HPCSAM CASE STUDY

TITLE: Build a two node disk less HPC cluster using openHPC with xCAT, openLDAP, slurm, HPL benchmarking, ganglia and document the results.

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XCAT Configuration

1. **Launch VM with configuration:**
   - ➢ **Master node :**
     - ▪ RAM - 6GB
     - ▪ Processor -2 & Core - 2
     - ▪ HDD-50GB
     - ▪ Network Adaptors - 2 (1 NAT, 1 Custom Host(disable DHCP))
   - ➢ **Client node1 & node2 :**
     - ▪ Ram - 4GB
     - ▪ Processor - 2 & Core -2
     - ▪ HDD -20GB
     - ▪ Network Adaptor- 1(Custom Host as Master's Custom Host)

2. **Provide manual IP & Check IP**

   # nmtui

   #ip a

3. **Stop and Disable Firewall**

   #systemctl stop firewalld
   #systemctl disable firewalld
   #systemctl status firewalld

4. **Disable Selinux**

   #vim /etc/selinux/config
       SELINUX= disabled
   #sestatus

5. **Install Utilities**

   #yum install yum-utils

6. **Download xCAT core/dependencies repository and Install xCAT**

   #wget -P /etc/yum.repos.d https://xcat.org/files/xcat/repos/yum/latest/xcat-core/xcat-core.repo --no-check-certificate

   #wget -P /etc/yum.repos.d https://xcat.org/files/xcat/repos/yum/xcat-dep/rh7/x86_64/xcat-dep.repo --no-check-certificate

   #yum install xCAT

7. **Set System Envornment**

   #. /etc/profile.d/xcat.sh
   #echo $PATH

8. **Set Interface and IP**

   #chdef -t site dhcpinterfaces="ens34"
   #chdef -t site master="192.168.100.11"
   #tabdump site | grep master
   #tabdump site | grep dhcp

9. **Copy ISO file**
   #dd if=/dev/sr0 of=/root/hpcsa2os7.iso
   #copycds /root/hpcsa2os7.iso
   #lsdef -t osimage

10. **Generate Image**
    #genimage hpcsa2os7.9-x86_64-netboot-compute

11. **Make Directory and add files**
    #mkdir -p /install/custom/netboot
    #chdef -t osimage hpcsa2os7.9-x86_64-netboot-compute synclists="/install/custom/netboot/compute.synclist"

    #echo "/etc/passwd -> /etc/passwd" > /install/custom/netboot/compute.synclist
    #echo "/etc/shadow -> /etc/shadow" >> /install/custom/netboot/compute.synclist
    #echo "/etc/gshadow -> /etc/gshadow" >> /install/custom/netboot/compute.synclist
    #echo "/etc/group -> /etc/group" >> /install/custom/netboot/compute.synclist
    #echo "/etc/hosts -> /etc/hosts" >> /install/custom/netboot/compute.synclist

12. **Pack Image**
    #packimage hpcsa2os7.9-x86_64-netboot-compute

13. **Copy MAC address of node1 & node2 and Assign**
    #mkdef -t node node1 groups=compute,all ip=192.168.100.17 mac=00:0C:29:AF:60:A7 netboot=xnba
    #mkdef -t node node2 groups=compute,all ip=192.168.100.20 mac=00:0C:29:26:3D:D7 netboot=xnba
    #lsdef node
    #chdef -t group compute provmethod=hpcsa2os7.9-x86_64-netboot-compute
    #chdef -t site domain=xcat.in
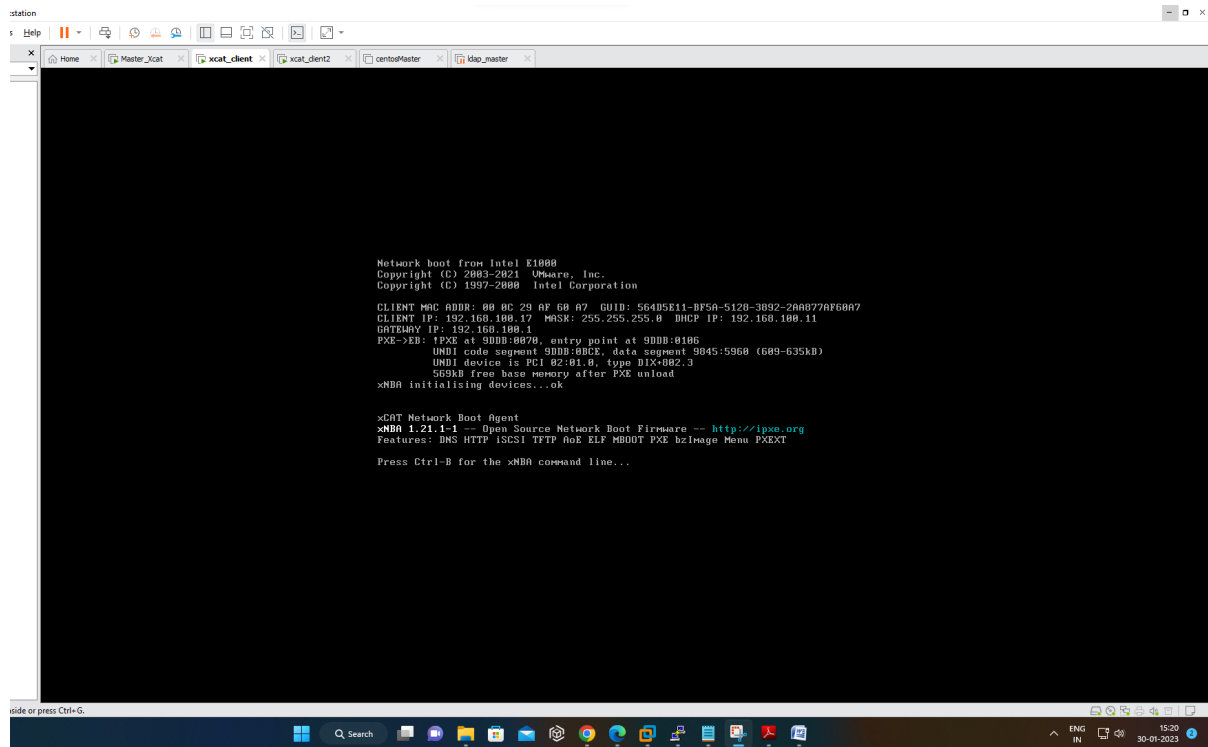
14. **Create**
    #makehosts
    #makenetworks
    #makedhcp -n
    #makedns -n
    #nodeset compute osimage=hpcsa2os7.9-x86_64-netboot-compute

15. **Restart DHCPD**
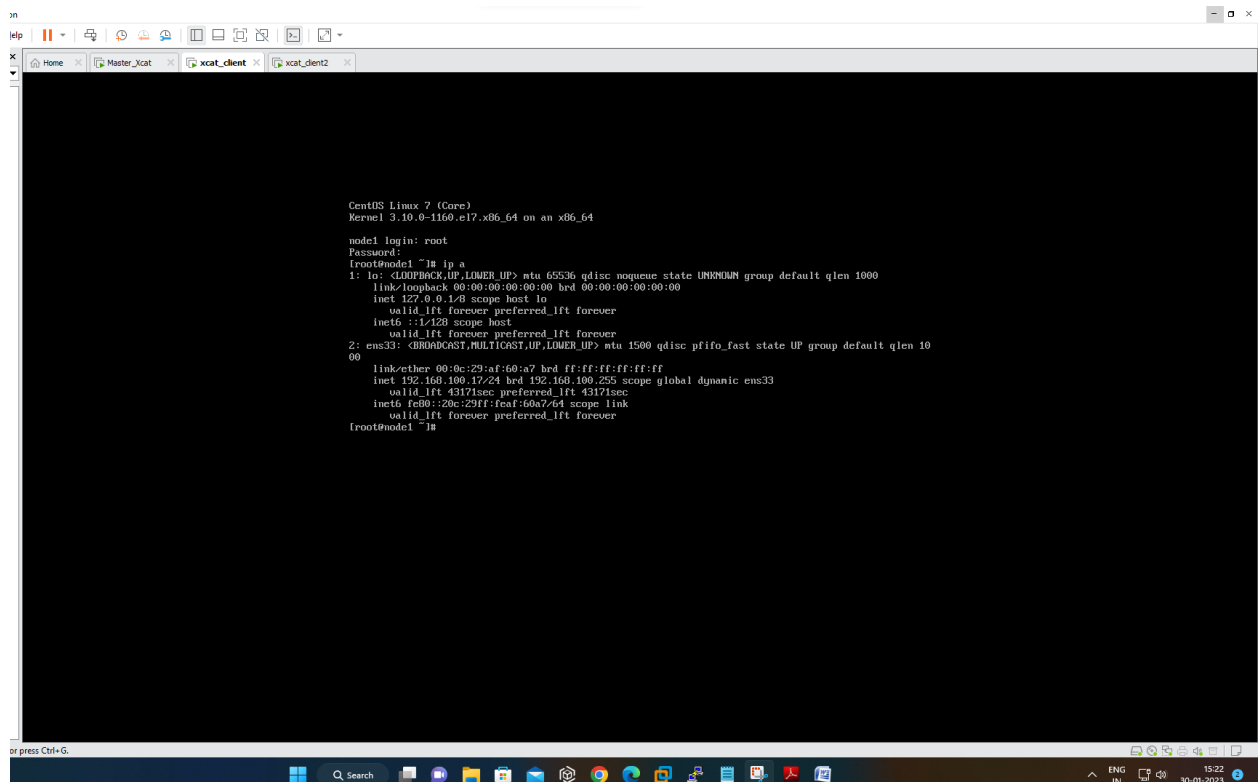   #systemctl restart dhcpd

16. Restart node1 & node2-

LDAP Configuration

> ## On Master Node:-

- ### Install OpenLDAP

#yum -y install openldap-servers openldap-clients

#cp /usr/share/openldap-servers/DB_CONFIG.example /var/lib/ldap/DB_CONFIG

#chown ldap. /var/lib/ldap/DB_CONFIG

#systemctl start slapd

#systemctl enable slapd

generate encrypted password

 #save this password to a file

password from user

#vi chrootpw.ldif

      specify the password generated above for "olcRootPW" section

     dn: olcDatabase={0}config,cn=config

     changetype: modify

     add: olcRootPW

     olcRootPW: {SSHA}xxxxxxxxxxxxxxxxxxxxxxxxx

#ldapadd -Y EXTERNAL -H ldapi:/// -f chrootpw.ldif

#ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/openldap/schema/cosine.ldif

#ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/openldap/schema/nis.ldif

#ldapadd -Y EXTERNAL -H ldapi:/// -f /etc/openldap/schema/inetorgperson.ldif

- **generate directory manager's password**

```
#slappasswd
#vi chdomain.ldif
            # 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}xxxxxxxxxxxxxxxxxxxxxxxxx
            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

#ldapmodify -Y EXTERNAL -H ldapi:/// -f chdomain.ldif
```

#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 in
  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
 ldapadd -x -D cn=Manager,dc=casestudy,dc=in -W -f basedomain.ldif
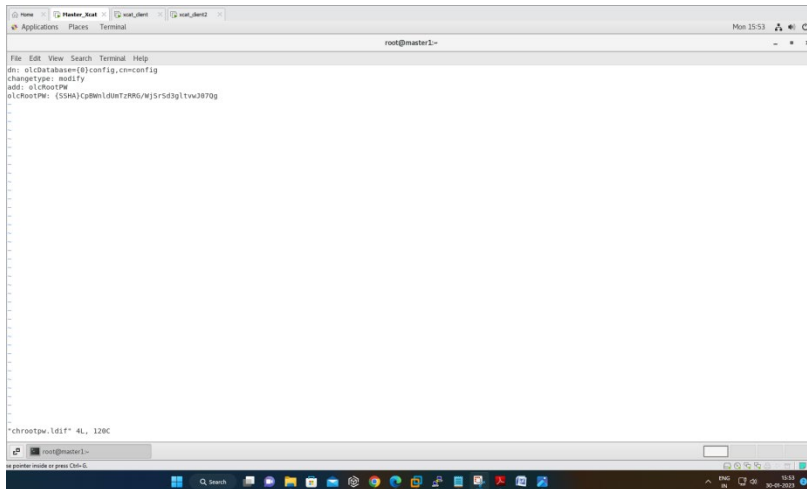
```
# replace to your own domain name for "dc=***,dc=***" section

# 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}CpBWnldUmTzRRG/Wj5r5d3gltvwJ07Qg

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

"chdomain.ldif" 32L, 1006C
```

#vi ldapuser.ldif

     # create new

     # replace to your own domain name for "dc=***,dc=***" section

     dn: uid=hpcsa2,ou=People,dc=casestudy,dc=in

     objectClass: inetOrgPerson

     objectClass: posixAccount

     objectClass: shadowAccount

     cn: hpcsa2

     sn: Linux

     userPassword: {SSHA}xxxxxxxxxxxxxxxxx

     loginShell: /bin/bash

     uidNumber: 1003

     gidNumber: 1003

     homeDirectory: /home/hpcsa2

     dn: cn=hpcsa2,ou=Group,dc=casestudy,dc=in

     objectClass: posixGroup

     cn: hpcsa2

     gidNumber: 1003

     memberUid: hpcsa2

```
File  Edit  View  Search  Terminal  Help
# create new
# replace to your own domain name for "dc=***,dc=***" section
dn: uid=hpcsa2,ou=People,dc=casestudy,dc=in
objectClass: inetOrgPerson
objectClass: posixAccount
objectClass: shadowAccount
cn: hpcsa2
sn: Linux
userPassword: {SSHA}CpBWnldUmTzRRG/WjSr5d3gltvwJ07Qg
loginShell: /bin/bash
uidNumber: 1003
gidNumber: 1003
homeDirectory: /home/hpcsa2

dn: cn=hpcsa2,ou=Group,dc=casestudy,dc=in
objectClass: posixGroup
cn: hpcsa2
gidNumber: 1003
memberUid: hpcsa2










"ldapuser.ldif" 19L, 467C
```

#ldapadd -x -D cn=Manager,dc=casestudy,dc=in -W -f ldapuser.ldif

#systemctl start slapd

 #systemctl status slapd


```
[root@master1 ~]# systemctl status slapd
● slapd.service - OpenLDAP Server Daemon
   Loaded: loaded (/usr/lib/systemd/system/slapd.service; enabled; vendor preset: disabled)
   Active: active (running) since Sun 2023-01-29 19:08:20 IST; 21h ago
     Docs: man:slapd
           man:slapd-config
           man:slapd-hdb
           man:slapd-mdb
           file:///usr/share/doc/openldap-servers/guide.html
  Process: 21238 ExecStart=/usr/sbin/slapd -u ldap -h ${SLAPD_URLS} $SLAPD_OPTIONS (code=exited, status=0/SUCCESS)
  Process: 21200 ExecStartPre=/usr/libexec/openldap/check-config.sh (code=exited, status=0/SUCCESS)
 Main PID: 21241 (slapd)
    Tasks: 4
   Memory: 32.0K
   CGroup: /system.slice/slapd.service
           └─21241 /usr/sbin/slapd -u ldap -h ldapi:/// ldap:///

Jan 29 19:08:32 master1 slapd[21241]: conn=1000 op=1 SEARCH RESULT tag=101 err=0 nentries=10 text=
Jan 29 19:08:32 master1 slapd[21241]: conn=1000 op=2 UNBIND
Jan 29 19:08:32 master1 slapd[21241]: conn=1000 fd=11 closed
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 fd=11 ACCEPT from IP=192.168.100.11:60158 (IP=0.0.0.0:389)
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 op=0 BIND dn="" method=128
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 op=0 RESULT tag=97 err=0 text=
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 op=1 SRCH base="dc=casestudy,dc=in" scope=2 deref=0 filter="(objectClass=*)"
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 op=1 SEARCH RESULT tag=101 err=0 nentries=10 text=
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 op=2 UNBIND
Jan 30 16:29:08 master1 slapd[21241]: conn=1001 fd=11 closed
[root@master1 ~]#
```

- **On clientNodes**

Install OpenLDAP Client.

#yum --installroot=/install/netboot/hpcsa2os7.9/x86_64/compute/rootimg install openldap-clients

#exports CHROOT=/install/netboot/hpcsa2os7.9/x86_64/compute/rootimg

#chroot $CHROOT

#authconfig --enableldap --enableldapauth --ldapserver=master --ldapbasedn="dc=casestudy,dc=in" --enablemkhomedir --update

#systemctl restart nslcd

#systemctl enable nslcd

#systemctl status nslcd

```
[root@node1 ~]#
[root@node1 ~]# 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 Mon 2023-01-30 20:13:59 IST; 1min 42s ago
     Docs: man:nslcd(8)
           man:nslcd.conf(5)
  Process: 1371 ExecStart=/usr/sbin/nslcd (code=exited, status=0/SUCCESS)
 Main PID: 1484 (nslcd)
    Tasks: 6
   CGroup: /system.slice/nslcd.service
           └─1484 /usr/sbin/nslcd

Jan 30 20:14:30 localhost.localdomain nslcd[1484]: [0bd78f] <group/member="ro...
Jan 30 20:14:30 localhost.localdomain nslcd[1484]: [0bd78f] <group/member="ro...
Jan 30 20:14:31 localhost.localdomain nslcd[1484]: [3ea438] <group/member="ge...
Jan 30 20:14:31 localhost.localdomain nslcd[1484]: [3ea438] <group/member="ge...
Jan 30 20:15:04 localhost.localdomain nslcd[1484]: [55585c] <group/member="ro...
Jan 30 20:15:04 localhost.localdomain nslcd[1484]: [55585c] <group/member="ro...
Jan 30 20:15:04 localhost.localdomain nslcd[1484]: [55585c] <group/member="ro...
Jan 30 20:15:17 node1 nslcd[1484]: [a64e2a] <group/member="root"> failed to...ed
Jan 30 20:15:17 node1 nslcd[1484]: [a64e2a] <group/member="root"> no availa...ed
Jan 30 20:15:17 node1 nslcd[1484]: [a64e2a] <group/member="root"> no availa...ed
Hint: Some lines were ellipsized, use -l to show in full.
[root@node1 ~]#
```
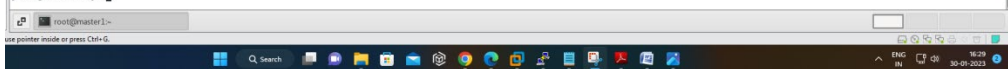
#ldapsearch –x

```
# hpcsa2, People, casestudy.in
dn: uid=hpcsa2,ou=People,dc=casestudy,dc=in
objectClass: inetOrgPerson
objectClass: posixAccount
objectClass: shadowAccount
cn: hpcsa2
sn: Linux
userPassword:: e1NTSEF9Q3BCV25sZFVtVHpSUkcvV2pTclNkM2dsdHZ3SjA3UWc=
loginShell: /bin/bash
uidNumber: 1003
gidNumber: 1003
homeDirectory: /home/hpcsa2
uid: hpcsa2

# hpcsa2, Group, casestudy.in
dn: cn=hpcsa2,ou=Group,dc=casestudy,dc=in
objectClass: posixGroup
cn: hpcsa2
gidNumber: 1003
memberUid: hpcsa2

# search result
search: 2
result: 0 Success

# numResponses: 11
# numEntries: 10
[root@master1 ~]#
```

```
root@master1:~
use pointer inside or press Ctrl+G.
```

```
rpc:x:32:32:Rpcbind Daemon:/var/lib/rpcbind:/sbin/nologin
saned:x:996:993:SANE scanner daemon user:/usr/share/sane:/sbin/nologin
saslauth:x:995:76:Saslauthd user:/run/saslauthd:/sbin/nologin
abrt:x:173:173::/etc/abrt:/sbin/nologin
setroubleshoot:x:994:991::/var/lib/setroubleshoot:/sbin/nologin
rtkit:x:172:172:RealtimeKit:/proc:/sbin/nologin
pulse:x:171:171:PulseAudio System Daemon:/var/run/pulse:/sbin/nologin
chrony:x:993:988::/var/lib/chrony:/sbin/nologin
unbound:x:992:987:Unbound DNS resolver:/etc/unbound:/sbin/nologin
radvd:x:75:75:radvd user:/:/sbin/nologin
tss:x:59:59:Account used by the trousers package to sandbox the tcsd daemon:/dev/null:/sbin/nologin
usbmuxd:x:113:113:usbmuxd user:/:/sbin/nologin
geoclue:x:991:985:User for geoclue:/var/lib/geoclue:/sbin/nologin
qemu:x:107:107:qemu user:/:/sbin/nologin
gluster:x:990:984:GlusterFS daemons:/run/gluster:/sbin/nologin
gdm:x:42:42::/var/lib/gdm:/sbin/nologin
rpcuser:x:29:29:RPC Service User:/var/lib/nfs:/sbin/nologin
nfsnobody:x:65534:65534:Anonymous NFS User:/var/lib/nfs:/sbin/nologin
gnome-initial-setup:x:989:983::/run/gnome-initial-setup/:/sbin/nologin
sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
avahi:x:70:70:Avahi mDNS/DNS-SD Stack:/var/run/avahi-daemon:/sbin/nologin
postfix:x:89:89::/var/spool/postfix:/sbin/nologin
ntp:x:38:38::/etc/ntp:/sbin/nologin
tcpdump:x:72:72::/:/sbin/nologin
hpcsa2:x:1000:1000:hpcsa2:/home/hpcsa2:/bin/bash
ldap:x:55:55:OpenLDAP server:/var/lib/ldap:/sbin/nologin
test:x:1001:1001::/home/test:/bin/bash
nscd:x:28:28:NSCD Daemon:/:/sbin/nologin
nslcd:x:65:55:LDAP Client User:/:/sbin/nologin
test:x:1001:1001:test:/home/test:/bin/bash
```

Slurm Configuration

- **On Master Node**

#wget https://download.schedmd.com/slurm/slurm-22.05.7.tar.bz2

#rpmbuild slurm-22.0507.tar.bz2

#yum install -y mariadb-server mariadb-devel epel-release munge munge-libs munge-devel rpm-build python3 perl-ExtUtitils-Install gcc

#yum install openssl openssl-devel pam-devel numactl numactl-devel hwloc hwloc-devel lua lua-devel readline-devel rrdtool-devel ncurses-devel man2html libibmad libibumad -y

#/usr/sbin/create-munge-key -r

#chown munge:munge /etc/munge

#chmod 400 /etc/munge/munge.key

#cd /root/rpmbuild/RPMS/x86_64/

#yum install slurm*

#export SLURMUSER=900

#groupadd -g $SLURMUSER slurm

#useradd -m -c "SLURM workload manager" -d /var/lib/slurm -u $SLURMUSER -g slurm -s /bin/bash slurm

#cp /etc/slurm/slurm.conf.example /etc/slurm/slurm.conf

#vi /etc/slurm/slurm.conf

       clusturname=oxygen

```
"
#
# slurm.conf file generated by configurator.html.
# Put this file on all nodes of your cluster.
# See the slurm.conf man page for more information.
#
ClusterName=oxygen
SlurmctldHost=master1
#SlurmctldHost=
#
#DisableRootJobs=NO
#EnforcePartLimits=NO
```

#mkdir -p /var/share/slurm/ctld

#vi /etc/slurm/slurm.conf

    stateSaveLocation=/var/share/slurm/ctld

    SlurmSpoolDir=/var/share/slurm/d

```
SlurmctldPidFile=/var/run/slurmctld.pid
SlurmctldPort=6817
SlurmdPidFile=/var/run/slurmd.pid
SlurmdPort=6818
SlurmdSpoolDir=/var/share/slurm/d
SlurmUser=slurm
#SlurmdUser=root
#SrunEpilog=
#SrunProlog=
StateSaveLocation=/var/share/slurm/ctld
SwitchType=switch/none
#TaskEpilog=
TaskPlugin=task/affinity
#TaskProlog=
#TopologyPlugin=topology/tree
#TmpFS=/tmp
#TrackWCKey=no
#TreeWidth=
#UnkillableStepProgram=
#UsePAM=0
#
#
```

#chown -R slurm:slurm /var/share/slurm

#touch /var/log/slurmctld.log

#systemctl start slurmctld

#systemctl status slurmctld

#systemctl enable slurmctld

```
[root@master1 ~]# systemctl status slurmctld.service
● slurmctld.service - Slurm controller daemon
   Loaded: loaded (/usr/lib/systemd/system/slurmctld.service; enabled; vendor preset: disabled)
   Active: active (running) since Mon 2023-01-30 11:56:44 IST; 4h 47min ago
 Main PID: 42651 (slurmctld)
    Tasks: 10
   Memory: 3.2M
   CGroup: /system.slice/slurmctld.service
           ├─42651 /usr/sbin/slurmctld -D -s
           └─42658 slurmctld: slurmscriptd

Jan 30 12:08:10 master1 slurmctld[42651]: slurmctld: sched: _slurm_rpc_allocate_resources JobId=7 NodeList=(null) usec=1961
Jan 30 12:09:08 master1 slurmctld[42651]: slurmctld: _slurm_rpc_kill_job: REQUEST_KILL_JOB JobId=4 uid 0
Jan 30 12:09:48 master1 slurmctld[42651]: slurmctld: sched: _slurm_rpc_allocate_resources JobId=8 NodeList=(null) usec=5383
Jan 30 15:49:26 master1 slurmctld[42651]: slurmctld: Node node2 now responding
Jan 30 15:50:25 master1 slurmctld[42651]: slurmctld: cleanup_completing: JobId=4 completion process took 13487 seconds
Jan 30 15:50:25 master1 slurmctld[42651]: slurmctld: sched/backfill: _start_job: Started JobId=7 in debug on node[1-2]
Jan 30 15:50:35 master1 slurmctld[42651]: slurmctld: _job_complete: JobId=7 done
Jan 30 15:50:36 master1 slurmctld[42651]: slurmctld: sched: Allocate JobId=8 NodeList=node[1-2] #CPUs=2 Partition=debug
Jan 30 15:50:46 master1 slurmctld[42651]: slurmctld: _job_complete: JobId=8 done
Jan 30 15:51:45 master1 slurmctld[42651]: slurmctld: error: Nodes node2 not responding
[root@master1 ~]#
```

#systemctl status munge

#systemctl start munge

#systemctl enable munge

```
Jan 30 15:51:45 master1 slurmctld[42651]: slurmctld: error: Nodes node2 not responding
[root@master1 ~]# systemctl status munge.service
● munge.service - MUNGE authentication service
   Loaded: loaded (/usr/lib/systemd/system/munge.service; enabled; vendor preset: disabled)
   Active: active (running) since Sun 2023-01-29 15:30:28 IST; 1 day 1h ago
     Docs: man:munged(8)
 Main PID: 1196 (munged)
    Tasks: 4
   Memory: 160.0K
   CGroup: /system.slice/munge.service
           └─1196 /usr/sbin/munged

Jan 29 15:30:18 master1 systemd[1]: Starting MUNGE authentication service...
Jan 29 15:30:28 master1 systemd[1]: Started MUNGE authentication service.
[root@master1 ~]#
```

> **On Client:-**

#yum --installroot=$CHROOT install -y mariadb-server mariadb-devel epel-release munge munge-libs munge-devel rpm-build python3 perl-ExtUtitils-Install gcc

#scp /etc/munge/munge.key /install/netboot/hpcsa2os7.9/x86_64/compute/rootimg/etc/munge

#yum --installroot=$CHROOT install -y openssl openssl-devel pam-devel numactl numactl-devel hwloc hwloc-devel lua lua-devel readline-devel rrdtool-devel ncurses-devel man2html libibmad libibumad –y

#cd /etc/munge/

#chown munge:munge munge.key

#cd /root/rpmbuild/RPMS/x86_64/

yum --installroot=$CHROOT install slurm*

#scp /etc/slurm/cgroup.conf $CHROOT/etc/slurm

#sinfo

```
[root@master1 ~]# sinfo
PARTITION AVAIL  TIMELIMIT  NODES  STATE NODELIST
debug*       up   infinite      1  idle* node1
debug*       up   infinite      1   unk* node2
[root@master1 ~]# sinfo
PARTITION AVAIL  TIMELIMIT  NODES  STATE NODELIST
debug*       up   infinite      1  idle* node1
debug*       up   infinite      1   unk* node2
[root@master1 ~]# sinfo
PARTITION AVAIL  TIMELIMIT  NODES  STATE NODELIST
debug*       up   infinite      2   idle node[1-2]
[root@master1 ~]# sinfo
PARTITION AVAIL  TIMELIMIT  NODES  STATE NODELIST
debug*       up   infinite      2   idle node[1-2]
[root@master1 ~]#
```

#srun –N2 –pty /bin/bash

```
[root@master1 ~]# srun -N2 --pty /bin/bash
srun: job 8 queued and waiting for resources

 root@master1:~
```

#squeue

```
root@node2 ~]# packet_write_wait: Connection to 192.168.100.20 port 22: Broken pipe
root@master1 ~]# squeue
          JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
              4     debug     bash     root  R       0:27      2 node[1-2]
root@master1 ~]#
```

Ganglia Configuration

> **On Master Node:**

#yum install epel-release
yum install ganglia rrdtool ganglia-gmetad ganglia-gmond ganglia-web
#htpasswd -c /etc/httpd/auth.basic adminganglia
vi /etc/httpd/conf.d/ganglia.conf
#vi /etc/ganglia/gmetad.conf

```
data_source "my cluster " localhost

#
# Round-Robin Archives
# You can specify custom Round-Robin archives here (defaults are listed below)
#
# Old Default RRA: Keep 1 hour of metrics at 15 second resolution. 1 day at 6 minute
# RRAs "RRA:AVERAGE:0.5:1:244" "RRA:AVERAGE:0.5:24:244" "RRA:AVERAGE:0.5:168:244" "RRA:AVERAGE:0.5:672:244" \
#      "RRA:AVERAGE:0.5:5760:374"
# New Default RRA
# Keep 5856 data points at 15 second resolution assuming 15 second (default) polling. That's 1 day
# Two weeks of data points at 1 minute resolution (average)
#RRAs "RRA:AVERAGE:0.5:1:5856" "RRA:AVERAGE:0.5:4:20160" "RRA:AVERAGE:0.5:40:52704"

#
#-------------------------------------------------------------------------
# Scalability mode. If on, we summarize over downstream grids, and respect
# authority tags. If off, we take on 2.5.0-era behavior: we do not wrap our output
# in <GRID></GRID> tags, we ignore all <GRID> tags we see, and always assume
# we are the "authority" on data source feeds. This approach does not scale to
# large groups of clusters, but is provided for backwards compatibility.
# default: on
# scalable off
#
#-------------------------------------------------------------------------
# The name of this Grid. All the data sources above will be wrapped in a GRID
# tag with this name.
# default: unspecified
gridname "Home office"
data_source "oxygen" 60 192.168.138.128:8649 # Master node
data_source "oxygen" 60 192.168.100.17 # Monitored node
data_source "oxygen" 60 192.168.100.20 # Monitored node
#-------------------------------------------------------------------------
# The authority URL for this grid. Used by other gmetads to locate graphs
# for our data sources. Generally points to a ganglia/
# website on this machine.
# default: "http://hostname/ganglia/",
#    where hostname is the name of this machine, as defined by gethostname().
```

#vi /etc/ganglia/gmond.conf

```
  deaf = no
  allow_extra_data = yes
  host_dmax = 86400 /*secs. Expires (removes from web interface) hosts in 1 day */
  host_tmax = 20 /*secs */
  cleanup_threshold = 300 /*secs */
  gexec = no
  # By default gmond will use reverse DNS resolution when displaying your hostname
  # Uncommeting following value will override that value.
  # override_hostname = "mywebserver.domain.com"
  # If you are not using multicast this value should be set to something other than 0.
  # Otherwise if you restart aggregator gmond you will get empty graphs. 60 seconds is reasonable
  send_metadata_interval = 0 /*secs */
}

/*
 * The cluster attributes specified will be used as part of the <CLUSTER>
 * tag that will wrap all hosts collected by this instance.
 */
cluster {
  name = "oxygen"
  owner = "unspecified"
  latlong = "unspecified"
  url = "unspecified"
}

/* The host section describes attributes of the host, like the location */
host {
  location = "unspecified"
}

/* Feel free to specify as many udp_send_channels as you like.  Gmond
   used to only support having a single channel */
udp_send_channel {
  #bind_hostname = yes # Highly recommended, soon to be default.
                       # This option tells gmond to use a source address
                       # that resolves to the machine's hostname.  Without
                       # this, the metrics may appear to come from any
                       # interface and the DNS names associated with
                       # those IPs will be used to create the RRDs.
```

#setsebool -P httpd_can_network_connect 3

#systemctl restart httpd gmetad gmond

#systemctl enable httpd gmetad httpd

#systemctl status httpd gmetad httpd

```
[root@master1 ~]# systemctl status gmetad.service
● gmetad.service - Ganglia Meta Daemon
   Loaded: loaded (/usr/lib/systemd/system/gmetad.service; enabled; vendor preset: disabled)
   Active: active (running) since Sun 2023-01-29 18:45:31 IST; 16h ago
 Main PID: 19045 (gmetad)
    Tasks: 10
   CGroup: /system.slice/gmetad.service
           └─19045 /usr/sbin/gmetad -d 1

Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/mem_buffers.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/mem_buffers.rr...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/load_fifteen.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/load_fifteen....second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/cpu_nice.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/cpu_nice.rrd: ill...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/pkts_in.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/pkts_in.rrd: illeg...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/cpu_idle.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/cpu_idle.rrd: ill...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/disk_total.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/disk_total.rrd:...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/cpu_system.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/cpu_system.rrd:...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/mem_cached.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/mem_cached.rrd:...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/mem_shared.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/mem_shared.rrd:...second step)
Jan 30 11:11:33 master1 gmetad[19045]: RRD_update (/var/lib/ganglia/rrds/oxygen/__SummaryInfo__/proc_run.rrd): /var/lib/ganglia/rrds/oxygen/__SummaryInfo__/proc_run.rrd: ill...second step)
Hint: Some lines were ellipsized, use -l to show in full.
[root@master1 ~]#
```

> **On Client Node:**

#export CHROOT=/install/netboot/hpcsa2os7.9/x86_64/compute/rootimg
#yum --installroot=$CHROOT install ganglia rrdtool ganglia-gmetad ganglia-gmond ganglia- web
#vi /etc/ganglia/gmond.conf

```
  deaf = no
  allow_extra_data = yes
  host_dmax = 86400 /*secs. Expires (removes from web interface) hosts in 1 day */
  host_tmax = 20 /*secs */
  cleanup_threshold = 300 /*secs */
  gexec = no
  # By default gmond will use reverse DNS resolution when displaying your hostname
  # Uncommeting following value will override that value.
  # override_hostname = "mywebserver.domain.com"
  # If you are not using multicast this value should be set to something other than 0.
  # Otherwise if you restart aggregator gmond you will get empty graphs. 60 seconds is reasonable
  send_metadata_interval = 0 /*secs */
}

/*
 * The cluster attributes specified will be used as part of the <CLUSTER>
 * tag that will wrap all hosts collected by this instance.
 */
cluster {
  name = "oxygen"
  owner = "unspecified"
  latlong = "unspecified"
  url = "unspecified"
}

/* The host section describes attributes of the host, like the location */
host {
  location = "unspecified"
}

/* Feel free to specify as many udp_send_channels as you like.  Gmond
   used to only support having a single channel */
udp_send_channel {
  #bind_hostname = yes # Highly recommended, soon to be default.
                       # This option tells gmond to use a source address
                       # that resolves to the machine's hostname.  Without
                       # this, the metrics may appear to come from any
                       # interface and the DNS names associated with
                       # those IPs will be used to create the RRDs.
```

packimage hpcsa2os7.9-x86_64-netboot-compute

#systemctl status gmond

> **On Client node1 & node2:-**

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

node1 login: root
Password:
[root@node1 ~]# systemctl status gmod
Unit gmod.service could not be found.
[root@node1 ~]# systemctl status gmond
● gmond.service - Ganglia Monitoring Daemon
   Loaded: loaded (/usr/lib/systemd/system/gmond.service; enabled; vendor preset: disabled)
   Active: active (running) since Sun 2023-01-29 18:08:37 IST; 24s ago
  Process: 1569 ExecStart=/usr/sbin/gmond (code=exited, status=0/SUCCESS)
 Main PID: 1570 (gmond)
    Tasks: 2
   Memory: 956.0K
   CGroup: /system.slice/gmond.service
           └─1570 /usr/sbin/gmond

Jan 29 18:08:37 node1.xcat.in systemd[1]: Starting Ganglia Monitoring Daemon...
Jan 29 18:08:37 node1.xcat.in systemd[1]: Started Ganglia Monitoring Daemon.
[root@node1 ~]# _
```
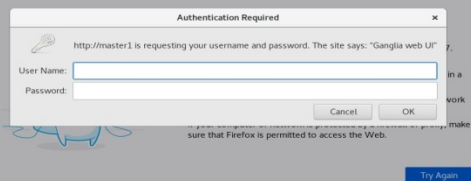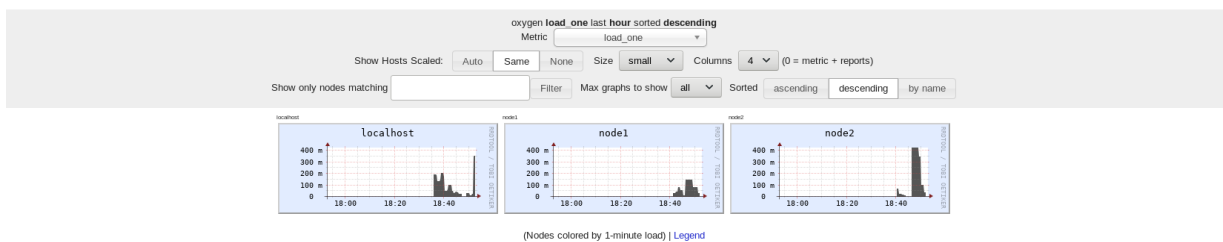


```
CentOS Linux 7 (Core)
Kernel 3.10.0-1160.el7.x86_64 on an x86_64

node2 login: root
Password:
[root@node2 ~]# systemctl status gmond
■ gmond.service - Ganglia Monitoring Daemon
   Loaded: loaded (/usr/lib/systemd/system/gmond.service; enabled; vendor preset: disabled)
   Active: active (running) since Mon 2023-01-30 10:42:59 IST; 38min ago
  Process: 1568 ExecStart=/usr/sbin/gmond (code=exited, status=0/SUCCESS)
 Main PID: 1569 (gmond)
    Tasks: 2
   Memory: 1.3M
   CGroup: /system.slice/gmond.service
           └─1569 /usr/sbin/gmond

Jan 30 10:42:59 node2.xcat.in systemd[1]: Starting Ganglia Monitoring Daemon...
Jan 30 10:42:59 node2.xcat.in systemd[1]: Started Ganglia Monitoring Daemon.
[root@node2 ~]#
```

← → C ⌂   ① 192.168.138.128/ganglia/?r=hour&cs=&ce=&m=load_one&s=by+name&c=&tab=m&vn=&tz=&hide-hf=false   ⋯ ☑ ☆   �III ⊡ ☻ ≡

Home office Grid Report at Sun, 29 Jan 2023 13:19:57 +0000   Get Fresh Data

Last | hour | 2hr | 4hr | day | week | month | year | job | or from [　　　　] 📅 to [　　　　] 📅 Go | Clear   Timezone: Server ▾

Sorted | ascending | descending | by name | by hosts up | by hosts down

Home office Grid > --Choose a Source ▾

Home office Grid (1 sources) (tree view)

CPUs Total: 8
Hosts up: 2
Hosts down: 0

Current Load Avg (15, 5, 1m):
   1%, 3%, 9%
Avg Utilization (last hour):
   2%
Localtime:
   2023-01-29 13:19

Home office Grid Load last hour

☐ 1-min	Now:677.7m	Min: 0.0	Avg:103.8m	Max:677.
■ Nodes	Now: 2.0	Min: 0.0	Avg: 1.1	Max: 2.
■ CPUs	Now: 7.9	Min: 0.0	Avg: 4.3	Max: 7.
■ Procs	Now: 0.0	Min: 0.0	Avg: 3.1	Max: 18.

Home office Grid Memory last hour

■ Use	Now: 544.4M	Min: 0.0	Avg: 1.3G	Max: 1.6G
■ Share	Now: 0.0	Min: 0.0	Avg: 0.0	Max: 0.0
■ Cache	Now: 2.9G	Min: 0.0	Avg: 3.0G	Max: 3.4G
■ Buffer	Now: 37.3k	Min: 0.0	Avg: 871.1k	Max: 1.1M
☐ Free	Now: 4.2G	Min: 0.0	Avg: 1.5G	Max: 4.2G
■ Swap	Now: 0.0	Min: 0.0	Avg: 0.0	Max: 0.0
■ Total	Now: 7.6G	Min: 0.0	Avg: 5.9G	Max: 7.6G

Home office Grid CPU last hour

■ User	Now: 0.1%	Min: 0.1%	Avg: 3.0%	Max: 15.9%
☐ Nice	Now: 0.0%	Min: 0.0%	Avg: 0.0%	Max: 0.0%
■ System	Now: 0.2%	Min: 0.1%	Avg: 1.2%	Max: 9.7%
■ Wait	Now: 0.4%	Min: 0.0%	Avg: 0.4%	Max: 0.4%
■ Steal	Now: 0.0%	Min: 0.0%	Avg: 0.0%	Max: 0.0%
☐ Idle	Now: 99.3%	Min: 74.2%	Avg: 95.7%	Max: 99.8%

Home office Grid Network last hour

■ In	Now:108.6	Min: 0.0	Avg: 4.1k	Max: 29.1k
■ Out	Now: 1.5k	Min: 0.0	Avg: 1.8M	Max: 16.1M

☐ Idle   Now: 99.3%   Min: 74.2%   Avg: 95.7%   Max: 99.8%

---

oxygen (physical view)

CPUs Total: 4
Hosts up: 1
Hosts down: 0

Current Load Avg (15, 5, 1m):
   3%, 2%, 1%
Avg Utilization (last hour):
   2%
Localtime:
   2023-01-29 13:19

oxygen Cluster Load last hour

☐ 1-min	Now:119.3m	Min: 0.0	Avg: 84.1m	Max:272.
■ Nodes	Now: 1.1	Min: 1.0	Avg: 1.1	Max: 1.
■ CPUs	Now: 4.5	Min: 4.0	Avg: 4.3	Max: 5.
■ Procs	Now: 0.0	Min: 0.0	Avg: 2.8	Max: 18.

oxygen Cluster Network last hour

■ In	Now:460.8	Min: 40.0m	Avg: 7.0k	Max: 60.1k
■ Out	Now: 3.1k	Min: 1.2	Avg: 3.1M	Max: 32.2M

Snapshot of the Home office Grid | Legend

oxygen

Ganglia Web Frontend version 3.7.4 Check for Updates.
Ganglia Web Backend (gmetad) version 3.7.2 Check for Updates.
Downloading and parsing ganglia's XML tree took 0.0026s.
Images created with RRDtool version 1.4.8.
Powered by Dwoo 1.2.0.

---

oxygen **load_one** last **hour** sorted **descending**
Metric [load_one ▾]

Show Hosts Scaled: Auto | Same | None   Size small ▾   Columns 4 ▾   (0 = metric + reports)

Show only nodes matching [　　　　] Filter   Max graphs to show all ▾   Sorted   ascending | descending   by name

localhost	node1	node2

(Nodes colored by 1-minute load) | Legend

Benchmarking

#yum install blas

yum install epel-release

yum install atlas

yum install blas-devel

wget https://netlib.org/benchmark/hpl/hpl-2.3.tar.gz

tar -xvf hpl-2.3.tar.gz

wget https://download.open-mpi.org/release/open-mpi/v4.1/openmpi-4.1.4.tar.gz

tar -xvf openmpi-4.1.4.tar.gz

cd openmpi-4.1.4

#./configure --prefix=/opt/openmpi-4.1.4 --enable-orterun-prefix-by-default

make –j4

make install

export PATH=/opt/openmpi-4.1.4/bin:$PATH

echo$PATH

export LD_LIBRARY_PATH=/opt/openmpi-4.1.4/lib:$LD_LIBRARY_PATH

cd /root/hpl-2.3/

cd setup/

cp Make.Linux_PII_CBLAS /root/hpl-2.3

#cd /root/hpl-2.3/

#vi Make.Linux_PII_CBLAS

#make arch=Linux_PII_CBLAS

#cd bin/

#cd Linux_PII_CBLAS/

#vim HPL.dat

#mpirun --allow-run-as-root -np 12 ./xhpl HPL.dat

#mpirun --allow-run-as-root -np 12 --host master, node1,node2 ./xhpl HPL.dat

```
--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N) =   4.04560734e-03 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR00R2L4          2500  128    2     2               0.27               3.9251e+01
HPL_pdgesv() start time Mon Jan 30 14:46:32 2023

HPL_pdgesv() end time   Mon Jan 30 14:46:32 2023


--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N) =   3.07201492e-03 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR00R2C2          2500  128    2     2               0.27               3.8564e+01
HPL_pdgesv() start time Mon Jan 30 14:46:32 2023

HPL_pdgesv() end time   Mon Jan 30 14:46:33 2023


--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N) =   4.04560734e-03 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR00R2C4          2500  128    2     2               0.32               3.2931e+01
HPL_pdgesv() start time Mon Jan 30 14:46:33 2023

HPL_pdgesv() end time   Mon Jan 30 14:46:33 2023


--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N) =   3.49949761e-03 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR00R2R2          2500  128    2     2               0.25               4.1203e+01
HPL_pdgesv() start time Mon Jan 30 14:46:33 2023

HPL_pdgesv() end time   Mon Jan 30 14:46:33 2023


--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N) =   4.04560734e-03 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR00R2R4          2500  128    2     2               0.33               3.1387e+01
HPL_pdgesv() start time Mon Jan 30 14:46:33 2023

HPL_pdgesv() end time   Mon Jan 30 14:46:34 2023


--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N) =   4.04560734e-03 ...... PASSED
================================================================================

Finished      18 tests with the following results:
              18 tests completed and passed residual checks,
               0 tests completed and failed residual checks,
               0 tests skipped because of illegal input values.
--------------------------------------------------------------------------------

End of Tests.
================================================================================
[root@master1 Linux_PII_CBLAS]#
```