

# Linux Cluster

## 1. About this experiment

In this experiment, you will learn how to build a Linux cluster for parallel programming and parallel computing using 2-3 physical machines or virtual machines. One of them is acting as a management node, the other nodes are computing nodes. The computing nodes should be accessed using SSH without requiring password. And you can install MPI and run MPI programs based on the basic services such as SSH, NFS and NIS.

## 2. Goal

- Master virtualization technology, to create 2-3 virtual machines (optional);
- Master some common Linux commands, such as useradd etc.
- Master some basic configurations and services for a Linux cluster, such as SSH, NIS, NFS;
- Master the installation and usage of gcc or Intel compilers (optional);
- Master the installation of MPI and running of MPI programs.

## 3. Team

1-3 students for a team.

If the number of students is equal or greater than 2, 1 team leader should be assigned, and the tasks of each team member should be clear.

## 4. Report

Please describe the process of building a Linux cluster, record your issues and your solutions, as well as your division of work.

## 5. Reference

- If possible, Please build the Linux cluster using physical machines. Otherwise, you can do it using 2-3 virtual machines on your laptop.

### 5.1 Virtualization technology

You may use free virtualization software, such as VMware workstation or open-source software. (Please search them on the internet for details.)

## 5.2 Basic configurations and services for a Linux Cluster

### 5.2.1 Creating an User Account

Using “useradd” to create a common user account (NOT root)

### 5.2.2 Configuration of network and /etc/hosts

e. g.

Redhat/Centos: /etc/sysconfig/network-scripts/ifcfg-eth0

Ubuntu: /etc/network/interfaces

e.g. :

```
echo "192.168.0.1    node1">>/etc/hosts
```

```
echo "192.168.0.2    node2">>/etc/hosts
```

```
cat /etc/hosts
```

### 5.2.3 SSH

```
ssh-keygen -t rsa (or dsa)
```

```
cat ~/.ssh/id_rsa.pub >> ~/.ssh/authorized_keys
```

```
chmod 600 ~/.ssh/authorized_keys
```

### 5.2.4 NIS

On Redhat/Centos Linux

#### (1) Installation

```
yum -y install ypserv rpcbind
```

#### (2) On the server side

```
ypdomainname server.world
```

```
echo "NISDOMAIN=server.world" >> /etc/sysconfig/network
```

```
/etc/yp.conf
```

```
ypserver node1
```

```
/etc/ypserv.conf
```

The last line is marked. \*: \*: \*: none

```
sudo sed -i '48s/#//g' /etc/ypserv.conf
```

```
/usr/lib64/yp/ypinit -m
```

```
service ypserv start
```

```
service yppasswdd start
```

```
chkconfig ypserv on
```

```
chkconfig yppasswdd on
```

### (3) on the Client side

```
ypdomainname server.world
```

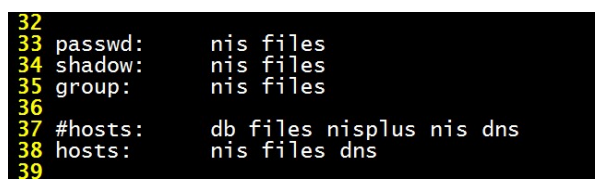
```
echo "NISDOMAIN=server.world" >> /etc/sysconfig/network
```

```
/etc/yp.conf
```

```
domain server.world server node1
```

```
/etc/nsswitch.conf
```

The lines for passwd, shadow, group, and hosts should be modified as described in the following Figure.



```
32  
33 passwd:      nis files  
34 shadow:      nis files  
35 group:       nis files  
36  
37 #hosts:      db files nisplus nis dns  
38 hosts:       nis files dns  
39
```

```
service ypbind restart
```

```
chkconfig ypbind on
```

### (4) Tests

```
ypwhich
```

```
nisdomainname
```

```
ypcat passwd
```

### (5) Add a new user account based on NIS service

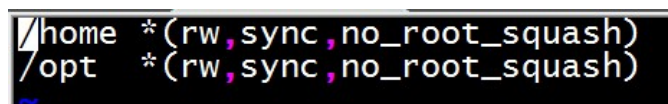
After the creation of a new user account on the server side, change to the directory /var/yp, and execute “make”.

## 5.2.5 NFS

On Redhat/Centos Linux

### (1) On the server side

Examples for /etc/exports



```
/home *(rw,sync,no_root_squash)  
/opt  *(rw,sync,no_root_squash)
```

```
service portreserve start
```

```
service nfs start
```

```
chkconfig portreserve on
```

```
chkconfig nfs on
```

```
exportfs -avr  
showmount -e
```

## **(2) on the Client side**

```
echo "mount -t nfs -o vers=3 node1:/home /home" >>/etc/rc.d/rc.local  
echo "mount -t nfs -o vers=3 node1:/opt /opt">>/etc/rc.d/rc.local  
cat /etc/rc.d/rc.local
```

## **(3) Tests**

```
df -h
```

## **5.3 gcc or icc (optional)**

If necessary, please try to upgrade gcc compiler on your machine.

## **5.4 MPI**

5.4.1 Please download and install one of the MPI versions:

Open MPI (<http://www.open-mpi.org/>)

Mpich (<https://www.mpich.org/>)

Mvapich ([mvapich.cse.ohio-state.edu/](http://mvapich.cse.ohio-state.edu/))

5.4.2 Please compile and run 1-3 MPI example programs with more than 1 processes on 1-3 nodes.