# Installation of Linux Cluster

## Practical No. 1

**Title:** Interactive installation of operating system (Centos) on the master node

**Aim:** To familiarize the participants on how to install Linux operating system from scratch

**Requirements**:

Centos 6.5 DVD

System unit

**Introduction**

A default installation with graphical interface will be installed on the master node. This node is serving as a gateway for the computing nodes in the cluster as result we have to make sure that we removed unused services for a security reason.

**Procedure:**

1. Change the boot sequence (BIOS), make sure it is starting from DVD drive

2. **Perform interactive installation**

**Exercise**

1. Observe available services

   chkconfig --list | grep  5:on

2. The following are likely to be unneeded services

| | | |
|---|---|---|
| anacron | haldaemon | messagebus |
| apmd | hidd | microcode_ctl |
| autofs` | hplip* | pcscd |
| avahi-daemon* | isdn | readahead_early |
| bluetooth | kdump | readahead_later |
| cups* | kudzu | rhnsd* |
| firstboot | mcstrans | setroubleshoot |
| gpm | mdmonitor | xfs |

3. Remove the unneeded services with command like this,

   for i in  anacron apmd  autofs  avahi-daemon bluetooth cups firstboot  gpm halddaemon  hidd hplip  isdn  kdump  kundzu mcstrans mdmonitor messagebus microcode_ctl readahead_early readahead_later  ; do service $i stop; chkconfig --del $i; done

# Installation of Linux Cluster

## Practical No. 2

**Title**: Configuring private network

**Aim:** To familiarize the participants on how to configure a private network

**Requirements:**

A system unit with the CentOS 6.5 running

And NIC is functioning properly (for internal network)

**Introduction**

Configuring a private network is essential for setting up linux cluster since we don't want the computing nodes to be accessed directly. It is the master node that is serving as a gateway for the computing nodes.

**Procedure:**

1.  Edit the ifcfg-eth0 file

2.  Modify the rules for iptables

**Exercise**

1.  Edit the  /etc/sysconfig/network-scripts/ifcfg-eth0

        DEVICE=eth0

        IPADDR=10.1.0.1

        BROADCAST=10.1.255.255

        NETMASK=255.255.0.0

        BOOTPROTO=static

        ONBOOT=yes

2.  Restart the network service

    service network restart   or,

    ifup eth0

3.  Add a rule that allows all traffic  for the private network

    iptables -I INPUT -i eth0 -j ACCEPT

    service iptables save

# Installation of Linux Cluster

## Practical No. 3

**Title:** Setup the local package repository and install required packages

**Aim**: To familiarize the participants on how to setup local repository

**Requirements**:

A system unit with the CentOS 6.5 running

And NIC is functioning properly

### Introduction

The master node can be configured as the local repository for the nodes in the cluster. Later we will use this repository to install operating system on computing nodes.

**Procedure**:

1. Create a repository  file in /etc/yum.repos.d/

2. Mount to /distro/centos director

3. Install packages like tftp, dhcp and syslinux

### Exercise

1. Create  /etc/yum.repos.d/local.repo file

    ```
    [base]
    name=CentOS-$releasever - Local
    baseurl=file:///distro/centos
    gpgcheck=0
    enabled=1
    ```

    Then move the existing repository files to backup folder(mkdir backup)

    mv Cent* backup/

2. Mount the image  and update the repository(the location depends where you put the iso file)

    mkdir -p /distro/centos

    mount -o loop /data/CentOS-6.5-x86_64-bin-DVD1.iso  /distro/centos/

    yum clean all

```
yum makecache
```

3. Install the  missing packages that we are going to use them to configure DHCP and TFTP  server as well as  the Network Bootstrap Program (pxelinux.0)

```
yum install tftp tftp-server dhcp syslinux
```

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**Practical No. 4**

**Title**: Configure DHCP server and create static name mapping file

**Aim**: To familiarize the participants on how to setup name resolution and dynamic ip assignment on local network

**Requirements**:

A system unit with the CentOS running

An installed DHCP server

**Introduction**

The master node can be configured to the local repository for the nodes in the cluster. Later we will use this repository to install operating system on computing nodes.

**Procedure**:

1. Edit /etc/hosts file

2. Create the configuration file for the DHCP server

**Exercise**

1. Add the following lines to /etc/hosts file

| | | |
|---|---|---|
| 127.0.0.1 | localhost.localdomain localhost | |
| 10.1.0.1 | master.mycluster | masternode |
| 10.1.1.1 | node1.mycluster | node1 |
| 10.1.1.2 | node2.mycluster | node2 |

2. Create the configuration file for the DHCP, /etc/dhcp/dhcpd.conf

ddns-update-style none;

ddns-updates off;

authoritative;

subnet 10.1.0.0 netmask 255.255.0.0 {

        option domain-name "clusterXY";

```
                    option domain-name-servers 10.1.0.1;

                    option ntp-servers 10.1.0.1;

                    option subnet-mask 255.255.0.0;

                    option broadcast-address 10.1.255.255;

                    filename "/pxe/pxelinux.0";

                    next-server 10.1.0.1;

          }

          #host node1 { hardware ethernet ..:..:..:..:..:.. ; fixed-address 10.1.1.1 ; option host-name "node1" ; }

          #host node2 { hardware ethernet ..:..:..:..:..:.. ; fixed-address 10.1.1.2 ; option host-name "node2" ; }
```

3. Restart the dhcp service

   `service dhcpd start`

4. Make it permanent (automatically start at the next reboot)

   `chkconfig --add dhcpd`

   `chkconfig dhcpd on`

5. In order to force the daemon to listen only on a specific interface, set the interface name on the DHCPDARGS variable by editing  the  file  /etc/sysconfig/dhcpd

   `DHCPDARGS="eth0"`

# Installation of Linux Cluster

## Practical No. 5

**Title**: Setup TFTP server and configure PXE booting

**Aim**: To familiarize the participants on how to setup PXE booting and TFTP server

**Requirements**:

A system unit with the CentOS running

And NIC is functioning properly

**Introduction**

In order to use network booting(PXE) , one need to setup a boot server which will allow client systems to Request an IP address(through DHCP) and download a kernel (through TFTP). TFTP is a very simple file-transfer protocol, which is very similar to FTP but which doesn't use any kind of authentication.

**Procedure**:

1. Modify the /etc/xinetd.d/tftp file

2. Populate the TFTP tree

3. Copy the kernel and the initial ramdisk from the installation media

4. Create a "default" configuration file for the clients with the local boot as default target (and therefore avoid unwanted installations)

5. Create the PXE configuration files for the computing nodes

**Exercise**

1. Modify the /etc/xinetd.d/tftp file and enable the service in order to be invoked by xinetd (disabled = no).  Enable also the verbose logging (-vvv). The service can also be enabled by using chkconfig tftp on.

        service xinetd restart

        chkconfig --add xinetd

        chkconfig xinetd on

2. Figure out where the PXE files are located and copy the files to the TFTP tree

        mkdir -p /tftpboot/pxe/pxelinux.cfg

```
locate  pxelinux.0

cp -a /usr/lib/syslinux/pxelinux.0  /tftpboot/pxe/
```

3. Copy the kernel and the initial ramdisk from the installation media

   cp -a /distro/centos/images/pxeboot/{initrd.img,vmlinuz} /tftpboot/pxe/

4. Create /tftpboot/pxe/pxelinux.cfg/default file

   ```
   prompt 1

   timeout 100

   default local

   label local

           LOCALBOOT 0

   label install

           kernel vmlinuz

           append initrd=initrd.img network ip=dhcp \

                   ksdevice=eth0 ks=nfs:10.1.0.1:/distro/ks/ks.cfg \

                   load_ramdisk=1 prompt_ramdisk=0 ramdisk_size=16384 \

                   vga=normal selinux=0
   ```

5. Create the PXE configuration files for the computing nodes and change the default target to install

   ```
   gethostip node1
   ```

   ➢ node1 10.1.1.1 0A010101

   ```
   cp -a /tftpboot/pxe/pxelinux.cfg/default /tftpboot/pxe/pxelinux.cfg/0A010101
   ```

   edit /tftpboot/pxe/pxelinux.cfg/0A010101          # local->install

   ```
   cp -a /tftpboot/pxe/pxelinux.cfg/0A010101 /tftpboot/pxe/pxelinux.cfg/0A010102

   chmod a+w /tftpboot/pxe/pxelinux.cfg/0A01010*
   ```

# Installation of Linux Cluster

## Practical No. 6

**Title**: Setup NFS and create kickstart  file

**Aim**: To familiarize the participants on how to export file system and create a kickstart file

**Requirements**:

A system unit with the CentOS running

Operating system image is mounted

Services like TFTP and DHCP are running

**Introduction**

Network File System (NFS) is allowing client computers to access files over a network in the same way as local storage is accessed.  Kickstart files are used for an automated installation since they can contain answers to all the questions that would normally be asked during a typical installation

**Procedure**:

1. Create the kickstart file

2. Edit /etc/exports

3. Start the NFS service

**Exercise**

1. Create  kickstart file in /distro/ks

    mkdir  -p /distro/ks

    cp -a /root/ks.cfg  /distro/ks

    Append the following lines  to /distro/ks/ks.cfg file

    tftp

    openssh-server

    openssh

    xorg-x11-xauth

    xterm

    mc

```
strace

-cups

-cups-libs

-bluez-utils

-bluez-libs

-bluez-gnome

-rp-pppoe

-ppp

%post

MASTER=10.1.0.1

tftp_get() { tftp $MASTER -v -c get $1 $2 2>&1 ; }

tftp_put() { tftp $MASTER -v -c put $1 $2 2>&1 ; }

ip_to_hex()

{

        /sbin/ip addr show dev $1     |\

        grep 'inet '                             |\

        awk '{print $2}'                  |\

        cut -f1 -d/                              |\

        awk -F. '{ printf( "%02X%02X%02X%02X" , $1 , $2 , $3 , $4 ); }'

}

HEX=`ip_to_hex eth0`

cd /tmp

tftp_get /pxe/pxelinux.cfg/default $HEX

tftp_put $HEX /pxe/pxelinux.cfg/$HEX

 [base]
name=CentOS-$releasever - Local
baseurl=file:///distro/centos
gpgcheck=0
enabled=1
```

2. Edit /etc/exports add the following lines

   /distro     10.1.0.0/16(ro,root_squash)

   /distro/centos  10.1.0.0/16(ro,root_squash)

3. Start the NFS service

   Service portmap start

   service nfs start

   chkconfig --add portmap

   chkconfig portmap on

   chkconfig --add nfs

   chkconfig nfs on

# Installation of Linux Cluster

## Practical No. 7

**Title**: Installation of computing nodes

**Aim**: To familiarize the participants on how to install Os from a master node

**Requirements**:

A system unit with the CentOS running

Service like TFTP, NFS, DHCP should be active

PXE booting with kickstart file should be configured properly

**Introduction**

Here the Computing nodes will be installed from the network, non-interactively

**Procedure**:

1. Make sure that the nodes have NIC as the boot device

2. Get information about MAC address of the node

3. Start the installation

**Exercise**

1. Make sure that the nodes have NIC as the boot device

    Go to BIOS and make the first boot device to be NIC

2. Get information about MAC address of the node  and update your DHCP server with this information

    tcpdump -i eth0 -n -q -t -e -p port bootpc and port bootps and ip broadcast

    tail -f /var/log/messages

3. Power on one computing node and check the status of the installation from the master node

    tcpdump -i eth0 -nn -qtep port bootpc or port tftp

    tail -f /var/log/messages

# Practical No. 8

**Title**: Passwordless environment

**Aim**: To familiarize the participants on how to setup passwordless environment among nodes

**Requirements**:

A system unit with the CentOS running

Service like TFTP, NFS, DHCP should be active

PXE booting with kickstart file should be configured properly

At least one installed node

## Introduction

Passworldless environment is essential when the nodes are talking among themselves using c3 tools, mpi or batch management software.

**Procedure**:

1. Generate a private/public identity key

2. Copy the public key to authorized_keys

3. Copy the ssh key to other computers


## Exercise

1. Generate a private/public identity key

   ssh-keygen  -t  dsa

2. Copy the id_dsa.pub file under the name authorized_keys

   cd ~/.ssh

   cp id_dsa.pub authorized_keys

3. Copy the contents of the .ssh directory to the computing nodes

   scp  -rp  ~/.ssh  nodex:

4. Check if you can login from the other node without password

   ssh root@nodex

5. Create a user account and repeat step 1 to 3 to configure passwordless environment for the account

```
useradd -n -m user1
```

```
passwd user1
```

# Practical No. 9

Title: Installation and usage of c3 tools

Aim: To familiarize the participants on how to  install and use c3 tools

Requirements:

     A system unit with the CentOS running

     Service like TFTP, NFS, DHCP should be active

     PXE booting with kickstart file should be configured properly

     At least one installed node

     Password less environment is configured

Introduction

Cluster Command and Control (C3), includes tools for cluster-wide command execution, file distribution and gathering, process termination, remote shutdown and restart, and system image updates

Procedure:

1. Download and install C3 tools

2. Edit the /etc/c3.conf

3. Export /home directory

4. Update the /etc/fstab file

5. Disseminate user information to the nodes

Exercise

1. Download and install C3 tools

     wget http://www.csm.ornl.gov/torc/C3/Software/5.1.3/c3-5.1.3.tar.gz, and install it

     ./configure

     make

     make install

2. Edit the /etc/c3.conf

     cluster lab {

master:master

    node[1-2]

}

Add the C3 utilities to the superuser's PATH:

`echo 'export PATH=$PATH:/opt/c3-4/' >> /root/.bashrc`

3. Export /home directory

`echo '/home 10.1.0.0/16(rw,no_root_squash)' >> /etc/exports`

`service nfs restart`

4. Update the /etc/fstab file

`cexec 'echo "10.1.0.1:/home /home nfs rw 0 0" >> /etc/fstab'`

`cexec mount /home`

5. Disseminate user information to the nodes

`for  j  in passwd shadow group ; do cpush /etc/$j ; done`

`cpush /etc/hosts /etc`