

How to configure Beowulf Cluster Computer

Server Set-up Procedure:

1. The following options are set during kernel configuration
 - a. CONFIG_NFS_YES = yes (network file system)
 - b. CONFIG_NFS_V3 = yes (version 3 of NFS to support MPI)
 - c. CONFIG_NFS_ROOT = yes(This option made the root device of kernel to NFS-root)
 - d. IP Kernel level Autoconfiguration
2. Linux 2.5.72 kernel was configured using “make xconfig” to obtain the new one for server.
3. Compilation of Kernel involves following steps:
 - a. cd /usr/src/linux-2.5.72
 - b. make clean, make mrproper
 - c. make dep bzImage modules modules_install
 - d. cp arch/i386/boot/bzImage /boot/bzImage-2.5.72
 - e. cp /usr/src/linux-2.5.72/System.map /boot/System.map-2.5.72
 - f. configure lilo.conf/grub file accordingly.
4. Restart the machine.
5. After successful start, activate the TFTP program. To activate TFTP, change “**disable=yes**” to “**disable = no**” in /etc/xinetd.d/tftp file.
6. The Following was added to the /etc/exports file:

```
/tftpboot/ 10.0.0.0/255.255.255.0 (rw, no_subtree_check, no_root_squash)
/tftpboot/remotes/ 10.0.0.0/255.255.255.0 (rw, no_subtree_check,
no_root_squash)
/tftpboot/remotes/node2 10.0.0.0/255.255.255.0 (rw, no_subtree_check,
no_root_squash)
```

.....
.....

Similarly, for other nodes. This file should only be modified on the master node. This file determines which directories will be exported by NFS. This will allow every host to access these directories and will eliminate the need to replicate work on every node.

7 Configure the **/etc/dhcpd.conf** file as following:

```
ddns-update-style ad-hoc;
default-lease-time      21600;
max-lease-time          21600;
option subnet-mask      255.255.255.0;
option broadcast-address 10.0.0.255;
option routers           10.0.0.1;
option domain-name-servers 10.0.0.1;
option domain-name      "beowulf.uml.edu";
option root-path        "/ftpboot/";

shared-network workstatio {
    subnet 10.0.0.0 netmask 255.255.255.0 {
    }
}
subnet 10.0.0.0 netmask 255.255.255.0 {
    range 10.0.0.2 10.0.0.100;
}

group {
    use-host-decl-names on;
    option log-servers 10.0.0.1;
    filename "vmlinuz-2.4.20-cluster";
    server-name "node1.beowulf.uml.edu";

    host node2 { hardware ethernet 00:A0:C9:69:88:60;
                 fixed-address 10.0.0.3; }
    host node3 {.....}

    host node4 {.....}

    host node5 {.....}
    .....
    .....
}

Restart the dhcpd daemon by executing: /etc/rc.d/init.d/dhcpd restart
```

8. change **/etc/hosts** and **/etc/hosts.equiv** according to the machine name.

Diskless Client Set-up Procedure:

1. Create the Following directories
 - a. /tftpboot
 - b. /tftpboot/remotes/
 - c. /tftpboot/remotes/node2
2. In /tftpboot/remotes/node2, copy the following directories
 - a. cp -a /sbin .
 - b. cp -a /bin .
 - c. cp -a /lib .
 - d. cp -a /opt .
 - e. cp -a /etc .
 - f. cp -a /var .
 - g. cp -a /dev .
3. In /tftpboot/remotes/node2,

```
mkdir root
mkdir proc
mkdir tmp
chmod 1777 tmp
```
4. Edit the /tftpboot/remotes/node2/etc/rc.d/rc.sysinit so that there was no file-system check. So, the line that says, “**mount -a -t nonfs, smbfs, ncfs**” was changed to “**mount -a smbfs, ncfs**”.
5. Delete the existing in **/tftpboot/remotes/node2/etc/fstab** and create a new one as follows:

```
node1.beowulf.uml.edu:/tftpboot/remotes/node2 / nfs defaults 0 0
node1.beowulf.uml.edu:/usr /usr nfs defaults 0 0
node1.beowulf.uml.edu:/bin /bin nfs defaults 0 0
node1.beowulf.uml.edu:/lib /lib nfs defaults 0 0
node1.beowulf.uml.edu:/home /home nfs defaults 0 0
none/proc proc defaults 0 0
/dev/cdrom /mnt/cdrom iso9660 ro, user,noauto,exec 0 0
/dev/fd0 /mnt/floppy auto defaults, user, noauto 0 0
devpts /dev/pts devpts gid=5, mode=0620 0 0
```
6. The **hosts file** in /tftpboot/remotes/node2/etc was modified as follows, that will contain the hostname and IP add of all nodes.

```
10.0.0.1 node1.beowulf.uml.edu node1
10.0.0.2 node2.beowulf.uml.edu node2
.....
.....
```

7. The **ifcfg-eth0** file in /tftpboot/remotes/node2/etc/sysconfig/network-script was modified as follows,

```
DEVICE = eth0
BOOTPROTO = static
IPADDR = 10.0.0.3
NETMASK = 255.255.255.0
BROADCAST = 10.0.0.255
NETWORK = 10.0.0.0
GATEWAY = 10.0.0.1
ONBOOT = yes
```

8. The **network** file in /tftpboot/remotes/node2/etc/sysconfig/ was modified as follows.

```
NETWORKING=yes
FORWARD_IPV=false
HOSTNAME=node2.beowulf.uml.edu
DOMAINNAME=uml.edu
GATEWAY=10.0.0.1
```

9. The steps from 1.c) to 9 were repeated for all remaining nodes.
10. Now, create a custom kernel for the Diskless clients. For this, download and execute the latest version of tagging utility software called "mknbi" which represents "make network bootable image". It creates network bootable image of compiled kernel for client nodes. "mknbi" is downloaded from <http://etherboot.sourceforge.net>. We use version 1.06.

Following steps are done.

- a. rpm -ivh mknbi-1.06 noarch.rpm
- b. cd /tftpboot
- c. **mknbi-linux --output =/tftpboot/vmlinuz-2.4-20-cluster **
**--ipaddrs=rom **
--rootdir = /tftpboot/remotes/%s
**--append = "ramdisk_size=1024" **
/usr/src/linux/arch/i386/boot/bzImage-2.4.20custom

11. Download the boot-code from ROM-o-matic. net. To make a bootable floppy on a Linux system, put a formatted floppy in the floppy drive and do:

\$ cat eb-5.1.7-name.zdisk > /dev/fd0 , where "eb-5.1.7-name.zdisk" is where the downloaded ROM image is stored.

12. **RSH** set up for server and client nodes. Following files should be changed in both server and client machines.

- a. `/.rhosts`
- b. `/etc/hosts.equiv`
- c. `/etc/securetty`
- d. `/etc/xinetd.d/rsh, rlogin, rexec`
- e. `/etc/pam.d/rsh, rlogin, rexec`

a. `/.rhosts`

This file should exist in each user's home directory. This file is also required so users can use RSH to connect to each node without supplying a password. A typical `/.rhosts` file for user account looks something like this:

```
.....  
  
merlin  
  
machine1  
  
machine2  
  
node1  
  
node2  
  
node3  
  
node4  
  
.....  
  
.....
```

b. `etc/hosts.equiv`

```
merlin  
  
machine1  
  
node1  
  
node2
```

.....

c. etc/securetty

This file is a list of tty's from which root can log in. This allows for easier administration of the nodes and is highly recommended. Simply add **"rsh", "rexec", and "rlogin"** to the end of the file.

d. etc/pam.d

This directory contains configuration files that effect logins of the various services defined here.

Modify the rsh, rlogin, and rexec files by rearranging the lines to have the line with "rhosts" as the first line and the line with "securetty" as the second line with "required" changed to "sufficient".

An example of these files after modification is given below:

```
auth    sufficient /lib/security/pam_rhosts_auth.so
auth    sufficient /lib/security/pam_securetty.so
auth    sufficient /lib/security/pam_nologin.so
auth    sufficient /lib/security/pam_env.so
account sufficient /lib/security/pam_stack.so service=system-auth
session sufficient /lib/security/pam_stack.so service=system-auth
```

e. etc/xinetd.d

rsh, rlogin, rexec files should be modified by changing "disable=no" to "disable=yes".