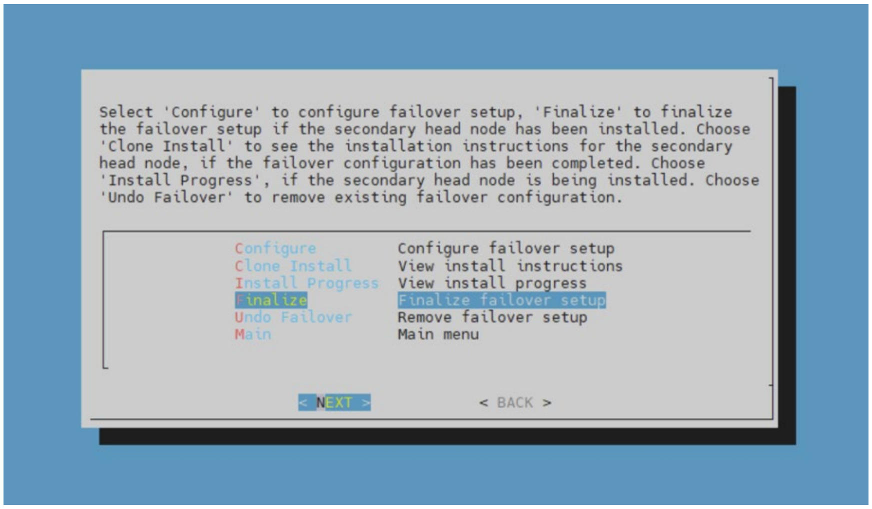


```
 ---------------------------------------------------------------------------
 |          *Welcome to the Cluster Manager rescue environment*            |
 |-------------------------------------------------------------------------|
 | Creating failover/clone nodes:                                          |
 | * Install the secondary head node                                       |
 |                                                                         |
 |   $ /cm/cm-clone-install --failover                                     |
 |                                                                         |
 | * Create a clone of the primary head node                               |
 |                                                                         |
 |   $ /cm/cm-clone-install --clone --hostname=new-hostname                |
 |                                                                         |
 | * Install the secondary (failover) head node and reboot automatically   |
 |                                                                         |
 |   $ /cm/cm-clone-install --failover --reboot                            |
 |                                                                         |
 | * Help                                                                  |
 |                                                                         |
 |   $ /cm/cm-clone-install --help                                         |
 ---------------------------------------------------------------------------
ClusterManager login: root (automatic login)

Linux ClusterManager 5.13.0-39-generic #44~20.04.1-Ubuntu SMP Thu Mar 24 16:43:35 UTC 2022 x86_64
root@ClusterManager:~# /cm/cm-clone-install --failover
Network interface to use [default: enp0]: ens1f1np1
Please wait while bringing up network...
Please wait while authentication is being set up....
Enter the password of the headnode node to continue.
root@master's password:
Please wait while installation begins...
Verifying license              ................ [  OK  ]
Getting disk layout            ................ [  OK  ]
The head node disk layout is saved in /cm/__headnodedisksetup.xml
[v - view, e - edit, c - continue ]: c
info: Detecting device '/dev/nvme0n1': found
info: Valid device nvme0n1. All checks have succeeded.
The contents of the following disks will be erased.
/dev/nvme0n1
Do you want to continue [yes/no]? yes
Getting mount points           ................ [  OK  ]
Partitioning hard drive        ................ [  OK  ]
Mounting partitions            ................ [  OK  ]
Syncing hard drive             ................ [  OK  ]
Finalizing installation        ................ [  OK  ]
Do you want to reboot[y/n]:y_
```

24. Wait for the secondary head node to reboot and then continue the HA setup procedure on the primary head node.

25. Select `finalize` from the `cmha-setup` menu.

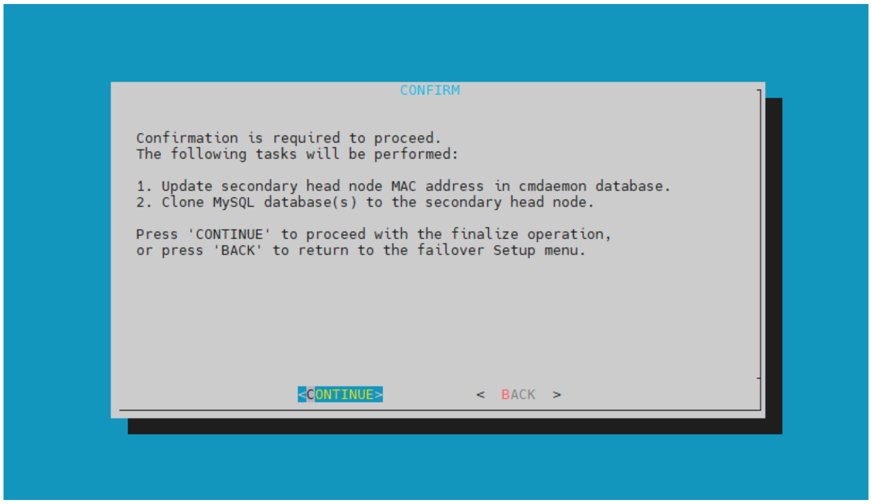
    This will clone the MySQL database from the primary to the secondary head node.



```
Select 'Configure' to configure failover setup, 'Finalize' to finalize
the failover setup if the secondary head node has been installed. Choose
'Clone Install' to see the installation instructions for the secondary
head node, if the failover configuration has been completed. Choose
'Install Progress', if the secondary head node is being installed. Choose
'Undo Failover' to remove existing failover configuration.
```

Configure Configure failover setup
Clone Install View install instructions
Install Progress View install progress
Finalize Finalize failover setup
Undo Failover Remove failover setup
Main Main menu
< NEXT >
< BACK >

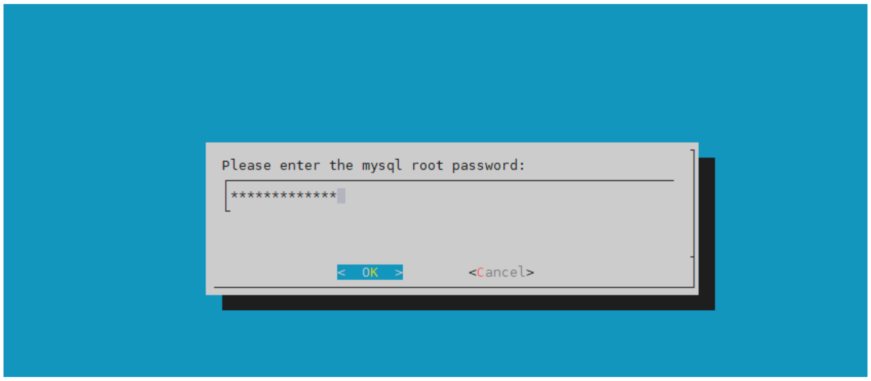
26. Select `<CONTINUE>` on the confirmation screen.



```
CONFIRM

Confirmation is required to proceed.
The following tasks will be performed:

1. Update secondary head node MAC address in cmdaemon database.
2. Clone MySQL database(s) to the secondary head node.

Press 'CONTINUE' to proceed with the finalize operation,
or press 'BACK' to return to the failover Setup menu.
```

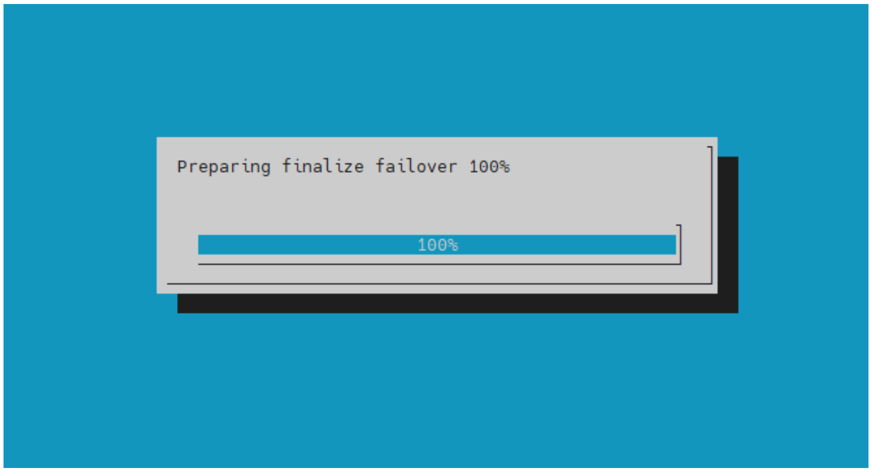
27. Enter the MySQL root password.

    The auto-generated password is in `/root/.mysql`.



```
Please enter the mysql root password:
*************
```

28. The `cmha-setup` wizard continues. Press `ENTER` to continue when prompted.

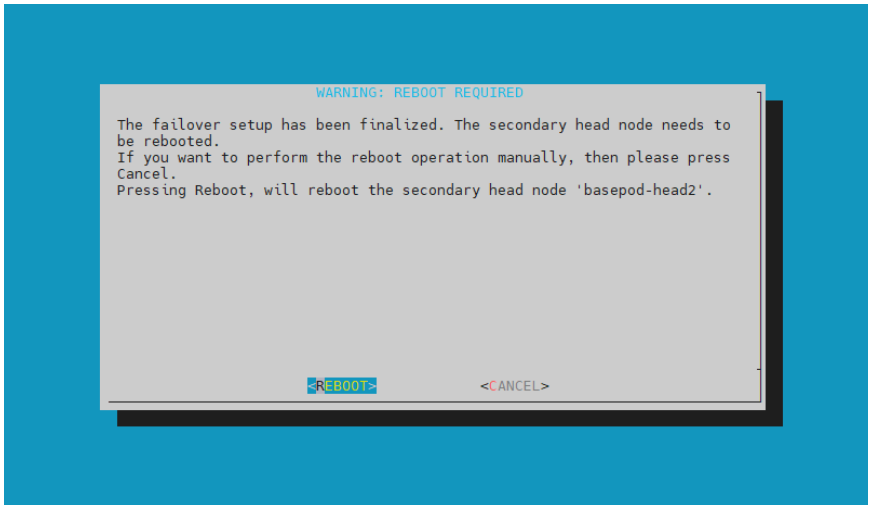


```
Preparing finalize failover 100%
```

The progress is shown below:

```
Updating secondary master mac address.............. [  OK  ]
Initializing failover setup on bcm-head-02......... [  OK  ]
Stopping cmdaemon.................................. [  OK  ]
Cloning cmdaemon database.......................... [  OK  ]
Checking database consistency...................... [  OK  ]
Starting cmdaemon, chkconfig services.............. [  OK  ]
Cloning workload manager databases................. [  OK  ]
Cloning additional databases....................... [  OK  ]
Update DB permissions.............................. [  OK  ]
Checking for dedicated failover network............ [  OK  ]
Press any key to continue
```

29. The `Finalize` step is now completed. Select `<REBOOT>` and wait for the secondary head node to reboot.



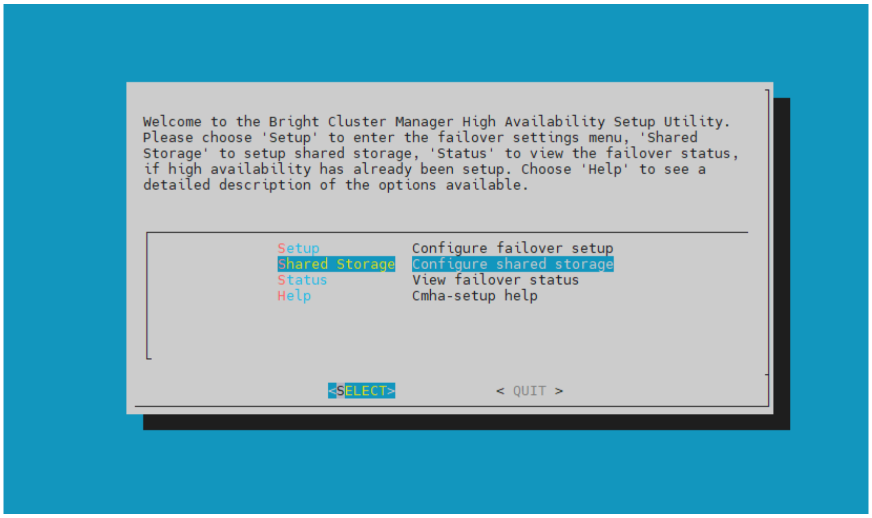
```
WARNING: REBOOT REQUIRED

The failover setup has been finalized. The secondary head node needs to
be rebooted.
If you want to perform the reboot operation manually, then please press
Cancel.
Pressing Reboot, will reboot the secondary head node 'basepod-head2'.
```

30. The secondary head node is now `UP`.

```
% device list -f hostname:20,category:12,ip:20,status:15
hostname (key)       category     ip                     status
-------------------- ---------- -------------------- ----------------
bcm-head-01                     10.130.122.254        [    UP    ]
bcm-head-02                     10.130.122.253        [    UP    ]
dgx01                dgx        10.130.122.5          [   DOWN   ]
dgx02                dgx        10.130.122.6          [   DOWN   ]
dgx03                dgx        10.130.122.7          [   DOWN   ]
dgx04                dgx        10.130.122.8          [   DOWN   ]
```

31. Select `Shared Storage` from the `cmha-setup` menu.

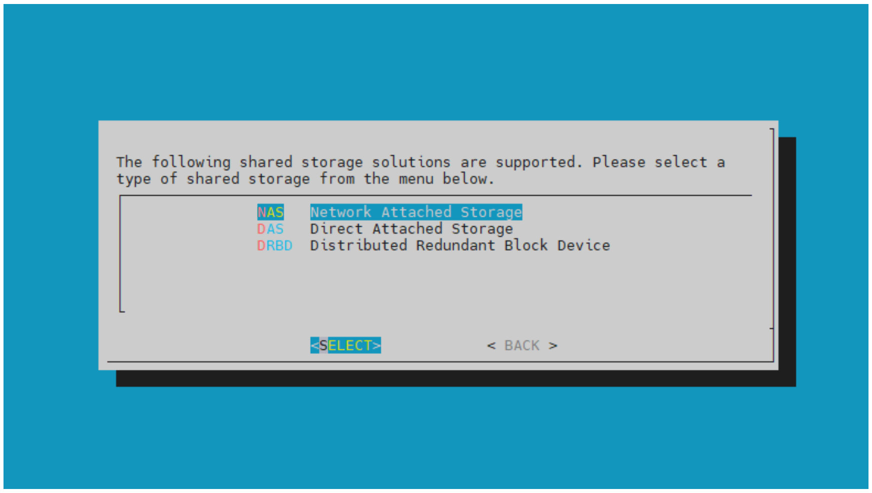
    In this final HA configuration step, `cmha-setup` will copy the `/cm/shared` and `/home` directories to the shared storage, and it configures both head nodes and all cluster nodes to mount it.



Welcome to the Bright Cluster Manager High Availability Setup Utility. Please choose 'Setup' to enter the failover settings menu, 'Shared Storage' to setup shared storage, 'Status' to view the failover status, if high availability has already been setup. Choose 'Help' to see a detailed description of the options available.

Setup Configure failover setup
Shared Storage Configure shared storage
Status View failover status
Help Cmha-setup help
<SELECT>
< QUIT >

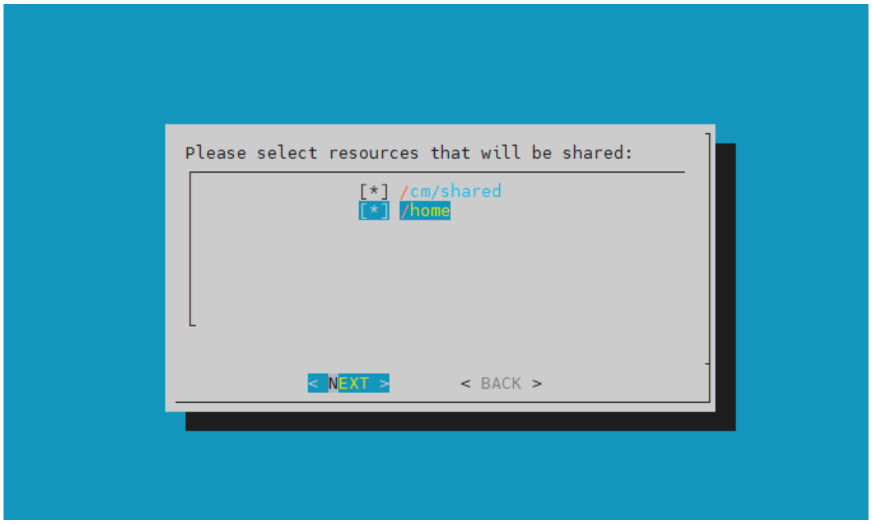
32. Choose `NAS` and then select `SELECT`.



The following shared storage solutions are supported. Please select a type of shared storage from the menu below.

NAS Network Attached Storage
DAS Direct Attached Storage
DRBD Distributed Redundant Block Device
<SELECT>
< BACK >

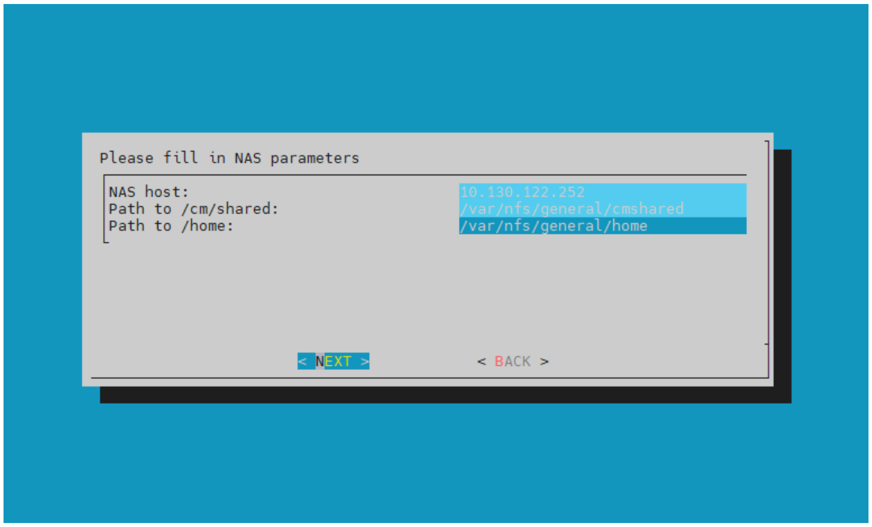
33. Choose both `/cm/shared` and `/home` and then select `NEXT`.



```
Please select resources that will be shared:

                [*] /cm/shared
                [*] /home
```

34. Provide the IP number of the NAS host, and the path that the `/cm/shared` and `/home` directories should be copied to on the shared storage.

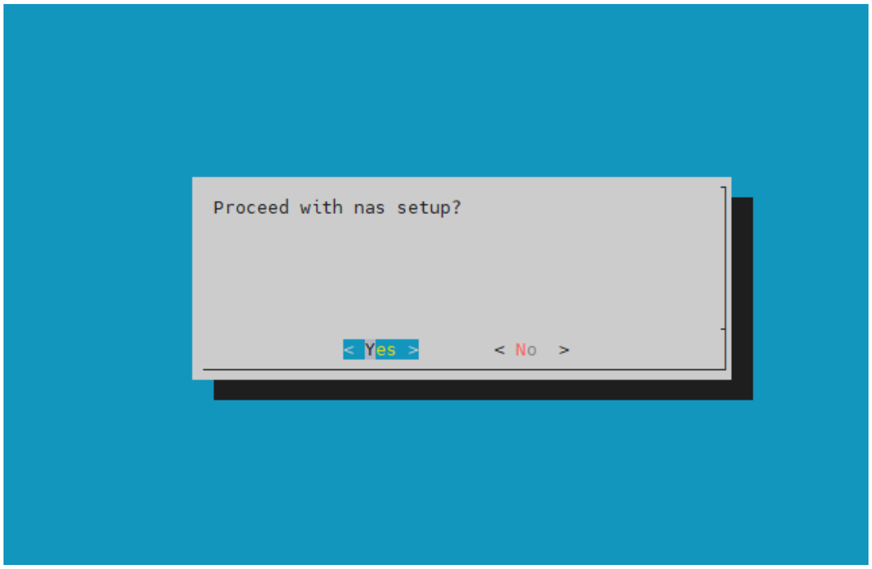
    In this case, /`var/nfs/general` is exported, so the `/cm/shared` directory will be copied to `10.130.122.252:/var/nfs/general/cmshared`, and it will be mounted over `/cm/shared` on the cluster nodes.



```
Please fill in NAS parameters

NAS host:                              10.130.122.252
Path to /cm/shared:                    /var/nfs/general/cmshared
Path to /home:                         /var/nfs/general/home
```

35. The wizard shows a summary of the information that it has collected. Press `ENTER` to continue.
36. Select `Yes` to continue.

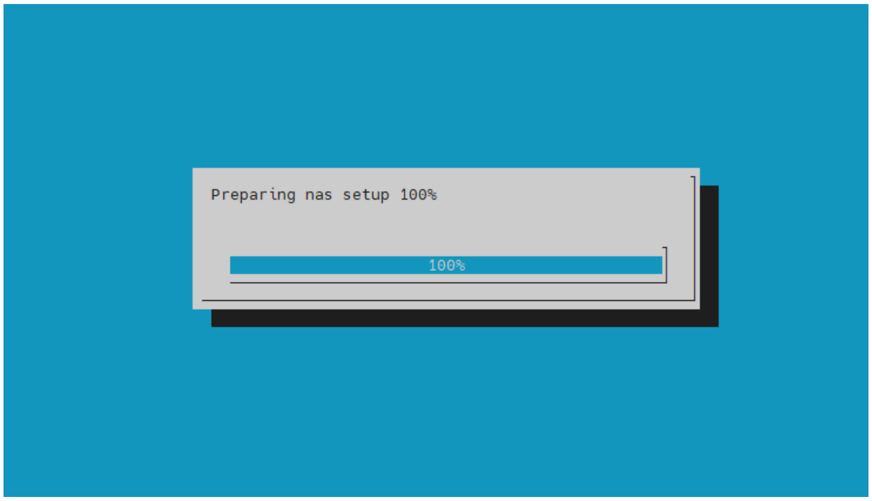
    This will initiate a copy and update to `fsexports`.



```
Proceed with nas setup?
```

37. The `cmha-setup` wizard proceeds with its work.

    When it completes, select `ENTER` to finish HA setup.

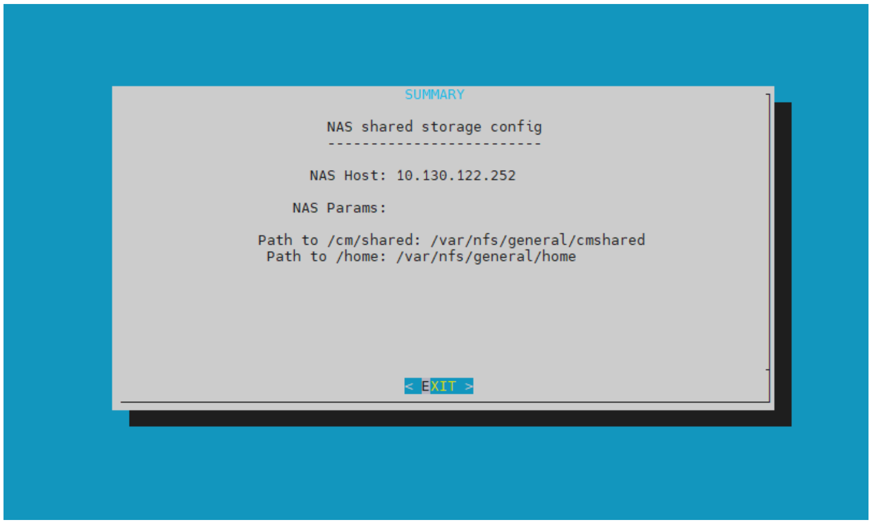


```
Preparing nas setup 100%
```

The progress is shown below:

```
Copying NAS data.................................. [  OK  ]
Mount NAS storage................................. [  OK  ]
Remove old fsmounts............................... [  OK  ]
Add new fsmounts.................................. [  OK  ]
Remove old fsexports.............................. [  OK  ]
Write NAS mount/unmount scripts................... [  OK  ]
Copy mount/unmount scripts........................ [  OK  ]
Press any key to continue
```

38. `cmha-setup` is now complete. `EXIT` the wizard to return to the shell prompt.
39. Run the `cmsh status` command to verify that the failover configuration is correct and working as expected.



```
SUMMARY

NAS shared storage config
-------------------------

NAS Host: 10.130.122.252

NAS Params:

Path to /cm/shared: /var/nfs/general/cmshared
Path to /home: /var/nfs/general/home
```

The command tests the configuration from both directions: from the primary head node to the secondary, and from the secondary to the primary. The active head node is indicated by an asterisk.

```
# cmha status
Node Status: running in active mode

bcm-head-01* -> bcm-head-02
  failoverping  [  OK  ]
  mysql         [  OK  ]
  ping          [  OK  ]
  status        [  OK  ]

bcm-head-02 -> bcm-head-01*
  failoverping  [  OK  ]
  mysql         [  OK  ]
  ping          [  OK  ]
  status        [  OK  ]
```

40. Verify that the `/cm/shared` and `/home` directories are being mounted from the NAS server.

```
# mount
. . . some output omitted . . .
10.130.122.252:/var/nfs/general/cmshared on /cm/shared type nfs4
(rw,relatime,vers=4.2,rsize=32768,wsize=32768,namlen=255,hard,proto=tcp,timeo=600
,retrans=2,sec=sys,clientaddr=10.130.122.253,local_lock=none,addr=10.130.122.252)
10.130.122.252:/var/nfs/general/home on /home type nfs4
(rw,relatime,vers=4.2,rsize=32768,wsize=32768,namlen=255,hard,proto=tcp,timeo=600
,retrans=2,sec=sys,clientaddr=10.130.122.253,local_lock=none,addr=10.130.122.252)
```

41. Login to the head node to be made active and run `cmha makeactive`.

```
# ssh bcm-head-02
# cmha makeactive
=========================================================================
This is the passive head node. Please confirm that this node should
become
the active head node. After this operation is complete, the HA status of
the head nodes will be as follows:

bcm-head-02 will become active head node (current state: passive)
bcm-head-01 will become passive head node (current state: active)
=========================================================================

Continue(c)/Exit(e)? c

Initiating failover.............................. [  OK  ]

bcm-head-02 is now active head node, makeactive successful
```

42. Run the `cmsh status` command again to verify that the secondary head node has become the active head node.

```
# cmha status
Node Status: running in active mode

bcm-head-02* -> bcm-head-01
  failoverping  [  OK  ]
  mysql         [  OK  ]
  ping          [  OK  ]
  status        [  OK  ]

bcm-head-01 -> bcm-head-02*
  failoverping  [  OK  ]
  mysql         [  OK  ]
  ping          [  OK  ]
  status        [  OK  ]
```

43. Manually failover back to the primary head node.

```
# ssh bcm-head-01
# cmha makeactive

===========================================================================
This is the passive head node. Please confirm that this node should become
the active head node. After this operation is complete, the HA status of
the head nodes will be as follows:

bcm-head-01 will become active head node (current state: passive)
bcm-head-02 will become passive head node (current state: active)
===========================================================================

Continue(c)/Exit(e)? c

Initiating failover.............................. [  OK  ]

bcm-head-01 is now active head node, makeactive successful
```

44. Run the `cmsh status` command again to verify that the primary head node has become the active head node.

```
# cmha status
Node Status: running in active mode

bcm-head-01* -> bcm-head-02
  failoverping  [  OK  ]
  mysql         [  OK  ]
  ping          [  OK  ]
  status        [  OK  ]

bcm-head-02 -> bcm-head-01*
  failoverping  [  OK  ]
  mysql         [  OK  ]
  ping          [  OK  ]
  status        [  OK  ]
```

45. Power on the cluster nodes.

```
# cmsh -c “power -c dgx on”
ipmi0 .................... [   ON    ] dgx01
ipmi0 .................... [   ON    ] dgx02
ipmi0 .................... [   ON    ] dgx03
ipmi0 .................... [   ON    ] dgx04
```

46. This concludes the setup and verification of HA.

Chapter 4. Slurm and Jupyter Setup

4.1 Slurm

1. Install Slurm.

   ```
   sudo /opt/bcm/provisioning/install_slurm
   ```

   This script will create the `slogin` nodes.

2. Update the interface names on the `slogin` nodes.

   ```
   % device use slogin-01
   ```

   Update interface names, If the `slogin-01` does not have the expected interface names ,

   ```
   % use networkdevicename
   % set networkdevicename new-name
   ```

3. Assign the MAC addresses to the slogin nodes.

   ```
   device use slogin-01
   set mac <MAC address>
   ```

4. Rerun the `install_slurm` script.

   ```
   /opt/bcm/provisioning/install_slurm
   ```

5. Reboot all the non-headnode systems involved with Slurm.

   ```
   cmsh
   device
   reboot -c slogin
   reboot -c dgxnodes
   ```

6. Modify the `slurmclient-gpu` role to remove the `slurm-client role` and convert `slurm-client-gpu` to use that name instead to simplify the configuration.

   ```
   cmsh
   configurationoverlay
   remove slurm-client
   commit
   use slurm-client-gpu
   set name slurm-client
   commit
   roles
   use slurmclient
   ```

7. Clear the `Type` value and set the correct core association with each GPU entry for maximum performance.

```
genericresources
use gpu0
clear type
set cores 48-63,176-191
use gpu1
clear type
set cores 48-63,176-191
use gpu2
clear type
set cores 16-31,144-159
use gpu3
clear type
set cores 16-31,144-159
use gpu4
clear type
set cores 112-127,240-255
use gpu5
clear type
set cores 112-127,240-255
use gpu6
clear type
set cores 80-95,210-223
use gpu7
clear type
set cores 80-95,210-223
commit
```

   The `gres.conf` file will be updated automatically by BCM—these settings align with the expectations of various scripts and tools in the NVIDIA ecosystem and will then maximize compatibility of this environment with those scripts and tools.

8. If the `/home` directory is not mounted on the nodes, increase the number of retries.

   Due to a race condition between the `bond0` interface being up and `/home` being mounted, sometimes `/home` will not be mounted. Increasing the number of retries should fix the issue.

```
cmsh
category
use dgxnodes
fsmounts
use home
set mountoptions “x-systemd.mount-timeout=150,defaults,_netdev,retry=2”
```

4.2 Jupyter Installation

1. Configure the Jupyter service on the head node.

```
/opt/bcm/provisioning/install_jupyter -j <hostname>.
```

2. Set `services` to use `cm-jupyterhub`.

```
% device
% use bcm-head-01
% services
% use cm-jupyterhub
```

3. Set the `runif` parameter to `ACTIVE`.

```

% set runif active
% commit
```

4. Ensure that the `Service` and `Run if` parameter are correctly set.

```
% show
Parameter                        Value
-------------------------------- ---------------------------------------
Revision
Service                          cm-jupyterhub
Run if                           ACTIVE
Monitored                        yes
Autostart                        yes
Timeout                          -1
Belongs to role                  yes
Sickness check script
Sickness check script timeout    10
Sickness check interval          60
```

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