

High Performance Computing

System Administrator



CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING PUNE

CASE STUDY

Submitted By:

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AIM

Build a two node Disk-less HPC-Cluster using OpenHPC with warewulf, PBS, Ganglia, LDAP and document the result.

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REQUIREMENTS

Hardware requirements:

- RAM : 8 GB
- PROCESSOR : i7 10 gen
- HDD : 100GB

Software requirements:

- Vmware workstation
- Centos 7 iso

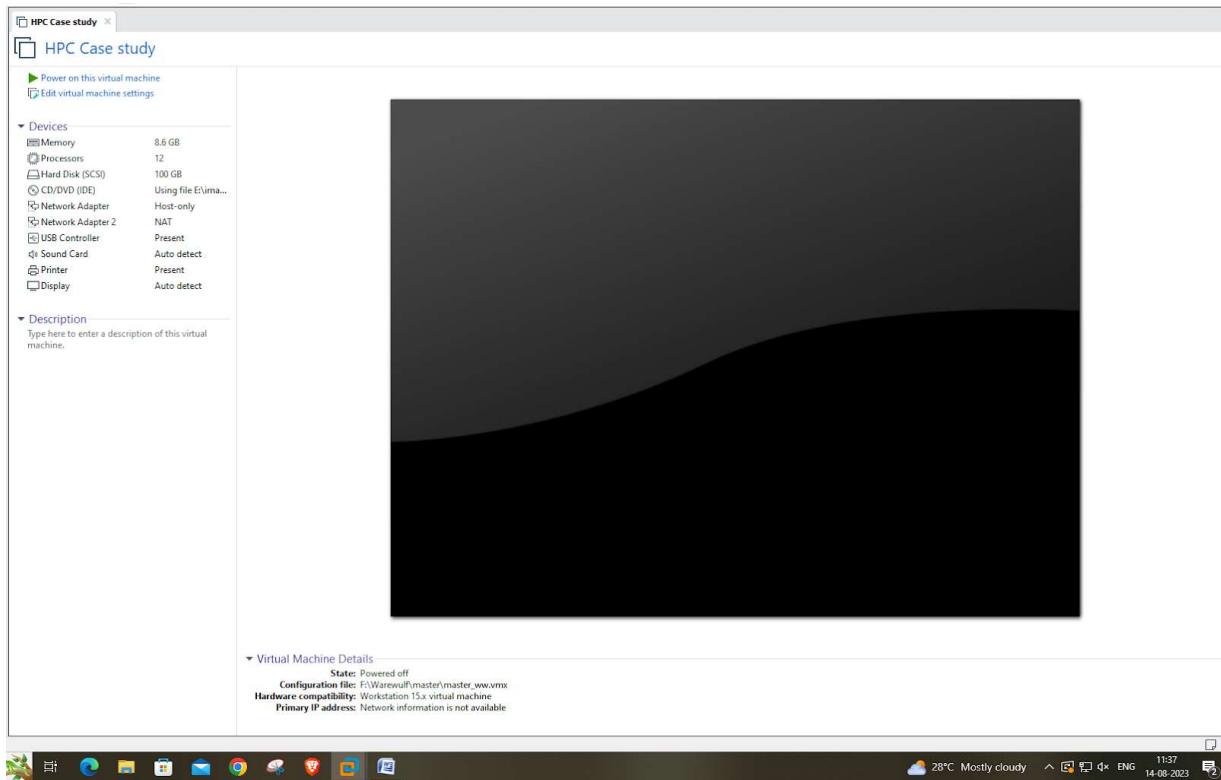
*Internet connectivity

INSTALLATION

The head node is configured as the primary node in the cluster and is setup to manage and install all compute nodes.

Install the Base Operating System

Create new virtual machine and Boot from the CentOS*installmedia(DVD).



After done to create virtual machine of Centos 7 with master configuration few must configuration are required

- 1) Setting hostname : master
- 2) Firewalld must be disabled
- 3) Selinux disable
- 4) Network configuration must be done

```
# hostnamectl set-hostname master
```

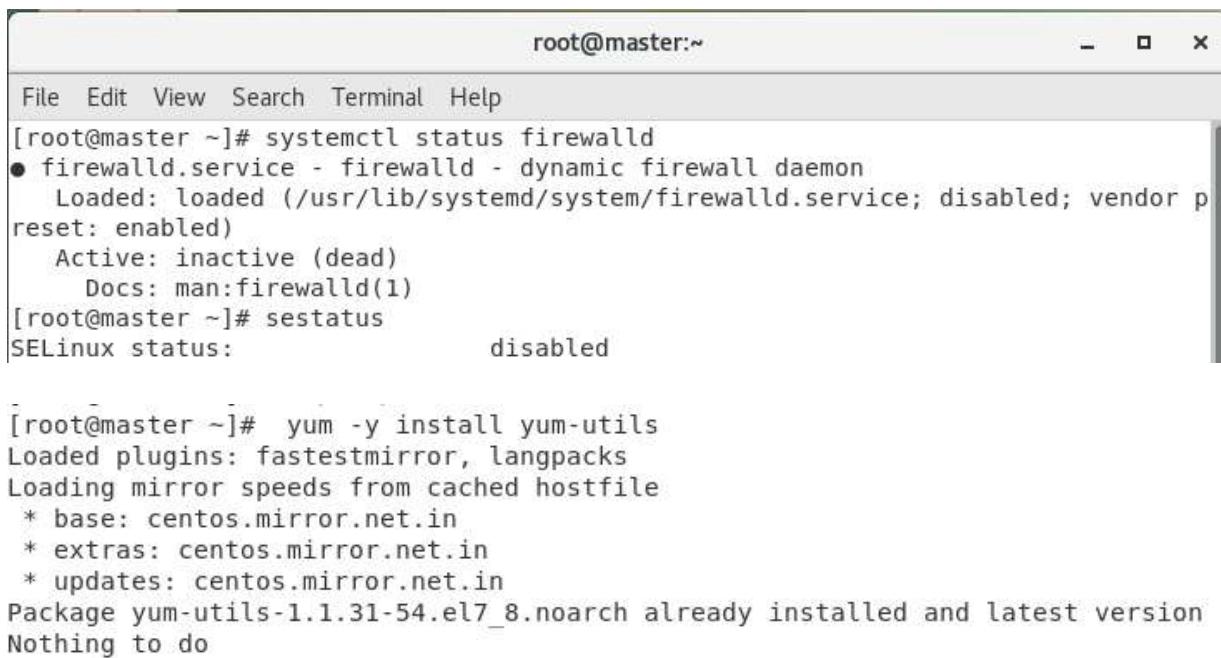
Post-Install Configuration

```
# systemctl stop firewalld
```

```
#systemctl disable firewalld
```

```
# vi /etc/selinux/conf
```

→ Change enforcing to disabled



The screenshot shows a terminal window titled "root@master:~". The window has a standard Linux terminal interface with a menu bar (File, Edit, View, Search, Terminal, Help) and a title bar. The main area displays the following text:

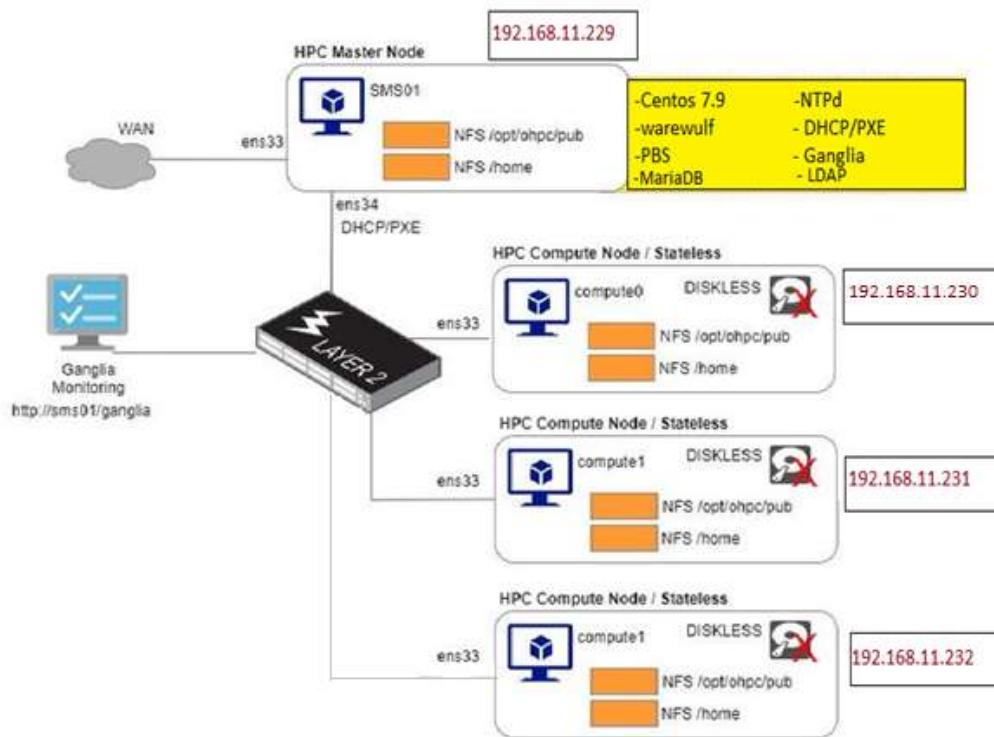
```
root@master:~#
File Edit View Search Terminal Help
[root@master ~]# systemctl status firewalld
● firewalld.service - firewalld - dynamic firewall daemon
  Loaded: loaded (/usr/lib/systemd/system/firewalld.service; disabled; vendor p
reset: enabled)
  Active: inactive (dead)
    Docs: man:firewalld(1)
[root@master ~]# sestatus
SELinux status:                 disabled

[root@master ~]# yum -y install yum-utils
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Package yum-utils-1.1.31-54.el7_8.noarch already installed and latest version
Nothing to do
```

```
# nmcli -p connection show --active
```

```
Nothing to do
[root@master ~]# nmcli -p connection show --active
=====
 NetworkManager active profiles
=====
NAME      UUID
ens34    ae34aac6-8966-4c04-b2a5-df830dbbe1e2d  ethernet  ens34
virbr0   4b8a68c1-01a5-4431-b3e8-e7b95f9e1b4d  bridge    virbr0
skipping
```

CASE-STUDY CLUSTER

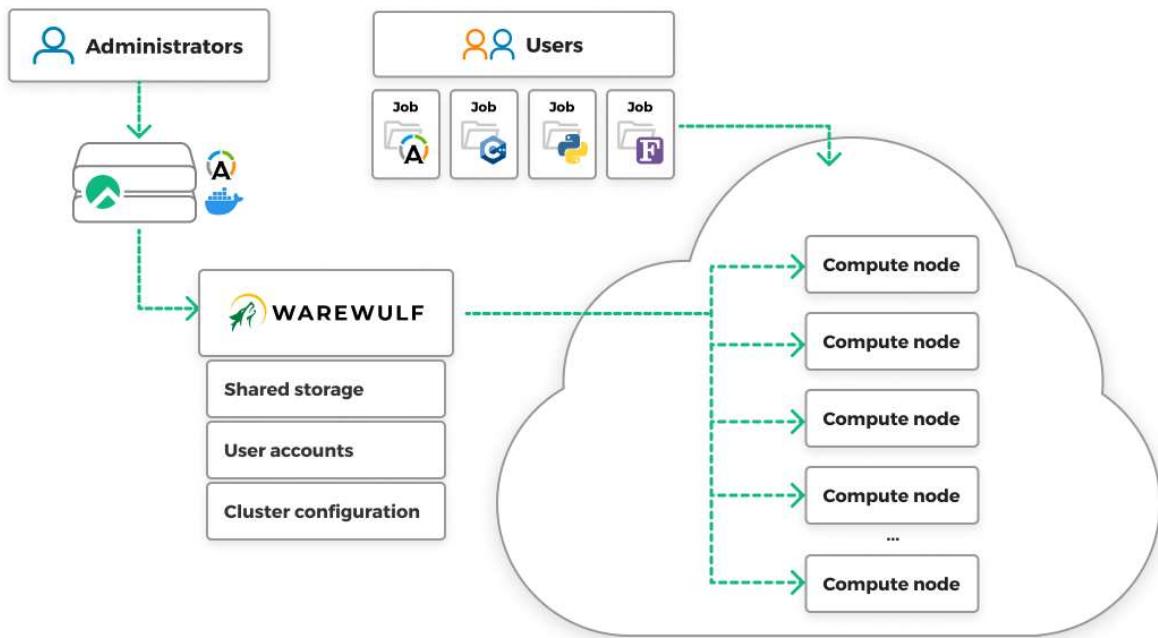


openHPC with Warewulf

Warewulf is an open-source, scalable high-performance computing (HPC) operating system provisioning and management framework. It is used to create and manage compute clusters, specifically designed for use in HPC environments.

With Warewulf, system administrators can easily provision, configure, and manage large-scale cluster installations. It provides features such as automated OS and software installation, centralized management, cluster monitoring, and remote system consoles.

Warewulf is known for its simplicity, flexibility, and seamless integration with other HPC tools and frameworks. It allows for easy management of node and image configurations, making it ideal for both small and large HPC deployments.



```
#Yum install
```

```
http://build.openhpc.community/OpenHPC:/1.3/CentOS_7/x86_64/ohpc-release-1.3-1.el7.x86_64.rpm
```

```
# yum -y install ohpc-base
```

```
[root@master ~]# yum install http://build.openhpc.community/OpenHPC:/1.3/CentOS_7/x86_64/ohpc-release-1.3-1.el7.x86_64.rpm
Loaded plugins: fastestmirror, langpacks
ohpc-release-1.3-1.el7.x86_64.rpm | 4.4 kB 00:00
Examining /var/tmp/yum-root-rPZf0f/ohpc-release-1.3-1.el7.x86_64.rpm: ohpc-release-1.3-1.el7.x86_64
Marking /var/tmp/yum-root-rPZf0f/ohpc-release-1.3-1.el7.x86_64.rpm to be installed
Resolving Dependencies
--> Running transaction check
--> Package ohpc-release.x86_64 0:1.3-1.el7 will be installed
--> Processing Dependency: epel-release for package: ohpc-release-1.3-1.el7.x86_64
Loading mirror speeds from cached hostfile
* base: centos.mirror.net.in
* extras: centos.mirror.net.in
* updates: centos.mirror.net.in
--> Running transaction check
--> Package epel-release.noarch 0:7-11 will be installed
--> Finished Dependency Resolution

Dependencies Resolved

=====
Package      Arch    Version       Repository      Size
=====
Installing:
ohpc-release  x86_64  1.3-1.el7   /ohpc-release-1.3-1.el7.x86_64  1.4 k
Installing for dependencies:
epel-release   noarch  7-11        extras          15 k

Transaction Summary
=====
```



```
[root@master ~]# yum repolist
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
epel/x86_64/metalink
* base: centos.mirror.net.in
* epel: mirror.citrahost.com
* extras: centos.mirror.net.in
* updates: centos.mirror.net.in
OpenHPC
OpenHPC-updates
epel
(1/6): epel/x86_64/group_gz
(2/6): OpenHPC/group.gz
| 3.4 kB 00:00
| 1.6 kB 00:00
| 1.2 kB 00:00
| 4.7 kB 00:00
| 99 kB 00:00
| 1.7 kB 00:00
```



```
[root@master ~]# yum -y install ohpc-base
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
* base: centos.mirror.net.in
* epel: mirror.citrahost.com
* extras: centos.mirror.net.in
* updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package ohpc-base.x86_64 0:1.3.8-3.1.ohpc.1.3.8 will be installed
--> Processing Dependency: conman-ohpc for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: lmod-ohpc for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: examples-ohpc for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: screen for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: libunwind for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: ipmitool for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: cmake-ohpc for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: binutils-devel for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: pdsh-ohpc for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: OpenIPMI for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: emacs-nox for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: losf-ohpc for package: ohpc-base-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Running transaction check
```

```
Complete!
[root@master ~]# yum -y install ohpc-warewulf
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: mirror.citrahost.com
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package ohpc-warewulf.x86_64 0:1.3.8-3.1.ohpc.1.3.8 will be installed
--> Processing Dependency: warewulf-provision-initramfs-x86_64-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-common-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-provision-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-vnfs-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-cluster-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-provision-server-ipxe-x86_64-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-ipmi-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Processing Dependency: warewulf-provision-server-ohpc for package: ohpc-warewulf-1.3.8-3.1.ohpc.1.3.8.x86_64
--> Running transaction check
```

vi /etc/chrony.conf

-> Edit this Conf. file -> server 192.168.11.229 iburst

-> allow 192.168.11.0/24 (uncomment and edit network address)

-> local stratum 10 (uncomment)

-> SAVE and Exit

```

File Edit View Search Terminal Help
# Use public servers from the pool.ntp.org project.
# Please consider joining the pool (http://www.pool.ntp.org/join.html).
#server 0.centos.pool.ntp.org iburst
#server 1.centos.pool.ntp.org iburst
#server 2.centos.pool.ntp.org iburst
#server 3.centos.pool.ntp.org iburst
server 192.168.11.229 iburst
# Record the rate at which the system clock gains/losses time.
driftfile /var/lib/chrony/drift

# Allow the system clock to be stepped in the first three updates
# if its offset is larger than 1 second.
makestep 1.0 3

# Enable kernel synchronization of the real-time clock (RTC).
rtcsync

# Enable hardware timestamping on all interfaces that support it.
#hwtimestamp *

# Increase the minimum number of selectable sources required to adjust
# the system clock.
#minsources 2

# Allow NTP client access from local network.
allow 192.168.0.0/16

# Serve time even if not synchronized to a time source.
local stratum 10

# Specify file containing keys for NTP authentication.
#keyfile /etc/chrony.keys

# Specify directory for log files.
logdir /var/log/chrony

# Select which information is logged.
#log measurements statistics tracking
~
```

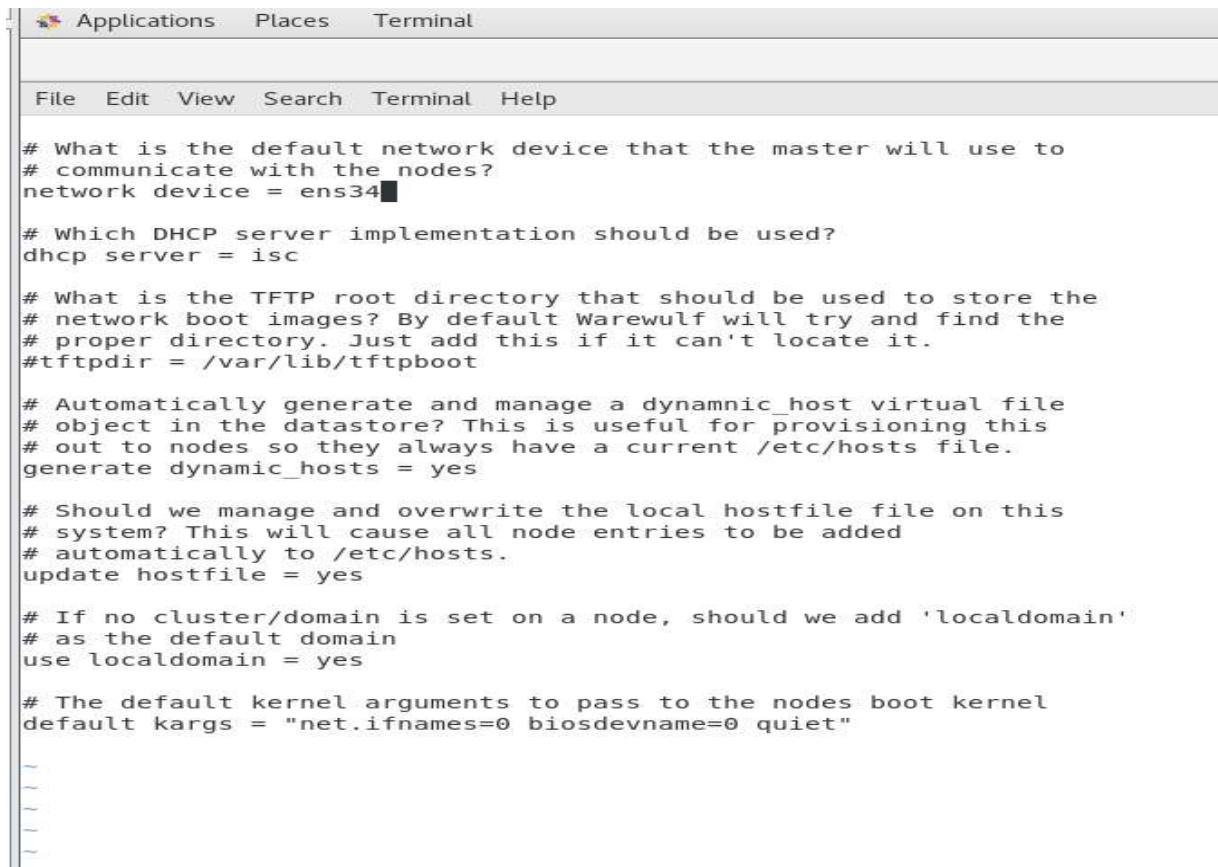
```

[root@master ~]# vi /etc/chrony.conf
[root@master ~]# systemctl start chronyd
[root@master ~]# systemctl enable chronyd
[root@master ~]# systemctl status chronyd
● chronyd.service - NTP client/server
   Loaded: loaded (/usr/lib/systemd/system/chronyd.service; enabled; vendor preset: enabled)
   Active: active (running) since Mon 2023-08-14 07:52:13 EDT; 34min ago
     Docs: man:chronyd(8)
           man:chrony.conf(5)
   Main PID: 920 (chronyd)
      CGroup: /system.slice/chronyd.service
              └─920 /usr/sbin/chronyd

Aug 14 07:52:13 master systemd[1]: Starting NTP client/server...
Aug 14 07:52:13 master chronyd[920]: chronyd version 3.4 starting (+CMDMON +NTP +REFCLOCK +RTC
Aug 14 07:52:13 master chronyd[920]: Frequency 0.000 +/- 1000000.000 ppm read from /var/lib/ch
Aug 14 07:52:13 master systemd[1]: Started NTP client/server.
Aug 14 07:54:37 master chronyd[920]: Source 95.216.144.226 replaced with 172.105.40.86
[root@master ~]#
```

```

[root@master ~]# ntpdate -q 192.168.11.229
server 192.168.11.229, stratum 0, offset 0.000000, delay 0.00000
14 Aug 08:27:27 ntpdate[4407]: no server suitable for synchronization found
```



The screenshot shows a Linux desktop environment with a terminal window open. The terminal window has a title bar with 'Applications', 'Places', and 'Terminal' and a menu bar with 'File', 'Edit', 'View', 'Search', 'Terminal', and 'Help'. The main area of the terminal contains configuration files for Warewulf. The configuration includes:

```
# What is the default network device that the master will use to
# communicate with the nodes?
network device = ens34

# Which DHCP server implementation should be used?
dhcp server = isc

# What is the TFTP root directory that should be used to store the
# network boot images? By default Warewulf will try and find the
# proper directory. Just add this if it can't locate it.
#tftpdir = /var/lib/tftpboot

# Automatically generate and manage a dynamic_host virtual file
# object in the datastore? This is useful for provisioning this
# out to nodes so they always have a current /etc/hosts file.
generate dynamic_hosts = yes

# Should we manage and overwrite the local hostfile file on this
# system? This will cause all node entries to be added
# automatically to /etc/hosts.
update hostfile = yes

# If no cluster/domain is set on a node, should we add 'localdomain'
# as the default domain
use localdomain = yes

# The default kernel arguments to pass to the nodes boot kernel
default kargs = "net.ifnames=0 biosdevname=0 quiet"

~  
~  
~  
~  
~  
~
```

[root@master ~]# grep device /etc/warewulf/provision.conf
What is the default network **device** that the master will use to
network **device** = ens34
[root@master ~]#

```
File Edit View Search Terminal Help
# default: off
# description: The tftp server serves files using the trivial file transfer \
#               protocol. The tftp protocol is often used to boot diskless \
#               workstations, download configuration files to network-aware printers, \
#               and to start the installation process for some operating systems.
service tftp
{
    socket_type          = dgram
    protocol              = udp
    wait                  = yes
    user                  = root
    server                = /usr/sbin/in.tftpd
    server_args            = -s /var/lib/tftpboot
    disable                = no
    per_source              = 11
    cps                    = 100 2
    flags                  = IPv4
}

[root@master ~]# vi /etc/xinetd.d/tftp
[root@master ~]# grep disable /etc/xinetd.d/tftp
  disable                = no
[root@master ~]#
```

```

ifconfig - ...
[root@master ~]# ifconfig ${INT_NIC}
ens33: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
      ether 00:0c:29:1a:b7:c9 txqueuelen 1000 (Ethernet)
      RX packets 3 bytes 276 (276.0 B)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 0 bytes 0 (0.0 B)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

ens34: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
      inet 192.168.11.229 netmask 255.255.255.0 broadcast 192.168.11.255
      inet6 fe80::4e7e:7f2c:4cf:f304 prefixlen 64 scopeid 0x20<link>
      ether 00:0c:29:1a:b7:d3 txqueuelen 1000 (Ethernet)
      RX packets 72639 bytes 107982166 (102.9 MiB)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 11706 bytes 740402 (723.0 KiB)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
      inet 127.0.0.1 netmask 255.0.0.0
      inet6 ::1 prefixlen 128 scopeid 0x10<host>
      loop txqueuelen 1000 (Local Loopback)
      RX packets 40 bytes 3312 (3.2 KiB)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 40 bytes 3312 (3.2 KiB)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

virbr0: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
      inet 192.168.122.1 netmask 255.255.255.0 broadcast 192.168.122.255
      ether 52:54:00:15:50:cc txqueuelen 1000 (Ethernet)
      RX packets 0 bytes 0 (0.0 B)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 0 bytes 0 (0.0 B)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

[root@master ~]# ■

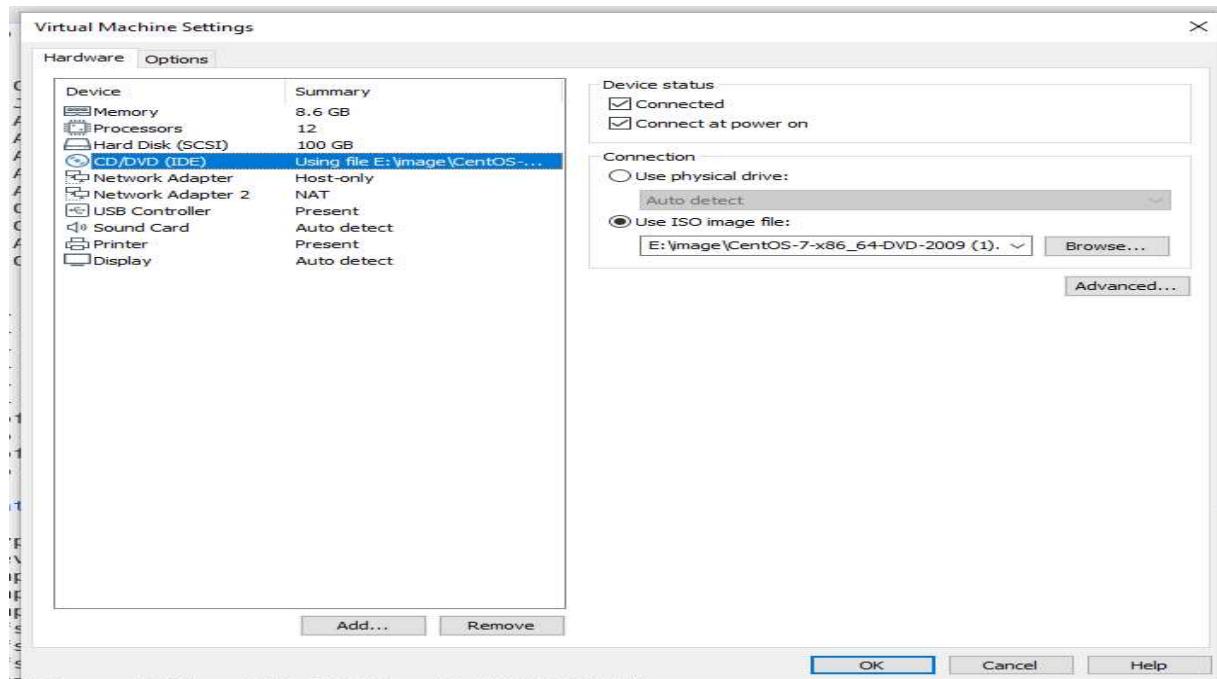
```

```

[root@master ~]# systemctl restart xinetd
[root@master ~]# systemctl enable mariadb.service
[root@master ~]# systemctl restart mariadb
[root@master ~]# systemctl enable httpd.service
[root@master ~]# systemctl restart httpd
[root@master ~]# systemctl enable dhcpd.service
Created symlink from /etc/systemd/system/multi-user.target.wants/dhcpd.service to /usr/lib/systemd/system/dhcpd.service.
[root@master ~]# ■

```

Select the ‘Connected’ check box to change device status to connected.



```
[root@master ~]# df -Th
Filesystem      Type   Size  Used Avail Use% Mounted on
devtmpfs        devtmpfs 4.1G    0  4.1G  0% /dev
tmpfs          tmpfs   4.1G    0  4.1G  0% /dev/shm
tmpfs          tmpfs   4.1G  13M  4.1G  1% /run
tmpfs          tmpfs   4.1G    0  4.1G  0% /sys/fs/cgroup
/dev/mapper/centos_master-root xfs     50G  6.4G  44G 13% /
/dev/sdal       xfs   1014M 185M 830M 19% /boot
/dev/mapper/centos_master-home xfs     45G  33M  45G  1% /home
tmpfs          tmpfs   839M  32K  839M  1% /run/user/0
/dev/sr0        iso9660  4.4G  4.4G    0 100% /run/media/root/CentOS 7 x86_64
[root@master ~]# dd if=/dev/sr0 of=/root/centos7.7.iso
9203712+0 records in
9203712+0 records out
4712300544 bytes (4.7 GB) copied, 68.0531 s, 69.2 MB/s
[root@master ~]#
```

```
[root@master ~]# export CHROOT=/opt/ohpc/admin/images/centos7.7
[root@master ~]# echo ${CHROOT}
/opt/ohpc/admin/images/centos7.7
[root@master ~]#
```

```
[root@master ~]# wwmkchroot centos-7 ${CHROOT}
Loaded plugins: fastestmirror, langpacks
Determining fastest mirrors
os-base
(1/2): os-base/x86_64/group_gz
(2/2): os-base/x86_64/primary_db
Resolving Dependencies
--> Running transaction check
--> Package basesystem.noarch 0:10.0-7.el7.centos will be installed
--> Package bash.x86_64 0:4.2.46-34.el7 will be installed
--> Processing Dependency: rtld(GNU_HASH) for package: bash-4.2.46-34.el7.x86_64
--> Processing Dependency: libdl.so.2(GLIBC_2.2.5)(64bit) for package: bash-4.2.46-34.el7.x86_64
--> Processing Dependency: libc.so.6(GLIBC_2.15)(64bit) for package: bash-4.2.46-34.el7.x86_64
--> Processing Dependency: libtinfo.so.5()(64bit) for package: bash-4.2.46-34.el7.x86_64
--> Processing Dependency: libdl.so.2()(64bit) for package: bash-4.2.46-34.el7.x86_64
--> Package centos-release.x86_64 0:7-9.2009.0.el7.centos will be installed
--> Package chkconfig.x86_64 0:1.7.6-1.el7 will be installed

=====
[root@master ~]# uname -r
3.10.0-1160.el7.x86_64
[root@master ~]# chroot ${CHROOT} uname -r
3.10.0-1160.el7.x86_64
[root@master ~]# yum -y --installroot=${CHROOT} install ohpc-base-compute
Loaded plugins: fastestmirror, langpacks
Determining fastest mirrors
epel/x86_64/metalink
* base: centos.mirror.net.in
* epel: mirror.citrahost.com
* extras: centos.mirror.net.in
* updates: centos.mirror.net.in
OpenHPC
OpenHPC-updates
http://centos.mirror.net.in/centos/7.9.2009/os/x86_64/repo/repodata/repomd.xml: [Errno 14] curl#
Trying other mirror.
base
epel
extras
updates
OpenHPC

=====
Complete!
[root@master ~]# # cat /etc/resolv.conf
[root@master ~]# cp -p /etc/resolv.conf ${CHROOT}/etc/resolv.conf
[root@master ~]# yum -y --installroot=${CHROOT} install chrony
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
* base: centos.mirror.net.in
* epel: mirror.citrahost.com
* extras: centos.mirror.net.in
* updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package chrony.x86_64 0:3.4-1.el7 will be installed
--> Finished Dependency Resolution

Dependencies Resolved

=====


| Package     | Arch   |
|-------------|--------|
| Installing: | x86_64 |


```

```

Complete!
[root@master ~]# yum -y --installroot=$CHROOT install kernel
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: mirror.citrahost.com
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package kernel.x86_64 0:3.10.0-1160.95.1.el7 will be installed
--> Processing Dependency: linux-firmware >= 20190429-72 for package: kernel-3.10.0-1160_
--> Processing Dependency: grubbo >= 8.28-2 for package: kernel-3.10.0-1160.95.1.el7.x86_
--> Processing Dependency: /usr/sbin/new-kernel-pkg for package: kernel-3.10.0-1160.95.1.
--> Processing Dependency: /usr/sbin/new-kernel-pkg for package: kernel-3.10.0-1160.95.1.
--> Running transaction check
--> Package grubbo.x86_64 0:8.28-26.el7 will be installed
--> Package linux-firmware.noarch 0:20200421-80.git78c0348.el7_9 will be installed
--> Finished Dependency Resolution

```

```

Complete!
[root@master ~]# wwinit database
database: Checking to see if RPM 'mysql-server' is installed NO
database: Checking to see if RPM 'mariadb-server' is installed OK
database: Activating Systemd unit: mariadb
database: + /bin/systemctl -q enable mariadb.service OK
database: + /bin/systemctl -q restart mariadb.service OK
database: + mysqladmin --defaults-extra-file=/tmp/0.qUL1b0n5WHrw/my.cnf OK
database: Database version: UNDEF (need to create database)
database: + mysql --defaults-extra-file=/tmp/0.qUL1b0n5WHrw/my.cnf ware OK
database: + mysql --defaults-extra-file=/tmp/0.qUL1b0n5WHrw/my.cnf ware OK
database: + mysql --defaults-extra-file=/tmp/0.qUL1b0n5WHrw/my.cnf ware OK
database: Checking binstore kind SUCCESS
Done.

```

```

[root@master ~]# wwinit ssh_keys
ssh_keys: Checking ssh keys for root OK
ssh_keys: Checking root's ssh config OK
ssh_keys: Checking for default RSA host key for nodes NO
ssh_keys: Creating default node ssh_host_rsa_key:
ssh_keys: + ssh-keygen -q -t rsa -f /etc/warewulf/vnfs/ssh/ssh_host_rsa OK
ssh_keys: Checking for default DSA host key for nodes NO
ssh_keys: Creating default node ssh_host_dsa_key:
ssh_keys: + ssh-keygen -q -t dsa -f /etc/warewulf/vnfs/ssh/ssh_host_dsa OK
ssh_keys: Checking for default ECDSA host key for nodes NO
ssh_keys: Creating default node ssh_host_ecdsa_key:
ssh_keys: Checking for default Ed25519 host key for nodes NO
ssh_keys: Creating default node ssh_host_ed25519_key: OK
Done.

```

```
# df -hT | grep -v tmpfs

# echo "master:/home /home nfs nfsvers=3,nodev,nosuid 0 0" >> $CHROOT/etc/fstab

# echo "master:/opt/ohpc/pub /opt/ohpc/pub nfs nfsvers=3,nodev 0 0" >> $CHROOT/etc/fstab

# cat ${CHROOT}/etc/fstab

# cat /etc/exports

# echo "/home *(rw,no_subtree_check,fsid=10,no_root_squash)" >> /etc/exports

# echo "/opt/ohpc/pub *(ro,no_subtree_check,fsid=11)" >> /etc/exports

[root@master ~]# df -hT | grep -v tmpfs
Filesystem           Type      Size  Used Avail Use% Mounted on
/dev/mapper/centos_master-root xfs       50G   17G   34G  33% /
/dev/sda1             xfs     1014M  185M  830M  19% /boot
/dev/mapper/centos_master-home xfs       45G   33M   45G   1% /home
/dev/sr0              iso9660  4.4G   4.4G    0 100% /run/media/root/CentOS 7 x86_64
[root@master ~]# echo "master:/home /home nfs nfsvers=3,nodev,nosuid 0 0" >> $CHROOT/etc/fstab
[root@master ~]# echo "master:/opt/ohpc/pub /opt/ohpc/pub nfs nfsvers=3,nodev 0 0" >> $CHROOT/etc/fstab
[root@master ~]# cat ${CHROOT}/etc/fstab
#GENERATED_ENTRIES#
tmpfs /dev/shm tmpfs defaults 0 0
devpts /dev/pts devpts gid=5,mode=620 0 0
sysfs /sys sysfs defaults 0 0
proc /proc proc defaults 0 0
naster:/home /home nfs nfsvers=3,nodev,nosuid 0 0
naster:/opt/ohpc/pub /opt/ohpc/pub nfs nfsvers=3,nodev 0 0
[root@master ~]# cat /etc/exports
[root@master ~]# echo "/home *(rw,no_subtree_check,fsid=10,no_root_squash)" >> /etc/exports
[root@master ~]# echo "/opt/ohpc/pub *(ro,no_subtree_check,fsid=11)" >> /etc/exports
[root@master ~]# exportfs -arv
exporting *:/opt/ohpc/pub
exporting *:/home

# systemctl start nfs-server

# systemctl enable nfs-server
```

```
[root@master ~]# systemctl start nfs-server
[root@master ~]# systemctl status nfs-server
● nfs-server.service - NFS server and services
  Loaded: loaded (/usr/lib/systemd/system/nfs-server.service; disabled)
  Active: active (exited) since Mon 2023-08-14 09:44:03 EDT; 8s ago
    Process: 71197 ExecStartPost=/bin/sh -c if systemctl -q is-active
    Process: 71181 ExecStart=/usr/sbin/rpc.nfsd $RPCNFSDARGS (code=exited, st
    Process: 71177 ExecStartPre=/usr/sbin/exportfs -r (code=exited, st
  Main PID: 71181 (code=exited, status=0/SUCCESS)
     Tasks: 0
    CGroup: /system.slice/nfs-server.service

Aug 14 09:44:03 master systemd[1]: Starting NFS server and services.
Aug 14 09:44:03 master systemd[1]: Started NFS server and services.
[root@master ~]# systemctl enable nfs-server

[root@master ~]# chroot $CHROOT systemctl enable chronyd
[root@master ~]# echo "server master" >> $CHROOT/etc/chrony.conf
[root@master ~]# wwsd file list
No objects found
[root@master ~]# wwsd file import /etc/passwd
[root@master ~]# wwsd file import /etc/group
[root@master ~]# wwsd file import /etc/shadow
[root@master ~]# wwsd file list
group : rw-r--r-- 1 root root 1072 /etc/group
passwd : rw-r--r-- 1 root root 2523 /etc/passwd
shadow : rw-r----- 1 root root 1357 /etc/shadow
[root@master ~]# export WW_CONF=/etc/warewulf/bootstrap.conf
[root@master ~]# echo "drivers += updates/kernel/" >> $WW_CONF
[root@master ~]# echo "modprobe += ahci, nvme" >> $WW_CONF
[root@master ~]# echo "drivers += overlay" >> $WW_CONF
[root@master ~]# wwbootstrap `uname -r`
Number of drivers included in bootstrap: 543
Number of firmware images included in bootstrap: 102
Building and compressing bootstrap
Integrating the Warewulf bootstrap: 3.10.0-1160.el7.x86_64
Including capability: provision-adhoc
Including capability: provision-files
Including capability: provision-selinux
Including capability: provision-vnfs
Including capability: setup-filesystems
Including capability: setup-ipmi
Including capability: transport-http
Compressing the initramfs
Locating the kernel object
Bootstrap image '3.10.0-1160.el7.x86_64' is ready
Done.
```

Node boot screenshots:

```
[root@master ~]# echo ${CHROOT}
/opt/ohpc/admin/images/centos7.7
[root@master ~]# wwvnfs --chroot ${CHROOT}
Using 'centos7.7' as the VNFS name
Creating VNFS image from centos7.7
Compiling hybridization link tree : 0.06 s
Building file list : 0.18 s
Compiling and compressing VNFS : 8.82 s
Adding image to datastore : 6.66 s
Wrote a new configuration file at: /etc/warewulf/vnfs/centos7.7.conf
Total elapsed time : 15.72 s
[root@master ~]# wwsd vnfs list
VNFS NAME      SIZE (M)   ARCH      CHROOT LOCATION
centos7.7      335.3     x86_64    /opt/ohpc/admin/images/centos7.7
[root@master ~]#
```

```
[root@master ~]# echo "GATEWAYDEV=ens34" > /tmp/network.wwsh
[root@master ~]# wwsd -y file import /tmp/network.wwsh --name network
[root@master ~]# wwsd -y file set network --path /etc/sysconfig/network --mode=0644 --uid=0
About to apply 3 action(s) to 1 file(s):
```

```
SET: PATH      = /etc/sysconfig/network
SET: MODE      = 0644
SET: UID       = 0
```

Proceed?

```
[root@master ~]# wwsd node new node1
Are you sure you want to make the following 2 change(s) to 1 node(s):
```

```
NEW: NODE      = node1
```

Yes/No [no]> Yes

```
[root@master ~]# wwsd node set node1 --netdev ens34 --ipaddr=192.168.11.230 --hwaddr=00:0C:29:0B:CF:9E --netmask=255.255.255.0 --gateway 192.168.122.1
Are you sure you want to make the following 4 change(s) to 1 node(s):
```

```
SET: ens34.HWADDR = 00:0C:29:0B:CF:9E
SET: ens34.IPADDR = 192.168.11.230
SET: ens34.NETMASK = 255.255.255.0
SET: ens34.GATEWAY = 192.168.122.1
```

Yes/No [no]> Yes

Booting Disk-less Node

```

Now Booting Warewolf...
Setting the hostname (node1): OK
Loading drivers: ahci-hcd ohci-hcd whci-hcd isp116x-hcd isp1362-hcd xhc
    hcd s100i-hcd sd_mod ahci name ahci name ahci name ahci name ahci name OK
Detecting hardware: ata_pmix ata_pmix mptspidev e1000 OK
Bringing up local loopback network: OK
Checking for network device: eth0 (ens34) OK
Configuring eth0 (ens34) statically: (192.168.11.230/255.255.255.0) OK
Configuring gateway: (192.168.122.1)ip: RTNETLINK answers: Network is unreachable ERROR
Creating network initialization files: (ens34) OK
Trying to reach the master node at 192.168.11.229 OK
Probing for HW Address: (00:0c:29:0b:cf:9e) OK
Starting syslogd: OK
Getting base node configuration: OK
Starting the provision handler:
  * adhoc-pre OK
  * ipmiconfig Auto configuration not activated SKIPPED
  * filesystems
    * mounting / RUNNING
  * filesystems OK
  * getvufs
    * fetching centos7.7 (ID:5) _ OK
    * fetching centos7.7 (ID:5) _ RUNNING

```

ip a (Booted node)

```

CentOS Linux 7 (Core)
Kernel 3.10.0-1160.el7.x86_64 on an x86_64

node1 login: root
Password:
[root@node1 ~]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 00:0c:29:0b:cf:9e brd ff:ff:ff:ff:ff:ff
    inet 192.168.11.230/24 brd 192.168.11.255 scope global eth0
        valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fe0b:cf9e/64 scope link
        valid_lft forever preferred_lft forever
[root@node1 ~]#

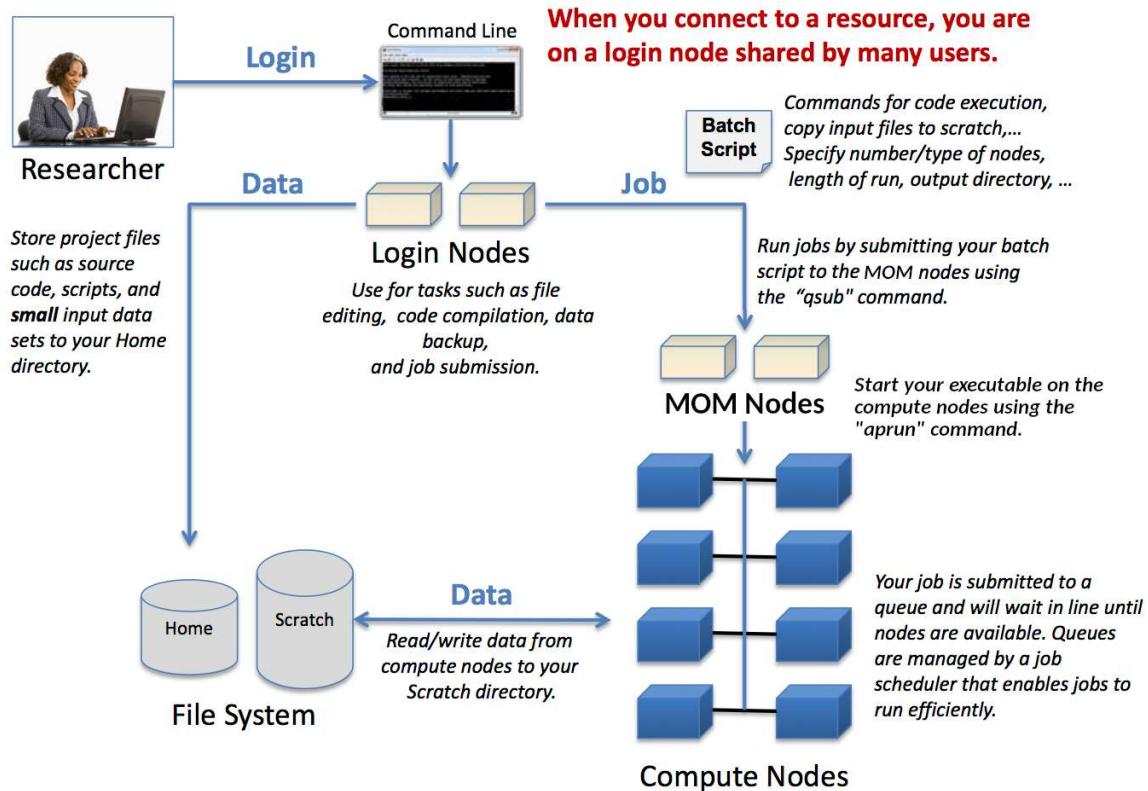
```

OpenPBS

OpenPBS, short for Open Portable Batch System, is an open-source workload manager and job scheduler specifically designed for high-performance computing (HPC) environments. It allows users to efficiently distribute and manage computing resources across a cluster or supercomputer.

OpenPBS is responsible for scheduling and managing the execution of computational tasks submitted by users, while optimizing resource utilization and minimizing job turnaround time. It provides various capabilities such as job submission and queuing, resource allocation and control, job monitoring and tracking, and job prioritization.

OpenPBS is widely used in academic and research institutions, government laboratories, and industrial settings to manage and coordinate the execution of large-scale scientific and engineering applications. It enables users to effectively utilize the available computing resources, improve system performance, and ensure fair resource sharing among multiple users and projects.



```
[root@master ~]# yum -y install pbspro-server-ohpc
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: mirror.citrahost.com
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package pbspro-server-ohpc.x86_64 0:19.1.3-3.1.ohpc.1.3.9 will be installed
--> Processing Dependency: postgresql-contrib >= 9.1 for package: pbspro-server-
--> Processing Dependency: postgresql-server >= 9.1 for package: pbspro-server-o
--> Processing Dependency: perl(Switch) for package: pbspro-server-ohpc-19.1.3-3
--> Processing Dependency: tk for package: pbspro-server-ohpc-19.1.3-3.1.ohpc.1.
```

Complete!

```
[root@master ~]# perl -pi -e "s/device = eth1/device = ${sms_eth_internal}/" /etc/warewulf/provision.conf
[root@master ~]# perl -pi -e "s/^$+disable\$+= yes/ disable = no/" /etc/xinetd.d/tftp
```

```
[root@master ~]# systemctl restart xinetd
[root@master ~]# systemctl enable mariadb.service
[root@master ~]# systemctl restart mariadb
[root@master ~]# systemctl enable httpd.service
[root@master ~]# systemctl restart httpd
[root@master ~]# systemctl enable dhcpd.service
[root@master ~]# export CHROOT=/opt/ohpc/admin/images/centos7.7
[root@master ~]# wwmkchroot centos-7 $CHROOT
mknod: '/opt/ohpc/admin/images/centos7.7/dev/urandom': File exists
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
os-base
(1/2): os-base/x86_64/group_gz
(2/2): os-base/x86_64/primary_db
Package basesystem-10.0-7.el7.centos.noarch already installed and 1
Package bash-4.2.46-34.el7.x86_64 already installed and latest vers
Package chkconfig-1.7.6-1.el7.x86_64 already installed and latest v
```

Nothing to do

```
[root@master ~]# yum -y --installroot=$CHROOT install ohpc-base-compute
```

```
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
epel/x86_64/metalink
 * base: mirrors.nxtgen.com
 * epel: repo.extreme-ix.org
 * extras: mirrors.nxtgen.com
 * updates: mirrors.nxtgen.com
```

OpenHPC

OpenHPC-updates

```
[root@master ~]# cp -p /etc/resolv.conf $CHROOT/etc/resolv.conf
cp: overwrite '/opt/ohpc/admin/images/centos7.7/etc/resolv.conf'? y
[root@master ~]# yum -y --installroot=$CHROOT install pbspro-execution-ohpc
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
* base: mirrors.nxtgen.com
* epel: repo.extreme-ix.org
* extras: mirrors.nxtgen.com
* updates: mirrors.nxtgen.com
Resolving Dependencies
--> Running transaction check

Complete!
[root@master ~]# perl -pi -e "s/PBS_SERVER=\$+/PBS_SERVER=${sms_name}/" $CHROOT/etc/pbs.conf
[root@master ~]# echo "PBS_LEAF_NAME=${sms_name}" >> /etc/pbs.conf
[root@master ~]# chroot $CHROOT opt/pbs/libexec/pbs_habitat
***  

***  

*** The hostname of the PBS Pro server in /etc/pbs.conf is invalid.  

*** Update the configuration file before starting PBS Pro.  

***  

[root@master ~]# perl -pi -e "s/\$clienthost \$+/\$clienthost ${sms_name}/" $CHROOT/var/spool/pbs/mom_priv/config
[root@master ~]# echo "\$usecp *:/home /home" >> $CHROOT/var/spool/pbs/mom_priv/config
[root@master ~]# chroot $CHROOT systemctl enable pbs
[root@master ~]# yum -y --installroot=$CHROOT install ntp
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
* base: mirrors.nxtgen.com
* epel: repo.extreme-ix.org
* extras: mirrors.nxtgen.com
* updates: mirrors.nxtgen.com
Resolving Dependencies

Complete!
[root@master ~]# yum -y --installroot=$CHROOT install kernel
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
* base: mirrors.nxtgen.com
* epel: repo.extreme-ix.org
* extras: mirrors.nxtgen.com
* updates: mirrors.nxtgen.com
Package kernel-3.10.0-1160.95.1.el7.x86_64 already installed and latest version
Nothing to do
[root@master ~]# yum -y --installroot=$CHROOT install lmod-ohpc
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
* base: mirrors.nxtgen.com
* epel: repo.extreme-ix.org
* extras: mirrors.nxtgen.com
* updates: mirrors.nxtgen.com
Package lmod-ohpc-8.1.18-6.1.ohpc.1.3.9.x86_64 already installed and latest version
```

Vi /etc/pbs.conf

```

File Edit View Search Terminal
PBS_EXEC=/opt/pbs
PBS_SERVER=master
PBS_START_SERVER=1
PBS_START_SCHED=1
PBS_START_COMM=1
PBS_START_MOM=1
PBS_HOME=/var/spool/pbs
PBS_CORE_LIMIT=unlimited
PBS SCP=/bin/scp
#PBS LEAF_NAME=
--
```

```

[root@master ~]# chmod 4755 /opt/pbs/sbin/pbs_iff /opt/pbs/sbin/pbs_rcp
[root@master ~]# systemctl restart pbs
[root@master ~]# systemctl status pbs
● pbs.service - Portable Batch System
  Loaded: loaded (/opt/pbs/libexec/pbs_init.d; enabled; vendor preset: disabled)
  Active: active (running) since Mon 2023-08-14 13:10:51 EDT; 7ms ago
    Docs: man:pbs(8)
 Process: 83174 ExecStop=/opt/pbs/libexec/pbs_init.d stop (code=exited, status=0/SUCCESS)
 Process: 83438 ExecStart=/opt/pbs/libexec/pbs_init.d start (code=exited, status=0/SUCCESS)
   Tasks: 9
  Memory: 6.7M
   CGroup: /system.slice/pbs.service
           └─83483 /opt/pbs/sbin/pbs_comm
             ├─83511 /opt/pbs/sbin/pbs_mom
             └─83523 /opt/pbs/sbin/pbs_sched
```

```

[root@master ~]# sudo /etc/init.d/pbs start
Starting PBS
PBS comm already running.
PBS mom already running.
PBS scheduler already running.
Connecting to PBS dataservice....connected to PBS dataservice@master
Server@master master: Warm mode and no server database exists,
do you wish to continue y/(n)?y
Licenses valid for 10000000 Floating hosts
PBS server
[root@master ~]# /etc/init.d/pbs status
pbs_server is pid 85352
pbs_mom is pid 83511
pbs_sched is pid 83523
pbs_comm is 83483
[root@master ~]# qstat -B
-----
```

Server	Max	Tot	Que	Run	Hld	Wat	Trn	Ext	Status
master	0	0	0	0	0	0	0	0	Idle

For node:-

```
root@node2:~  
PBS_EXEC=/opt/pbs  
PBS_SERVER=master  
PBS_START_SERVER=0  
PBS_START_SCHED=0  
PBS_START_COMM=0  
PBS_START_MOM=1  
PBS_HOME=/var/spool/pbs  
PBS_CORE_LIMIT=unlimited  
PBS_SCP=/bin/scp  
~  
~  
~
```

```
root@node2:~  
clienthost=node2  
$usecp *:/home /home  
$restrict_user_maxsysid 999  
~  
~
```

```
[root@node2 ~]# vi /var/spool/pbs/mom_priv/config  
[root@node2 ~]# /etc/init.d/pbs restartmom_priv/config  
Restarting PBS  
Stopping PBS  
Waiting for shutdown to complete  
Starting PBS  
PBS Home directory /var/spool/pbs needs updating.  
Running /opt/pbs/libexec/pbs_habitat to update it.  
***  
*** End of /opt/pbs/libexec/pbs_habitat  
Home directory /var/spool/pbs updated.  
PBS mom  
[root@node2 ~]# /etc/init.d/pbs restart  
Restarting PBS  
Stopping PBS  
PBS mom - was pid: 2840  
Waiting for shutdown to complete  
Starting PBS  
PBS mom
```

```
[root@node2 ~]# systemctl restart pbs
[root@node2 ~]# systemctl status pbs
● pbs.service - Portable Batch System
  Loaded: loaded (/opt/pbs/libexec/pbs_init.d; enabled; vendor preset: enabled)
  Active: active (running) since Mon 2023-08-14 13:41:34 EDT; 2s ago
    Docs: man:pbs(8)
 Process: 2992 ExecStop=/opt/pbs/libexec/pbs_init.d stop (code=exited)
 Process: 3046 ExecStart=/opt/pbs/libexec/pbs_init.d start (code=exit)
   Tasks: 2
  Memory: 2.7M
    CGroup: /system.slice/pbs.service
            └─3107 /opt/pbs/sbin/pbs_mom

Aug 14 13:41:34 node2 systemd[1]: Starting Portable Batch System...
Aug 14 13:41:34 node2 pbs_init.d[3046]: Starting PBS
Aug 14 13:41:34 node2 pbs_init.d[3046]: PBS mom
Aug 14 13:41:34 node2 systemd[1]: Started Portable Batch System.
```

```
[root@master ~]# pbsnodes -a
master
  Mom = master
  Port = 15002
  pbs_version = 19.1.3
  ntype = PBS
  state = free
  pcpus = 12
  resources_available.arch = linux
  resources_available.host = master
  resources_available.mem = 8581936kb
  resources_available.ncpus = 12
  resources_available.vnode = master
  resources_assigned.accelerator_memory = 0kb
  resources_assigned.hbmem = 0kb
  resources_assigned.mem = 0kb
  resources_assigned.naccelerators = 0
  resources_assigned.ncpus = 0
  resources_assigned.vmem = 0kb
  resv_enable = True
  sharing = default_shared
  last_state_change_time = Mon Aug 14 13:31:08 2023

node2
  Mom = node2.localdomain
  Port = 15002
  pbs_version = 19.1.3
  ntype = PBS
  state = free
  pcpus = 12
  resources_available.arch = linux
  resources_available.host = node2
  resources_available.mem = 8154780kb
  resources_available.ncpus = 12
  resources_available.vnode = node2
  resources_assigned.accelerator_memory = 0kb
  resources_assigned.hbmem = 0kb
  resources_assigned.mem = 0kb
  resources_assigned.naccelerators = 0
  resources_assigned.ncpus = 0
  resources_assigned.vmem = 0kb
  resv_enable = True
  sharing = default_shared
  last_state_change_time = Mon Aug 14 13:41:33 2023
```

```
[root@master ~]# qmgr
Max open servers: 49
Qmgr: create queue workq
Qmgr: set queue workq queue_type = Execution
Qmgr: set queue workq enabled = True
Qmgr: set queue workq started = True
Qmgr: exit
[root@master ~]# qmgr
Max open servers: 49
Qmgr: set server default_queue=workq
Qmgr: exit
```

```
[root@master ~]# su - test
Configuring SSH for cluster access
[test@master ~]$ vi testjob.pbs
[test@master ~]$ [test@master ~]$
[test@master ~]$
[test@master ~]$
[test@master ~]#
[test@master ~]# !/bin/bash
[test@master ~]# #PBS -N MyJob
[test@master ~]# #PBS -l nodes=1:ppn=4
[test@master ~]# #PBS -l walltime=1:00:00
[test@master ~]#
[test@master ~]# cd $PBS_O_WORKDIR
[test@master ~]# echo "Running job on host: $HOSTNAME"
Running job on host: master
[test@master ~]# ./my_executable
./my_executable: No such file or directory
[test@master ~]# qsub testjob.pbs
9.master
[test@master ~]# qstat -B
Server          Max   Tot   Que   Run   Hld   Wat   Trn   Ext Status
-----  -----
master           0     1     0     0     0     0     0     0    0  Idle
[test@master ~]#
```

Ganglia

Ganglia is an open-source, scalable, and distributed monitoring system used in High-Performance Computing (HPC) environments. It is designed to collect and visualize real-time performance metrics from clusters and grids.

By using Ganglia in an HPC environment, system administrators can identify performance bottlenecks, monitor resource utilization, and make informed decisions to optimize the cluster's performance. It is widely used in research institutions, universities, and large-scale computing facilities.

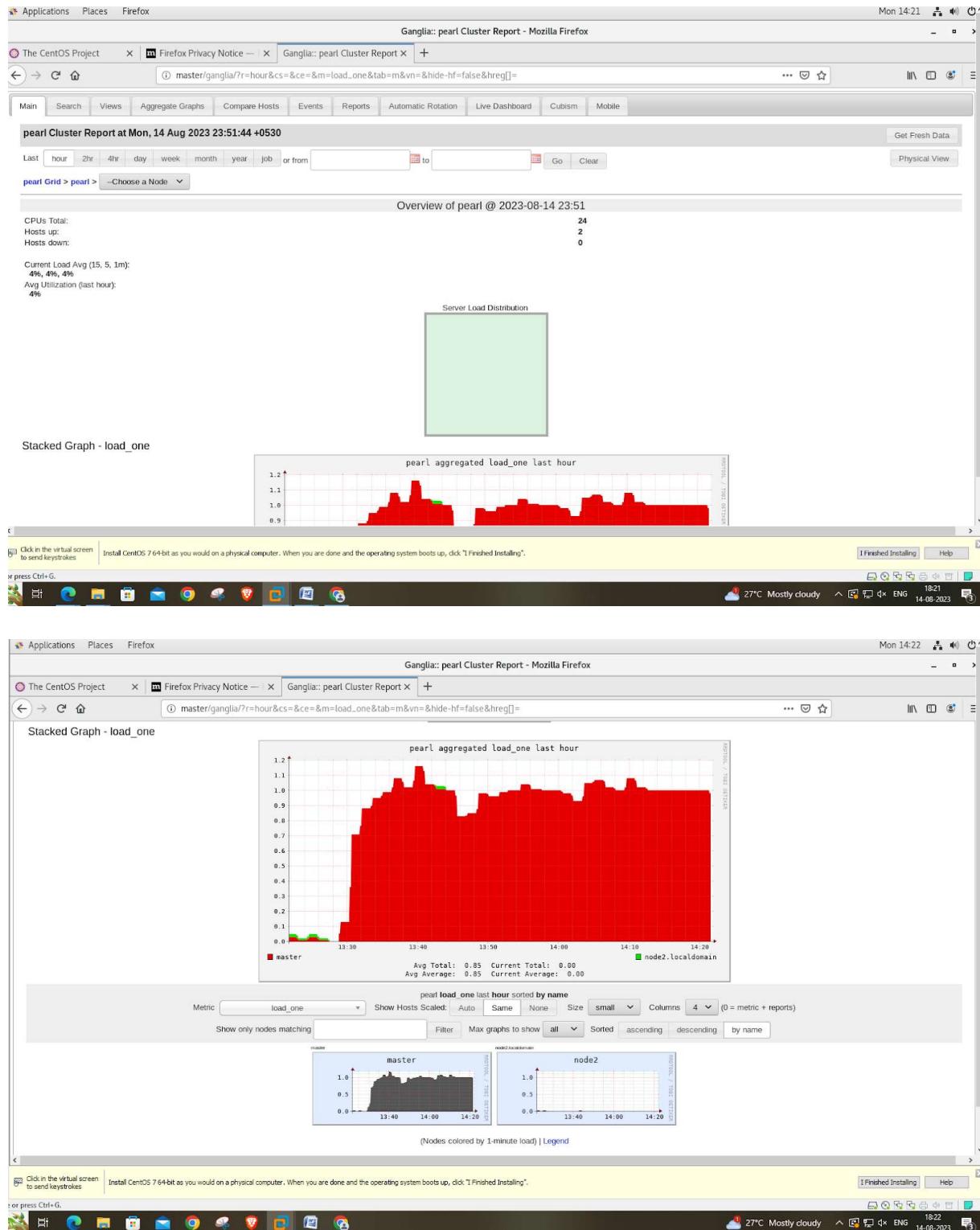
Commands for configurations-

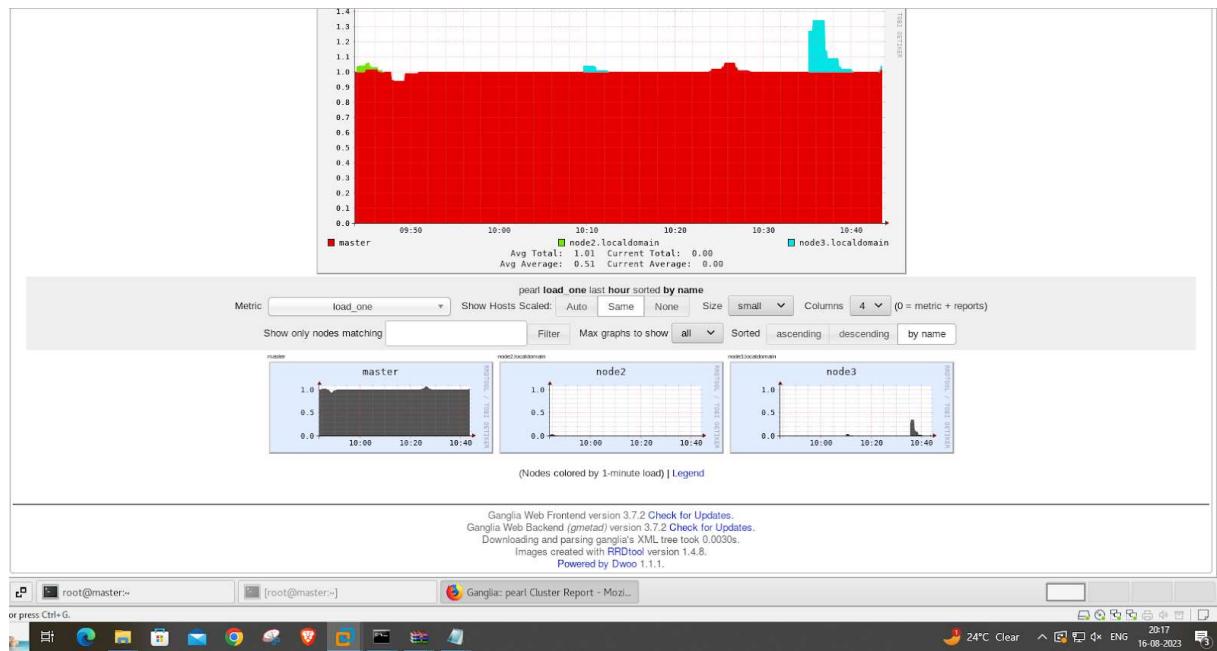
```
[root@master ~]# yum -y install ohpc-ganglia
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: mirror.citrahost.com
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check

Complete!
[root@master ~]# yum -y --installroot=${CHROOT} install ganglia-gmond-ohpc
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: mirror.citrahost.com
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package ganglia-gmond-ohpc.x86_64 0:3.7.2-26.1.ohpc.1.3.7 will be installed
--> Processing Dependency: ganglia-ohpc = 3.7.2-26.1.ohpc.1.3.7 for package: ganglia-gr...
```

```
Complete!
[root@master ~]# cp /opt/ohpc/pub/examples/ganglia/gmond.conf /etc/ganglia/gmond.conf
cp: overwrite '/etc/ganglia/gmond.conf'? y
[root@master ~]# # sed -i "s/<sms>/master/" /etc/ganglia/gmond.conf
[root@master ~]# sed -i "s/<sms>/master/" /etc/ganglia/gmond.conf
[root@master ~]# sed -i "s/OpenHPC/pearl/" /etc/ganglia/gmond.conf
[root@master ~]# cp /etc/ganglia/gmond.conf ${CHROOT}/etc/ganglia/gmond.conf
cp: overwrite '/opt/ohpc/admin/images/centos7.7/etc/ganglia/gmond.conf'? y
[root@master ~]# echo "gridname pearl" >> /etc/ganglia/gmetad.conf
[root@master ~]# grep gridname /etc/ganglia/gmetad.conf
# gridname "MyGrid"
gridname pearl

[root@master ~]# echo "
> systemctl enable gmond
> systemctl enable gmetad
> systemctl start gmond
> systemctl start gmetad
> chroot ${CHROOT} systemctl enable gmond
> " > /tmp/start_ganglia_service.sh
[root@master ~]# bash /tmp/start_ganglia_service.sh
[root@master ~]# grep "^date.timezone =" /etc/php.ini
[root@master ~]# echo "date.timezone = Asia/Kolkata" >> /etc/php.ini
[root@master ~]# grep "^date.timezone =" /etc/php.ini
date.timezone = Asia/Kolkata
[root@master ~]# systemctl try-restart httpd
[root@master ~]# █
```





OpenLDAP

LDAP stands for Lightweight Directory Access Protocol

LDAP, the Lightweight Directory Access Protocol, is a mature, flexible, and well supported standards-based mechanism for interacting with directory servers. It's often used for authentication and storing information about users, groups, and applications, but an LDAP directory server is a fairly general-purpose data store and can be used in a wide variety of applications.

On master node:

```
[root@master ~]# yum -y install openldap-servers openldap-clients
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
epel/x86_64/metalink
 * base: centos.mirror.net.in
 * epel: epel.excellmedia.net
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
OpenHPC
OpenHPC-updates
base
epel
extras
updates
(1/3): epel/x86_64/updateinfo
(2/3): epel/x86_64/primary_db
(3/3): updates/7/x86_64/primary_db
| 5.5 kB  00:00:00
| 1.6 kB  00:00:00
| 1.2 kB  00:00:00
| 3.6 kB  00:00:00
| 4.7 kB  00:00:00
| 2.9 kB  00:00:00
| 2.9 kB  00:00:00
| 1.0 MB  00:00:00
| 7.0 MB  00:00:00
| 22 MB  00:00:00
```

```
[root@master ~]# cp /usr/share/openldap-servers/DB_CONFIG.example /var/lib/ldap/DB_CONFIG
[root@master ~]# chown ldap. /var/lib/ldap/DB_CONFIG
[root@master ~]# systemctl start slapd
[root@master ~]# systemctl enable slapd
Created symlink from /etc/systemd/system/multi-user.target.wants/slapd.service to /usr/lib/systemd/system/slapd.service.
[root@master ~]# systemctl status slapd
● slapd.service - OpenLDAP Server Daemon
   Loaded: loaded (/usr/lib/systemd/system/slapd.service; enabled; vendor preset: disabled)
   Active: active (running) since Wed 2023-08-16 02:31:50 EDT; 11s ago
     Docs: man:slapd(8)
           man:slapd-config(8)
           man:slapd-hdb(8)
           man:slapd-mdb(8)
           file:///usr/share/doc/openldap-servers/guide.html
 Main PID: 91648 (slapd)
    CGroup: /system.slice/slapd.service
            └─91648 /usr/sbin/slapd -u ldap -h ldap:// ldap://
```

Vi chrootpw.ldif

```
-#specify the password generated above for "olcRootPW" section
dn: olcDatabase={0}config,cn=config
changetype: modify
add: olcRootPW
olcRootPW:{SSHA}onec6BeHyg4/Xs5JnydvZTK5iGZ600gB
~
~
```

```
[root@master ~]# ldapadd -Y EXTERNAL -H ldapi:/// -f chrootpw.ldif
SASL/EXTERNAL authentication started
SASL username: gidNumber=0+uidNumber=0,cn=peercred,cn=external,cn=auth
SASL SSF: 0
modifying entry "olcDatabase={0}config,cn=config"

[root@master ~]# ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/openldap/schema/cosine.ldif
SASL/EXTERNAL authentication started
SASL username: gidNumber=0+uidNumber=0,cn=peercred,cn=external,cn=auth
SASL SSF: 0
adding new entry "cn=cosine,cn=schema,cn=config"

[root@master ~]# ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/openldap/schema/nis.ldif
SASL/EXTERNAL authentication started
SASL username: gidNumber=0+uidNumber=0,cn=peercred,cn=external,cn=auth
SASL SSF: 0
adding new entry "cn=nis,cn=schema,cn=config"

[root@master ~]# ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/openldap/schema/inetorgperson.ldif
SASL/EXTERNAL authentication started
SASL username: gidNumber=0+uidNumber=0,cn=peercred,cn=external,cn=auth
SASL SSF: 0
adding new entry "cn/inetorgperson,cn=schema,cn=config"
```

Vi chdomain.ldif

```
root@master~#
#replace to your own domain_name for "dc=***,dc=***" section
# specify the password generated above for "olcRootPW" section
dn: olcDatabase={1}monitor,cn=config
changetype: modify
replace: olcAccess
olcAccess: {0}to * by dn.base="gidNumber=0+uidNumber=0,cn=peercred,cn=external,cn=auth" read by dn.base="cn=Manager,dc=casestudy,dc=in" read by * none

dn: olcDatabase={2}hdb,cn=config
changetype: modify
replace: olcSuffix
olcSuffix: dc=casestudy,dc=in

dn: olcDatabase={2}hdb,cn=config
changetype: modify
replace: olcRootDN
olcRootDN: cn=Manager,dc=casestudy,dc=in

dn: olcDatabase={2}hdb,cn=config
changetype: modify
add: olcRootPW
olcRootPW: {SSHA}onec6BeHyg4/Xs5JnydvZTK51GZ600gB

dn: olcDatabase={2}hdb,cn=config
changetype: modify
add: olcAccess
olcAccess: {0}to attrs=userPassword,shadowLastChange by
dn="cn=Manager,dc=casestudy,dc=in" write by anonymous auth by self write by * none
olcAccess: {1}to dn.base="" by * read
olcAccess: {2}to * by dn="cn=Manager,dc=casestudy,dc=in" write by * read
```

```
[root@master ~]# ldapmodify -Y EXTERNAL -H ldap:/// -f chdomain.ldif
SASL/EXTERNAL authentication started
SASL username: gidNumber=0+uidNumber=0,cn=peercred,cn=external,cn=auth
SASL SSF: 0
modifying entry "olcDatabase={1}monitor,cn=config"

modifying entry "olcDatabase={2}hdb,cn=config"

modifying entry "olcDatabase={2}hdb,cn=config"

modifying entry "olcDatabase={2}hdb,cn=config"
ldap_modify: Inappropriate matching (18)
        additional info: modify/add: olcRootPW: no equality matching rule
```

Vi basedomain.ldif

```
[root@master:~]# vi basedomain.ldif
# replace to your own domain name for "dc=***,dc=***" section.
dn: dc=casestudy,dc=in
objectClass: top
objectClass: dcObject
objectclass: organization
o: casestudy
dc: Casestudy

dn: cn=Manager,dc=casestudy,dc=in
objectClass: organizationalRole
cn: Manager
description: Directory Manager

dn: ou=People,dc=casestudy,dc=in
objectClass: organizationalUnit
ou: People

dn: ou=Group,dc=casestudy,dc=in
objectClass: organizationalUnit
ou: Group
```

```
[root@master ~]# ldapadd -x -D cn=Manager,dc=casestudy,dc=in -W -f basedomain.ldif
Enter LDAP Password:
adding new entry "dc=casestudy,dc=in"
adding new entry "cn=Manager,dc=casestudy,dc=in"
adding new entry "ou=People,dc=casestudy,dc=in"
adding new entry "ou=Group,dc=casestudy,dc=in"
```

Vi ldapuser.ldif

```
root@master:~#
# create new_
# replace to your own domain name for "dc=***,dc=***" section
dn: uid=hpcsa1,ou=People,dc=casestudy,dc=in
objectClass: inetOrgPerson
objectClass: posixAccount
objectClass: shadowAccount
cn: hpcsa1
sn: Linux
userPassword: {SSHA}onec6BeHyg4/Xs5JnydvZTK5iGZ600gB
loginShell: /bin/bash
uidNumber: 1003
gidNumber: 1003
homeDirectory: /home/hpcsa1
dn: cn=hpcsa1,ou=Group,dc=casestudy,dc=in
objectClass: posixGroup
cn: hpcsa1
gidNumber: 1003
memberUid: hpcsa1
```

```
[root@master ~]# ldapadd -x -D cn=Manager,dc=casestudy,dc=in -W -f ldapuser.ldif
Enter LDAP Password:
ldapadd: attributeDescription "dn": (possible missing newline after line 14, entry "uid=hpcsa1,ou=People,d
c=casestudy,dc=in"?)
adding new entry "uid=hpcsa1,ou=People,dc=casestudy,dc=in"
ldap_add: Type or value exists (20)
          additional info: cn: value #0 provided more than once
```

```
[root@master ~]# systemctl start slapd
[root@master ~]# systemctl status slapd
● slapd.service - OpenLDAP Server Daemon
   Loaded: loaded (/usr/lib/systemd/system/slapd.service; enabled; vendor preset: disabled)
   Active: active (running) since Wed 2023-08-16 02:31:50 EDT; 51min ago
     Docs: man:slapd(8)
           man:slapd-config(8)
           man:slapd-hdb(8)
           man:slapd-mdb(8)
           file:///usr/share/doc/openldap-servers/guide.html
 Main PID: 91648 (slapd)
    Tasks: 3
   Memory: 32.8M
      CGroup: /system.slice/slapd.service
              └─91648 /usr/sbin/slapd -u ldap -h ldap:/// ldap:///


```

```
[root@master ~]# ldapsearch -x cn=hpcsa1 -b dc=casestudy,dc=in
# extended LDIF
#
# LDAPv3
# base <dc=casestudy,dc=in> with scope subtree
# filter: cn=hpcsa1
# requesting: ALL
#
# search result
search: 2
result: 0 Success

# numResponses: 1
```

For client installation

```
[root@master ~]# yum -y --installroot=$CHROOT install openldap-clients nss-pam-ldapd
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: epel.excellmedia.net
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package nss-pam-ldapd.x86_64 0:0.8.13-25.el7 will be installed
--> Processing Dependency: nsqd for package: nss-pam-ldapd-0.8.13-25.el7.x86_64
--> Package openldap-clients.x86_64 0:2.4.44-25.el7_9 will be installed
--> Processing Dependency: openldap(x86-64) = 2.4.44-25.el7_9 for package: openldap-clients-2.4.44-25.el7_9.x86_64
```

```
[root@master ~]# yum -y --installroot=$CHROOT authconfig
Loaded plugins: fastestmirror, langpacks
No such command: authconfig. Please use /usr/bin/yum --help
[root@master ~]# yum -y --installroot=$CHROOT install authconfig
Loaded plugins: fastestmirror, langpacks
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net.in
 * epel: epel.excellmedia.net
 * extras: centos.mirror.net.in
 * updates: centos.mirror.net.in
Resolving Dependencies
--> Running transaction check
--> Package authconfig.x86_64 0:6.2.8-30.el7 will be installed
```

```
[root@master ~]# chroot $CHROOT authconfig --enableldap --enableldapauth --ldapserver=master --ldapbasedn="dc=casestudy,dc=in" --enablemkhomedir --update
```

```
[root@master ~]# systemctl enable nslcd.service
Created symlink from /etc/systemd/system/multi-user.target.wants/nslcd.service to /usr/lib/systemd/system/nslcd.service.
```

```
[root@node3 ~]
[root@node3 ~]# systemctl start nslcd
[root@node3 ~]# systemctl status nslcd
● nslcd.service - Naming services LDAP client daemon.
   Loaded: loaded (/usr/lib/systemd/system/nslcd.service; enabled; vendor preset: disabled)
   Active: active (running) since Wed 2023-08-16 16:07:46 EDT; 4s ago
     Docs: man:nslcd(8)
           man:nslcd.conf(5)
     Process: 1418 ExecStart=/usr/sbin/nslcd (code=exited, status=0/SUCCESS)
    Main PID: 1419 (nslcd)
      Tasks: 6
     Memory: 972.0K
        CGrou: /system.slice/nslcd.service
                 └─1419 /usr/sbin/nslcd
```

```
postfix:x:89:89::/var/spool/postfix:/sbin/nologin
tcpdump:x:72:72:::/sbin/nologin
master:x:1000:1000:master:/home/master:/bin/bash
dhcpd:x:177:177:DHCP server:/sbin/nologin
apache:x:48:48:Apache:/usr/share/httpd:/sbin/nologin
mysql:x:27:27:MariaDB Server:/var/lib/mysql:/sbin/nologin
ganglia:x:987:980:Ganglia Monitoring System:/var/lib/ganglia:/sbin/nologin
postgres:x:26:26:PostgreSQL Server:/var/lib/pgsql:/bin/bash
nslcd:x:1001:1001:/home/nslcd:/bin/bash
hpcsa1:x:1002:1002:/home/hpcsa1:/bin/bash
[root@node3 ~]#
```

```
[root@node3 ~]# ldapsearch -x
# extended LDIF
#
# LDAPv3
# base <dc=casestudy,dc=in> (default) with scope subtree
# filter: (objectclass=*)
# requesting: ALL
#
# casestudy.in
dn: dc=casestudy,dc=in
objectClass: top
objectClass: dcObject
objectClass: organization
o: casestudy in
dc: Casestudy

# Manager, casestudy.in
dn: cn=Manager,dc=casestudy,dc=in
objectClass: organizationalRole
cn: Manager
description: Directory Manager

# People, casestudy.in
dn: ou=People,dc=casestudy,dc=in
objectClass: organizationalUnit
ou: People

# Group, casestudy.in
dn: ou=Group,dc=casestudy,dc=in
objectClass: organizationalUnit
ou: Group

# search result
search: 2
result: 0 Success

# numResponses: 5
# numEntries: 4
```

```
[root@node3 ~]# su - hpcsa1
Creating directory '/home/hpcsa1'.
Last login: Wed Aug 16 16:10:44 EDT 2023 on pts/0
[hpcsa1@node3 ~]$ ls
```