

User Mode Linux



Suhas Aggarwal

This document describes User mode Linux. User Mode Linux (UML) is open source software that allows you to run Linux in a “virtual machine” on top of a physical Linux box.

I N S

Hochschule für Technik Rapperswil

Phone : 055 222 42 68

Fax : 055 222 42 68

Index

Part a

1.Introduction.....	1
2.UML set up.....	2
2.1Software needed.....	2
2.2Installation.....	2
3.Initializing a virtual machine using UML.....	2
4.Starting multiple UML instances with different root filesystem images.....	3
5.Starting multiple UML instances with same filesystem image – Copy on write.....	3
6.Using hostfs to access files on the physical host from the virtual machine.....	4
7.Running a script inside UML virtual machine.....	5
8.UML networking.....	6
8.1.Bridging.....	6
8.1.1.Bridging in practice.....	6
8.1.2.UML network set up.....	14
8.1.3Example.....	18
9.Personal statement.....	21
10.References.....	22

Part b

11.UML automation.....	23
12.Client limit test.....	30
13.Client simulation.....	35
14.UML Client Network configuration on INS /HSR network.....	58
15.Execute command on N* uml clients simultaneously.....	82
16.Clock synchronisation for N UML clients.....	89

17.Clock synchronization in UML clients.....	140
18.Simulation of more no. of clients	142
19.An Observation.....	143
20.A Question.....	145
21.Personal Statement.....	146
22.References.....	148
23.Project plan.....	149
24.Meetings.....	151
25.Experience.....	156

List of figures

1)Figure1:User Mode Linux architecture.....	1
2)Figure2:Script running on virtual machine to display system configuration.....	5
3)Figure3:Subnet.....	6
4)Figure4:UML network set up.....	14
5)Figure5:Activity Diagram –Set up N UML clients.....	28
6)Figure6:Activity Diagram – Execute command on N UML clients using while loop.....	86
7)Figure7:Activity Diagram -Execute command on N UML clients simultaneously using cron daemon.	141
8)Figure8:Project progression Gantt chart.....	157

Goals

This work is part of my internship at HSR.I am working on a product called MPP which enables users to buy access to the internet at hotspots. My main job is to implement a software with the help of which we can simulate large no. of clients trying to connect to the landing page .It will help us to do performance analysis of product.

User mode linux is a open source software that allows to run Linux in a “virtual machine” on top of a physical Linux box.It plays a key role in designing the software.With the help of UML ,we can simulate large no. of UML virtual machines trying to connect to landing page.My first task was to do an in depth study of UML and gain knowledge of its essential components.

1. Introduction

User Mode Linux (UML) allows one to run Linux kernels as user mode processes under a host Linux kernel, giving a simple way to run several independent virtual machines on a single piece of physical hardware.

Under UML, each of the virtual machines can run its own selection of software, including different distributions of Linux and different kernels. This gives one the ability to have completely customizable virtual machines that are isolated from each other, and from the host machine.

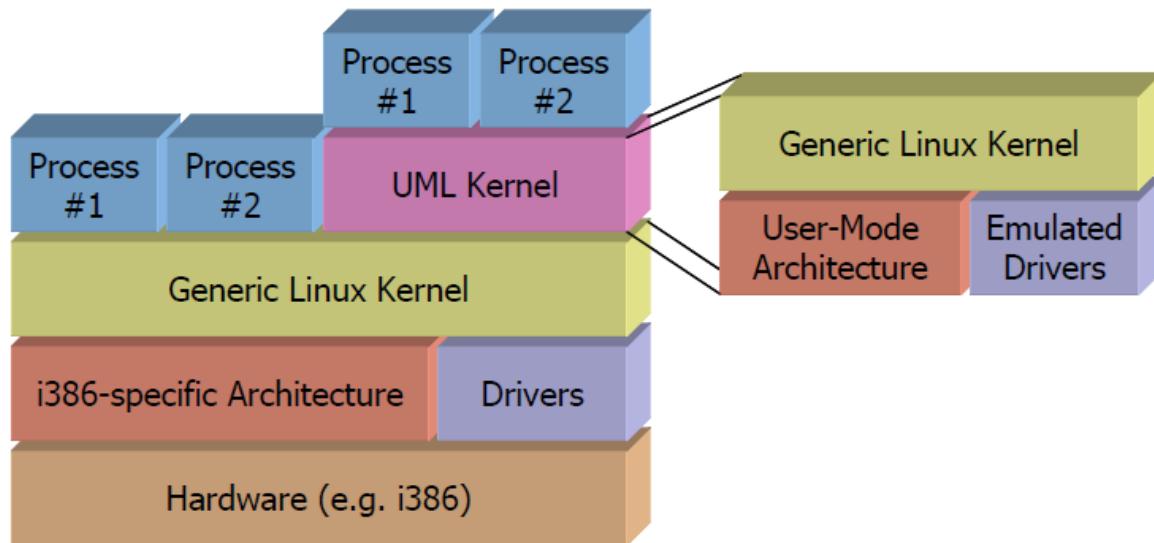


Figure1:User mode linux architecture

A virtual host running with a User-Mode-Linux kernel is just another user process according to figure1 , so that even if the virtual machine crashes, the kernel of the host system is not affected.

2.UML setup

2.1 Software needed

A precompiled UML guest kernel (linux-2.6.24-rc7.bz2) is available at -

<http://user-mode-linux.sourceforge.net/>

Root filesystems (e.g. FedoraCore4-x86-root_fs.bz2, Debian-3.1-x86-root_fs.bz2) are available at -

<http://uml.nagafix.co.uk/filesystems/>

Host System Configuration

OS – Fedora Core 10 (32 bit operating system)

Memory (RAM) – 3GB

2.2 Installation

Download the UML kernel and root filesystem to same working directory.

Uncompress them:

- host% bunzip2 linux-2.6.24-rc7.bz2 FedoraCore5-x86-root_fs.bz2

3.Initializing a virtual machine using UML

- Run UML as follows:

```
host% chmod 755 ./linux-2.6.24-rc7  
host% ./linux-2.6.24-rc7 ubda=FedoraCore4-x86-root_fs mem=128M
```

The `mem` parameter simply specifies the amount of RAM that the virtual machine will have.

The `ubda` parameter in this command is giving the UML kernel the name of a file to use to create the virtual machine's /dev/ubda virtual block device, which will be its root filesystem. The /dev/ubda virtual block device is the first block device of the virtual machine and is analogous to the /dev/hda physical block device of the host Linux system

4. Starting multiple UML instances with different root filesystem images

- host% chmod 755 ./linux-2.6.24-rc7
host% ./linux-2.6.24-rc7 ubda=FedoraCore4-x86-root_fs mem=128M
host% ./linux-2.6.24-rc7 ubda=Debian-3.1-x86-root_fs mem=128M

Two virtual machines are initialized, one running Fedora core 4 root file system and another using Debian root file system .

5. Starting multiple UML instances with same filesystem image – Copy on write

- host% chmod 755 ./linux-2.6.24-rc7
host% ./linux-2.6.24-rc7 ubda=machine1.cow,FedoraCore4-x86-root_fs
mem=128M
host% ./linux-2.6.24-rc7 ubda=machine2.cow,FedoraCore4-x86-root_fs
mem=128M

Imagine that there are several very similar virtual machines. One would like for them to all use the same root file system image, as this would save a lot of space. This is not a good idea, as all of the machines could write to this shared image and cause problems for the other machines. So one would like each virtual machine to have its own file system that it can write to, but this would waste a lot of disk space, since one'd be making separate copies of the file for each machine.

UML solves this problem with a feature called Copy-on-write (COW). The idea is that one can create a virtual block device from two files: one that is read-only and contains all of the shared data, and another that is read-write and stores all of the private changes.

By specifying `ubdb=cowfile,sharedfile` when invoking the UML kernel, one is creating a `/dev/ubdb` device that writes changes to a file called `cowfile`, while using the file `sharedfile` for the much larger shared read-only data.

6.Using hostfs to access files on the physical host from the virtual machine

UML provides a few ways for virtual machines to access files on the physical host. The simplest method is to use hostfs. Running the following command within the guest host makes the entire host file system available as /host in the virtual machine:

- `mount -t hostfs none /host`

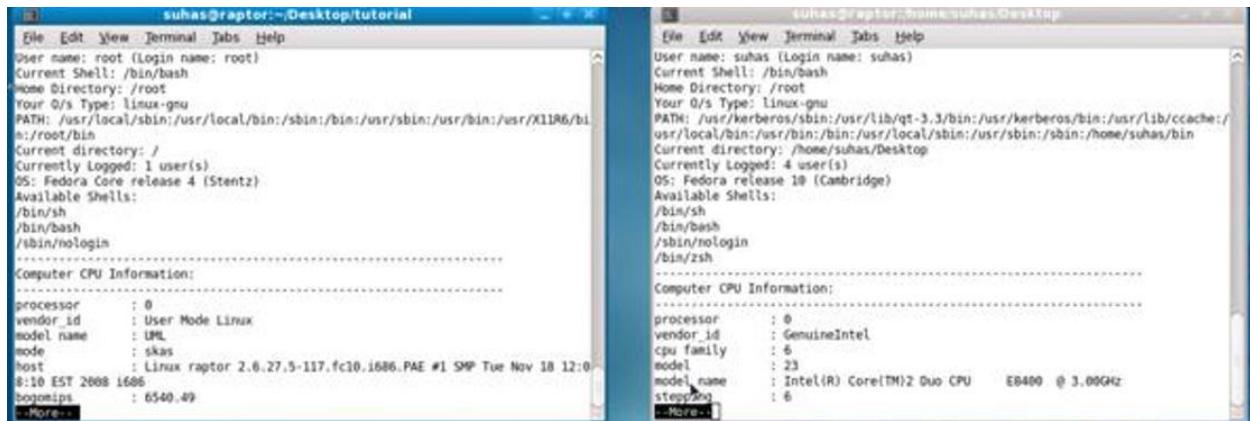
One example that shows how to mount just one particular directory on the host file system.

- `mount -t hostfs none /home/suhas -o /home/suhas`

7. Running a script inside UML virtual machine

Tested scripts -

- 1) Script to display 'Hello world'
- 2) Script to display system configuration



The image shows two side-by-side terminal windows. Both windows have a title bar 'suhas@raptor:~/Desktop/tutorial' and a menu bar 'File Edit View Terminal Tabs Help'. The left window is run as root ('User name: root (Login name: root)') and displays system information for a Fedora Core release 4 (Stentz) system. It includes details like the PATH, current directory, OS, available shells, and CPU information for a processor with vendor ID 'User Mode Linux', model name 'UML', and host 'Linux raptor 2.6.27.5-117.fc10.i686.PAE #1 SMP Tue Nov 18 12:08:10 EST 2008 i686'. The right window is run as suhas ('User name: suhas (Login name: suhas)') and displays information for a Fedora release 10 (Cambridge) system. It shows a similar structure with a different processor (Intel(R) Core(TM)2 Duo CPU E8400 @ 3.00GHz).

```
suhas@raptor:~/Desktop/tutorial
File Edit View Terminal Tabs Help
User name: root (Login name: root)
Current Shell: /bin/bash
Home Directory: /root
Your O/S Type: linux-gnu
PATH: /usr/local/sbin:/usr/local/bin:/sbin:/bin:/usr/sbin:/usr/bin:/usr/X11R6/bl
n:/root/bin
Current directory: /
Currently Logged: 1 user(s).
OS: Fedora Core release 4 (Stentz)
Available Shells:
/bin/sh
/bin/bash
/sbin/nologin
-----
Computer CPU Information:
processor : 0
vendor_id : User Mode Linux
model_name : UML
model : skas
host : Linux raptor 2.6.27.5-117.fc10.i686.PAE #1 SMP Tue Nov 18 12:08:10 EST 2008 i686
bogomips : 6540.49
-More...-
```

```
suhas@raptor:~/Desktop/tutorial
File Edit View Terminal Tabs Help
User name: suhas (Login name: suhas)
Current Shell: /bin/bash
Home Directory: /root
Your O/S Type: Linux-gnu
PATH: /usr/kerberos/sbin:/usr/lib/qt-3.3/bin:/usr/kerberos/bin:/usr/lib/ccache:/usr/local/bin:/usr/bin:/bin:/usr/local/sbin:/usr/sbin:/home/suhas/bin
Current directory: /home/suhas/Desktop
Currently Logged: 4 user(s)
OS: Fedora release 10 (Cambridge)
Available Shells:
/bin/sh
/bin/bash
/sbin/nologin
/bin/zsh
-----
Computer CPU Information:
processor : 0
vendor_id : GenuineIntel
cpu family : 6
model : 23
model_name : Intel(R) Core(TM)2 Duo CPU E8400 @ 3.00GHz
stepping : 6
-More...-
```

Figure2: Script running on virtual machine to display system configuration

8. UML Networking

8.1. Bridging

With bridging, the TUN/TAP device used by the UML instance is combined with the host's physical Ethernet device into a sort of virtual switch. The bridge interface forwards Ethernet frames from one interface to another based on their destination MAC addresses. This effectively merges the broadcast domains associated with the bridged interfaces.

8.1.1. Bridging in Practice

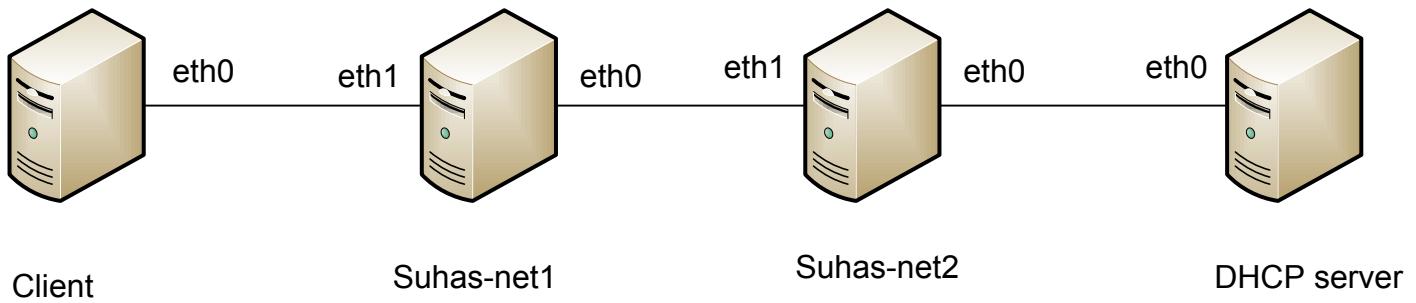


Figure3: Subnet

Bridging

Suhas net -1

Interfaces eth0 and eth1 attached to the bridge.

- 1) ip link set eth0 up
- 2) ip link set eth1 up
- 3) brctl addbr br0
- 4) ip link set br0 up
- 5) brctl addif br0 eth0
- 6) brctl addif br0 eth1

Suhas net -2

Interfaces eth0 and eth1 attached to the bridge

- 1) ip link set eth0 up
- 2) ip link set eth1 up
- 3) brctl addbr br0
- 4) ip link set br0 up
- 5) brctl addif br0 eth0
- 6) brctl addif br0 eth1

Configuration details

- 1) ip link set eth0 up, ip link set eth1 up : **Interfaces eth0 and eth1 are activated.**
- 2) brctl addbr br0 : **Then, we make bridge and call it br0.** This creates a bridge with nothing connected to it.
- 3) ip link set br0 up : **Bridge is activated.**
- 4) brctl addif br0 eth0, brctl addif br0 eth1 : **Finally, we add eth0 and eth1 to the bridge.**

1) Suhas client requests ip address from DHCP server (suhas-DHCP)

Clients initial configuration-



```
File Edit View Terminal Tabs Help
suhas@suhas-client:~$ su
Password:
suhas-client:/home/suhas# ifconfig
lo      Link encap:Local Loopback
        inet addr:127.0.0.1 Mask:255.0.0.0
        inet6 addr: ::1/128 Scope:Host
              UP LOOPBACK RUNNING MTU:16436 Metric:1
              RX packets:144 errors:0 dropped:0 overruns:0 frame:0
              TX packets:144 errors:0 dropped:0 overruns:0 carrier:0
              collisions:0 txqueuelen:0
              RX bytes:10960 (10.7 KiB) TX bytes:10960 (10.7 KiB)

suhas-client:/home/suhas#
```

DHCP server running on suhas-DCHP.

DHCP configuration file –

The configuration file for DHCP server is */etc/dhcp3/dhcpd.conf*.

```
ddns-update-style none;

option domain-name-servers 145.253.2.75, 193.174.32.18;

default-lease-time 86400;
max-lease-time 604800;

authoritative;

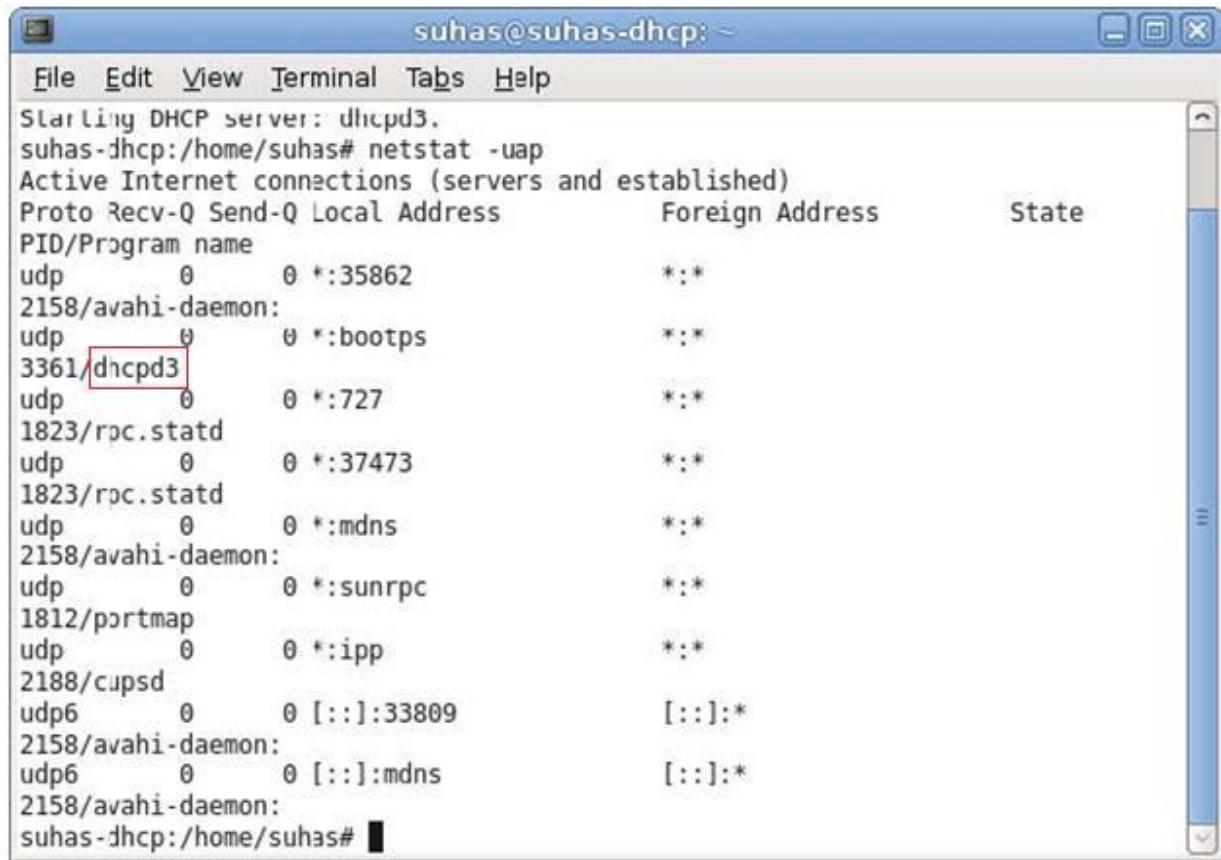
subnet 192.168.0.0 netmask 255.255.255.0 {
    range 192.168.0.200 192.168.0.229;
    option subnet-mask 255.255.255.0;
    option broadcast-address 192.168.0.255;
    option routers 192.168.0.1;
}
```

Configuration options

- `option domain-name-servers`: This tells the DHCP server which DNS servers it should assign to a client. You can specify more than one DNS server here, separated by commas.
- `default-lease-time`, `max-lease-time`: A client can tell the DHCP server for how long it would like to get an IP address. If it doesn't do this, the server assigns an IP address for *default-lease-time* seconds; if it does, the server grants the requested time, but only up to *max-lease-time* seconds.
- `authoritative`: If this is not set this means that if a client requests an address that the server knows nothing about and the address is incorrect for that network segment, the server will not send a DHCPNAK (which tells the client it should stop using the address.) We don't want this so we set *authoritative*.
- `subnet`: The subnet to use.
- `netmask`: The netmask to use.
- `range`: Tells the DHCP server from which range it can assign IP addresses to clients. In our setup it's from `192.168.0.200` to `192.168.0.229` (30 IP addresses).
- `option broadcast-address`: The broadcast address to use.
- `option routers`: Tells the DHCP server the gateway address it should assign to requesting clients. In our scenario the gateway is `192.168.0.1`.

DHCP server running on suhas-DHCP.

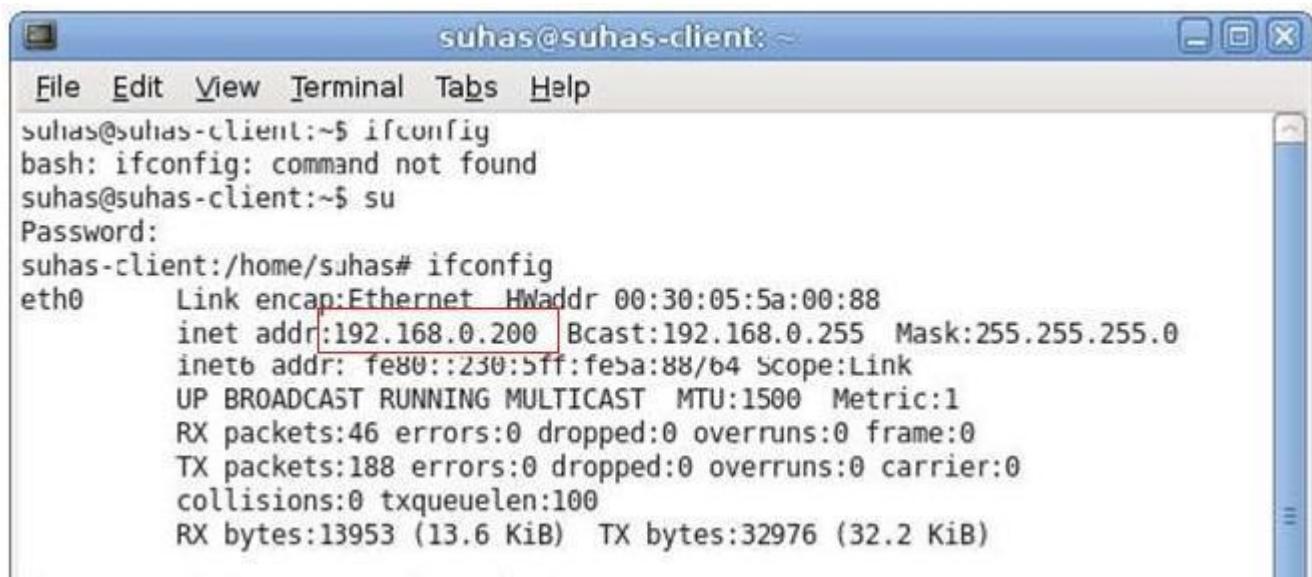
Output of ps -aux displaying processes with process IDs-



```
Starting DHCP server: dhcpcd3.
suhas-dhcp:/home/suhas# netstat -uap
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
PID/Program name
udp        0      0 *:35862                  *:*
2158/avahi-daemon:
udp        0      0 *:bootps                *:*
3361/dhcpcd3
udp        0      0 *:727                  *:*
1823/rpc.statd
udp        0      0 *:37473                *:*
1823/rpc.statd
udp        0      0 *:mdns                 *:*
2158/avahi-daemon:
udp        0      0 *:sunrpc                *:*
1812/portmap
udp        0      0 *:ipp                  *:*
2188/cupsd
udp6       0      0 [::]:33809              [::]:*
2158/avahi-daemon:
udp6       0      0 [::]:mdns               [::]:*
2158/avahi-daemon:
suhas-dhcp:/home/suhas#
```

dhcpcd3 process is running.

Client gets ip address from DHCP server.



```
File Edit View Terminal Tabs Help
suhas@suhas-client:~$ ifconfig
bash: ifconfig: command not found
suhas@suhas-client:~$ su
Password:
suhas-client:/home/suhas# ifconfig
eth0      Link encap:Ethernet HWaddr 00:30:05:5a:00:88
          inet addr:192.168.0.200 Bcast:192.168.0.255 Mask:255.255.255.0
          inet6 addr: fe80::230:5ff:fe5a:88/b4 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:46 errors:0 dropped:0 overruns:0 frame:0
          TX packets:188 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:100
          RX bytes:13953 (13.6 KiB) TX bytes:32976 (32.2 KiB)
```

IP address 192.168.0.200 is allocated to client from IP address range.

DHCP lease file on suhas-DHCP is located at /var/lib/dhcp3/dhcpd.leases

```
File Edit View Terminal Tabs Help
Sudo: suhas-DHCP:~
```

```
lease 192.168.0.238 {
    starts 2 2009/04/07 11:24:03;
    ends 3 2009/04/08 11:24:03;
    tstp 3 2009/04/08 11:24:03;
    cltt 2 2009/04/07 11:24:03;
    binding state active;
    next binding state free;
    hardware ethernet 00:30:05:5a:00:d9;
    uid "001,00000,0052,0001,331";
    client-hostname "ws2183c-06";
}
lease 192.168.0.231 {
    starts 2 2009/04/07 11:24:04;
    ends 3 2009/04/08 11:24:04;
    tstp 3 2009/04/08 11:24:04;
    cltt 2 2009/04/07 11:24:04;
    binding state active;
    next binding state free;
    hardware ethernet 00:30:05:5a:00:d9;
    uid "001,00000,0052,0001,331";
    client-hostname "ws2183c-07";
}
lease 192.168.0.230 {
    starts 2 2009/04/07 16:04:50;
    ends 3 2009/04/08 16:04:50;
    cltt 2 2009/04/07 16:04:50;
    binding state active;
    next binding state free;
    hardware ethernet 00:30:05:5a:00:80;
}
lease 192.168.0.206 {
    starts 2 2009/04/07 16:04:50;
    ends 3 2009/04/08 16:05:25;
    cltt 2 2009/04/07 16:05:25;
    binding state free;
    hardware ethernet 00:30:05:5a:00:80;
}
lease 192.168.0.200 {
    starts 2 2009/04/07 16:06:31;
    ends 3 2009/04/08 16:06:31;
    cltt 2 2009/04/07 16:06:31;
    binding state active;
    next binding state free;
    hardware ethernet 00:30:05:5a:00:80;
}
lease 192.168.0.209 {
    starts 2 2009/04/07 16:06:38;
    ends 3 2009/04/08 16:06:38;
    cltt 2 2009/04/07 16:06:38;
    binding state active;
    next binding state free;
    hardware ethernet 00:30:05:5a:00:80;
```

Entry for the client in DHCP server lease file.

starts and ends field in the lease file indicates the duration for which lease is granted –here it is 24 hours.

8.1.2. UML Network set up

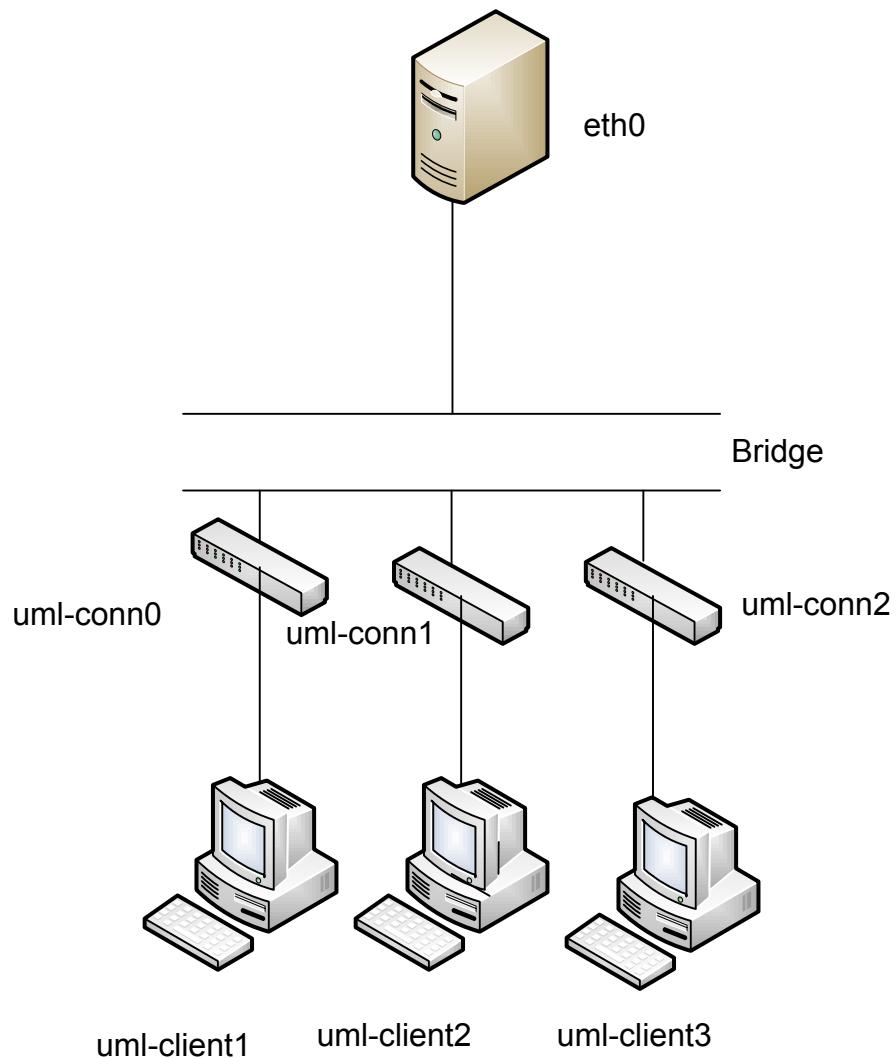


Figure4: UML network setup

Configuration

```
1)ip link set eth0 up  
2)brctl addbr uml-bridge  
3)brctl setfd uml-bridge 0  
4)brctl sethello uml-bridge 0  
5)brctl stp uml-bridge off  
6)ip link set uml-bridge up  
7)brctl addif uml-bridge eth0  
8)tunctl -t uml-conn0  
9)ip link set uml-conn0 up  
10)brctl addif uml-bridge uml-conn0  
11)tunctl -t uml-conn1  
12)ip link set uml-conn1 up  
13)brctl addif uml-bridge uml-conn1  
14)tunctl -t uml-conn2  
15)ip link set uml-conn2 up  
16)brctl addif uml-bridge uml-conn2
```

Configuration

- 1) ip link set eth0 up: Interfaces eth0 is activated.
- 2) brctl addbr uml-bridge: We make a bridge called uml-bridge.
- 3) brctl setfd uml-bridge 0: Set the forwarding delay to 0 seconds.
- 4) brctl sethello uml-bridge 0: How often STP "hello" packets with information on the bridged topology are sent.
- 5) brctl stp uml-bridge off: Turn off spanning tree protocol.
- 6) ip link set uml-bridge up: Bridge interface is activated.
- 7) brctl addif uml-bridge eth0: eth0 is added to the bridge.
- 8) tunctl -t uml-conn0: tun device ,uml-conn0 corresponding to uml client1 is created.
- 9) ip link set uml-conn0 up: uml-conn0 interface is activated.
- 10) brctl addif uml-bridge uml-conn0: uml-conn0 is added to the bridge.
- 11) tunctl -t uml-conn1: tun device ,uml-conn1 corresponding to uml client2 is created
- 12) ip link set uml-conn1 up: uml-conn1 interface is activated.
- 13) brctl addif uml-bridge uml-conn1: uml-conn1 is added to the bridge.
- 14) tunctl -t uml-conn2: tun device ,uml-conn2 corresponding to uml client3 is created
- 15) ip link set uml-conn2 up: uml-conn2 interface is activated.
- 16) brctl addif uml-bridge uml-conn2: uml-conn2 is added to the bridge.

Output of ip link list –

Displays interfaces which are active on the system.

```
suhas-client:/home/suhas# ip link list
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue state UNKNOWN
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 100
    link/ether 00:30:05:5a:00:88 brd ff:ff:ff:ff:ff:ff
3: uml-bridge: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UNKNOWN
    link/ether 00:30:05:5a:00:88 brd ff:ff:ff:ff:ff:ff
4: uml-conn0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UNKNOWN qlen 500
    link/ether 00:ff:b3:84:da:49 brd ff:ff:ff:ff:ff:ff
5: uml-conn1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UNKNOWN qlen 500
    link/ether 00:ff:10:06:b8:1e brd ff:ff:ff:ff:ff:ff
6: uml-conn2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UNKNOWN qlen 500
    link/ether 00:ff:09:48:c9:d4 brd ff:ff:ff:ff:ff:ff
suhas-client:/home/suhas#
```

8.1.3. Example

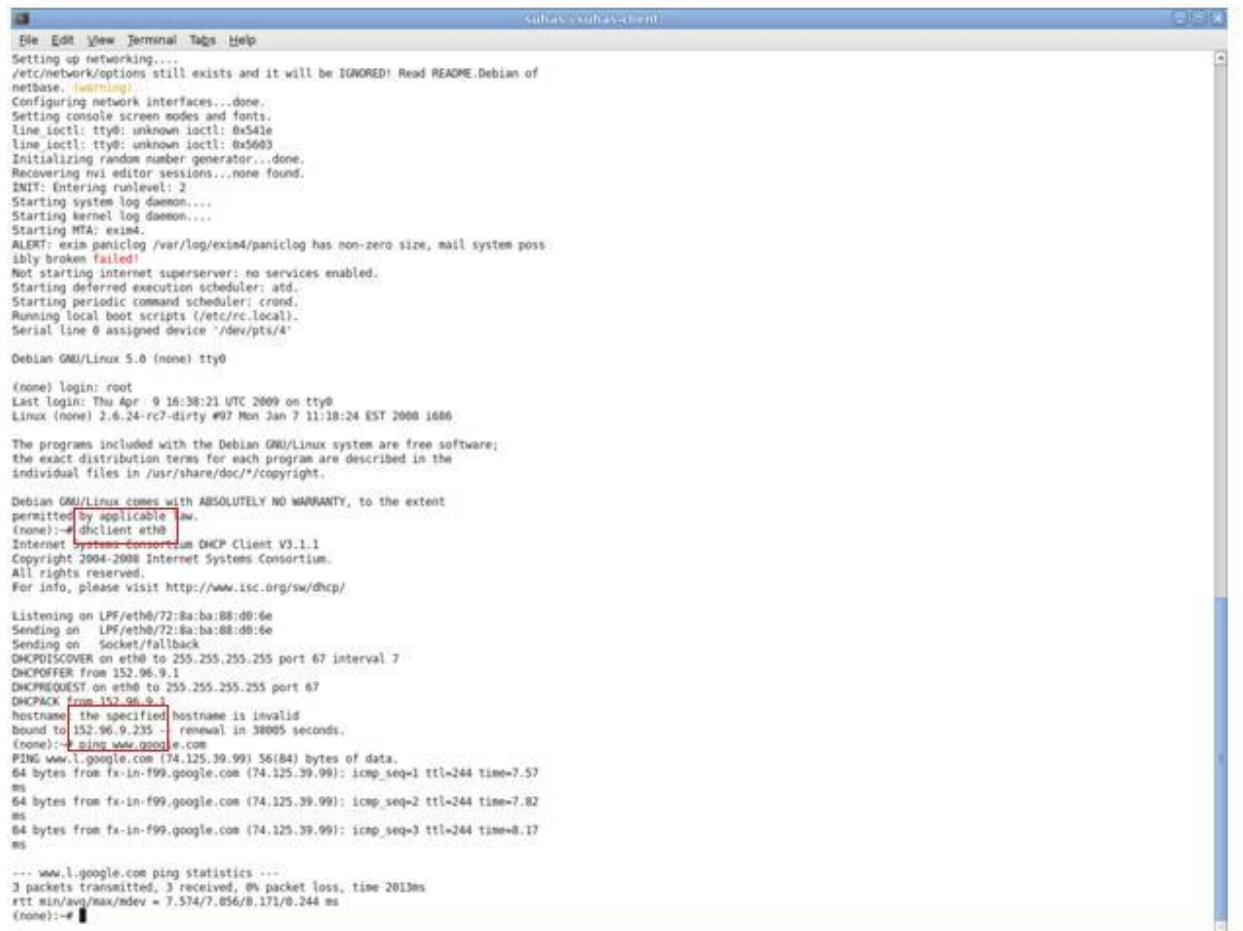
Host hosting 3 uml clients.

Host is running Debian Linux 5.0.

UML clients are using Debian 4.0 x86 root filesystem.

UML clients are configured by DHCP server on the network.

Client 1



```
Setting up networking...
/etc/network/options still exists and it will be IGNORED! Read README.Debian of
netbase. [warning]
Configuring network interfaces...done.
Setting console screen modes and fonts.
line ioctl: tty0: unknown ioctl: 0x541e
line ioctl: tty0: unknown ioctl: 0x5603
Initializing random number generator...done.
Recovering rvi editor sessions...none found.
INIT: Entering runlevel: 2
Starting system log daemon...
Starting kernel log daemon...
Starting MTA: exim4.
ALERT: exim paniclog /var/log/exim4/paniclog has non-zero size, mail system poss-
ibly broken [failed].
Not starting internet superserver: no services enabled.
Starting deferred execution scheduler: atd.
Starting periodic command scheduler: cron.
Running local boot scripts (/etc/rc.local).
Serial line 0 assigned device '/dev/pts/4'

Debian GNU/Linux 5.0 (none) tty0

(none): login: root
Last login: Thu Apr  9 16:38:21 UTC 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan  7 11:18:24 EST 2008 i686.

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
(none):~# dhclient eth0
Internet Systems Consortium DHCP Client V3.1.1
Copyright 2004-2008 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/72:8a:ba:88:d9:6e
Sending on  LPF/eth0/72:8a:ba:88:d9:6e
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 7
DHCPoffer from 152.96.9.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.9.1
hostname: the specified hostname is invalid
bound to 152.96.9.235 -- renewal in 30005 seconds.
(none):~# ping www.google.com
PING www.l.google.com (74.125.39.99) 56(84) bytes of data.
64 bytes from fx-in-f99.google.com (74.125.39.99): icmp_seq=1 ttl=244 time=7.57 ms
64 bytes from fx-in-f99.google.com (74.125.39.99): icmp_seq=2 ttl=244 time=7.82 ms
64 bytes from fx-in-f99.google.com (74.125.39.99): icmp_seq=3 ttl=244 time=8.17 ms
...
--- www.l.google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2013ms
rtt min/avg/max/mdev = 7.574/7.856/8.171/0.244 ms
(none):~#
```

UML client 1 gets ip address 152.96.9.235 from DCHP server and is able to access internet.

Client 2

```
File Edit View Terminal Tags Help
       Sabay Sabay-client
iby Broken failed!
Not starting internet superserver: no services enabled.
Starting deferred execution scheduler: atd.
Starting periodic command scheduler: cron.
Running local boot scripts (/etc/rc.local).
Serial line 0 assigned device '/dev/pts/2'

Debian GNU/Linux 5.0 (none) tty0

(none): login: root
Last login: Mon Apr 13 15:33:59 UTC 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686.

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
(none):~# dhclient eth0
Internet [redacted] DHCP Client V3.1.1
Copyright 2004-2008 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0@e:7c:32:7b:59:06
Sending on LPF/eth0@e:7c:32:7b:59:06
Sending on Socket/fallback
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPNAK from 152.96.9.1
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 6
DHCPoffer from 152.96.9.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.9.1
hostname: [redacted] hostname is invalid
bound to 152.96.9.237 -- renewal in 39168 seconds...
(none):~# ping -c 1 www.google.com
PING www.google.com (74.125.39.147) 56(84) bytes of data.
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=1 ttl=244 time=0.1
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=2 ttl=244 time=7.5
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=3 ttl=244 time=7.7
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=4 ttl=244 time=7.5
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=5 ttl=244 time=7.6
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=6 ttl=244 time=7.9
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=7 ttl=244 time=8.2
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=8 ttl=244 time=7.7
  ms
64 bytes from fx-in-f147.google.com (74.125.39.147): icmp_seq=9 ttl=244 time=7.9
  ms
2 ms

--- www.google.com ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 8098ms
rtt min/avg/max/mdev = 7.543/7.948/9.112/0.469 ms
(none):~#
```

UML client 2 gets IP address 152.96.9.237 from DHCP server and is able to access internet.

Client 3

```
(none):~# login: root
Last login: Mon Apr 13 15:35:23 UTC 2009 on ttyB
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
(none):~# dhclient eth0
Internet (none):~# dhclient eth0
dhclient: Using DHCP Client V3.1.1
Copyright 2004-2008 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/
Listening on LPF/eth0:da:65:ac:e7:96:6c
Sending on  LPF/eth0:da:65:ac:e7:96:6c
Sending on  Socket/fallback
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPMAX from 152.96.9.1
DHCPDISCOVER from 152.96.9.1
DHCPOffer from 152.96.9.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.9.1
hostname: the specified hostname is invalid
bound to 152.96.9.238 - renewal in 41511 seconds.
(none):~# ifconfig
eth0    Link encap:Ethernet  HWaddr da:65:ac:e7:96:6c
        inet addr:152.96.9.238  Bcast:152.96.9.255  Mask:255.255.255.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:24 errors:0 dropped:0 overruns:0 frame:0
        TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:3964 (2.9 Kib)  TX bytes:1026 (1.0 Kib)
        Interrupt:5

(none):~# ping www.yahoo.com
PING www.real.wal.b.yahoo.com (87.248.113.14) 56(84) bytes of data.
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=1 ttl=51 time
e=38.3 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=2 ttl=51 time
e=37.8 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=3 ttl=51 time
e=37.9 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=4 ttl=51 time
e=37.9 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=5 ttl=51 time
e=37.8 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=6 ttl=51 time
e=38.1 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=7 ttl=51 time
e=37.9 ms
64 bytes from fl.us.www.vip.ird.yahoo.com (87.248.113.14): icmp_seq=8 ttl=51 time
e=37.7 ms
--- www.real.wal.b.yahoo.com ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7087ms
rtt min/avg/max/mdev = 37.764/37.988/38.303/0.288 ms
(none):~#
```

UML client 3 gets IP address 152.96.9.238 from DHCP server and is able to access internet.

9.Personal statement

I divided my work into different phases-

- 1)Collecting resources on UML.
- 2)Do a study of resources obtained.

3)Do a step by step implementation of different aspects related to UML,involved installation,running UML,running multiple UML clients with different file system image,running multiple UML clients with same file system image using Copy on write ,running scripts on UML,set up UML networking.

While ,study of most aspects of UML was smooth ,UML networking involved more troubleshooting and analysis.My task was to set up UML clients using DHCP sever.This part involved setting up a bridge.I did a of concept by simulating a practical scenario. After that,I implemented the concept in UML.

First ,I tried the implementation on Fedora core 10.I got stuck in a problem that Uml clients were not able to locate DHCP server.I searched ,came across issues that there can be some problems with network manager.I tried disabling network manager ,but still I got the same problem.

I tried the configuration in Debian linux 5.0,configuration worked fine.

This work was carried on from 14/3/2009 – 30/4/2009

10. References

- 1) UML project page -<http://user-mode-linux.sourceforge.net/>
- 2) Documentation : <http://user-mode-linux.sourceforge.net/old/UserModeLinux-HOWTO.html>
- 3) Linux.com : How to run linux inside linux using UML
- 4) The UML book (c) Jeff Dike - Chapter 7 – UML networking in Depth
- 5) http://www.howtoforge.com/dhcp_server_linux_debian_sarge
- 6) Bridging tutorial- <http://edeca.net/articles/bridging/index.html>
- 7) DFN 2005 Paper: Advanced Simulation under User-Mode Linux

11.UML automation

1)UML start script

```
#!/bin/sh
# start N UML instances on Debian 5.0

UML_EXEC="/home/suhas/Desktop/uml"
UML_DIR="/home/suhas/Desktop/uml/Debian-4.0-x86-root_fs"
MEMORY="16MB"

cd $UML_EXEC

#start UML instance in a separate screen started by screen command
#UMLs are accessible by screen -R H$i

start_instance() {

screen -S H$i -d -m ./linux-2.6.24-rc7 ubd0=$i.cow,$UML_DIR mem=$MEMORY
eth0=tuntap,uml-conn$i &

}

start.uml() {

    i=1
    while [ $i -lt 50 ]
    do
        start_instance $i
        i=`expr $i + 1`
        done
}

start.uml
```

2)login script

```
#!/bin/sh
# Login to UML instances

login() {

    i=1
    while [ $i -lt 50 ]
    do
        screen -S H$i -p 0 -X eval 'stuff root\012'
        i=`expr $i + 1`
    done
}

login
```

3)Network_configuration script

```
#!/bin/sh
# Configure Network interface for UML

ip link set eth0 up
brctl addbr uml-bridge
brctl setfd uml-bridge 0
brctl sethello uml-bridge 0
brctl stp uml-bridge off
ip link set uml-bridge up
brctl addif uml-bridge eth0

i=1
while [ $i -lt 50 ]
do
    tunctl -t uml-conn$i
    ip link set uml-conn$i up
    brctl addif uml-bridge uml-conn$i
    i=`expr $i + 1`
done
```

4)start_network script

```
#!/bin/sh
#UML clients get ip address from DHCP server

start_network() {

    i=1
    while [ $i -lt 50 ]
    do
        screen -S H$i -p 0 -X eval 'stuff dhclient\012'
        i=`expr $i + 1`
    done

}

start_network
```

5)Transferring file stored in host to UML Clients

```
#!/bin/sh

change_directory() {

    i=1
    while [ $i -lt 50 ]
    do
        screen -S H$i -p 0 -X eval 'stuff cd\040/\012'
        i=`expr $i + 1`
    done

}

create_directory1() {

    i=1
    while [ $i -lt 50 ]
    do
        screen -S H$i -p 0 -X eval 'stuff mkdir\040host\012'
        i=`expr $i + 1`
    done

}

mount_directory() {

    i=1
    while [ $i -lt 50 ]
    do
        screen -S H$i -p 0 -X eval 'stuff mount\040-
t\040hostfs\040none\040/host\012'
        i=`expr $i + 1`
    done

}

change_directory
create_directory1
mount_directory
```

6)Script scheduling using cron daemon

```
#!/bin/sh
#Using cron daemon to schedule script on UML clients

set_crontab() {

    i=1
    while [ $i -lt 50 ]
    do
        screen -S H$i -p 0 -X eval 'stuff
crontab\040/host/home/suhas/Desktop/cron.txt\012'
        i=`expr $i + 1`
    done

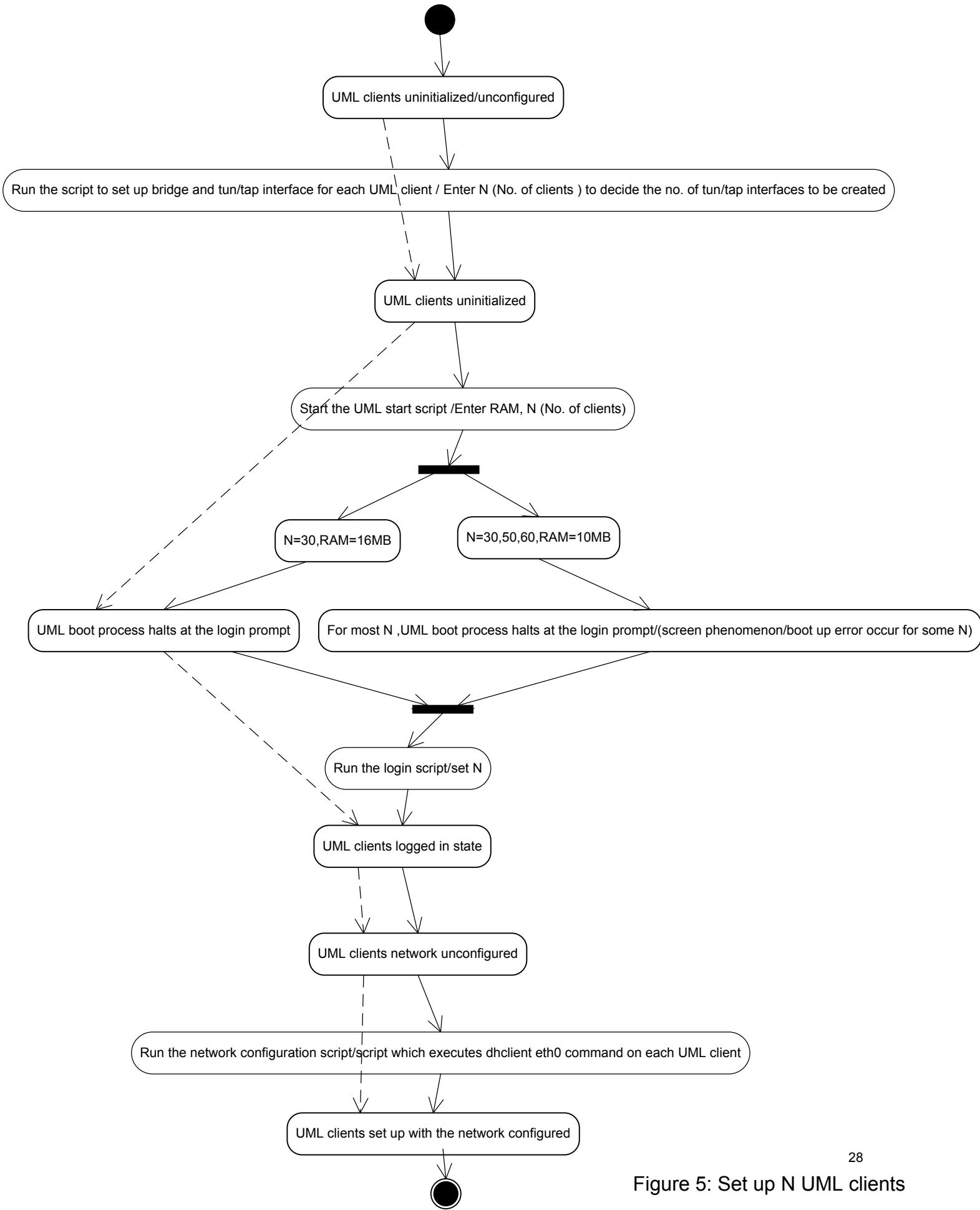
}

set_crontab
```

7)Cron file – cron.txt

```
0 10 * * * /host/home/suhas/Desktop/script
```

Set up N UML clients



Client Access interface -

Access ith UML Client -

```
screen -R H$i
```

Execute command on ith UML client -

```
screen -S H$i -p 0 -X eval 'stuff command\012'
```

Client scrolling scheme –

Following method can be used to scroll through N UML clients with minimal effort –

1) Execute screen -R H\$i on the bash prompt to access ith UML client.

2) Press Ctrl A then followed by D to detach the screen and return to the command prompt.

3) Press the up arrow to get previous command executed (to save typing string ‘screen -R H\$i’ again, change \$i on the prompt and press Enter to access the ith UML client.

This method is particularly useful for performing Client limit test described in the next section as one have to navigate through large no. of UML clients.

All the UML experiments described in the later sections of the document used following Configuration –

Host system – Debian Lenny 5.0

UML clients are using Debian 4.0 x86 root filesystem.

12. Client limit test

1) Vary RAM allocated to each UML client and check no. of clients getting initialized with the start script

a) Minimum no. of clients being tried to initialize with the start script - 15

Ram size (RAM allocated by the program to each UML CLIENT) - 8MB

No. of UML clients tried	System RAM (occupied by UML CLIENTS(IN MB))	Host system RAM (in GB)	Clients initialized
15	120	1.0 (307 MB occupied)	<<15(*some screen phenomenon's/boot up error)
30	240		
60	480		

8MB RAM allocated to each UML Client was insufficient to start 15 UML clients with the help of start script.

b) Minimum no. of clients being tried to initialize with the start script - 15

Ram size (RAM allocated by the program to each UML CLIENT) - 16MB

No. of UML clients tried	System RAM (occupied by UML CLIENTS (in MB))	Host system RAM (in GB)	Clients initialized
15	240	1.0 (307 MB occupied)	15
30	480		30
60	960		<<60 (some screen phenomenon's)

16MB RAM allocated to each UML Client was sufficient to start 15 UML clients with the help of start script.

c)Minimum no. of clients being tried to initialized with the start script - 15

Ram size (RAM allocated by the program to each UML CLIENT) - 32MB

No. of UML clients tried	System RAM (occupied by UML CLIENTS (in MB))	Host system RAM (in GB)	Clients initialized
15	480	1.0 (307 MB occupied)	15
30	960		30
60	1920		Few clients initialized

32MB RAM allocated to each UML Client was sufficient to start 15 UML clients with the help of start script

2)Find minimum RAM parameter size in script needed to start 15 UML CLIENTS

RAM parameter size needed to start 15 UML clients with start script >8MB

RAM parameter size needed to start 15 UML clients with start script <=16MB

a)

RAM size (in MB)	No. of Clients tried	Clients initialized
9	15	<15 (screen phenomenon's/boot up error)
10	15	15
11	15	15

Ideal RAM - 10MB,11MB

b)Increase the no. of clients to test the limit

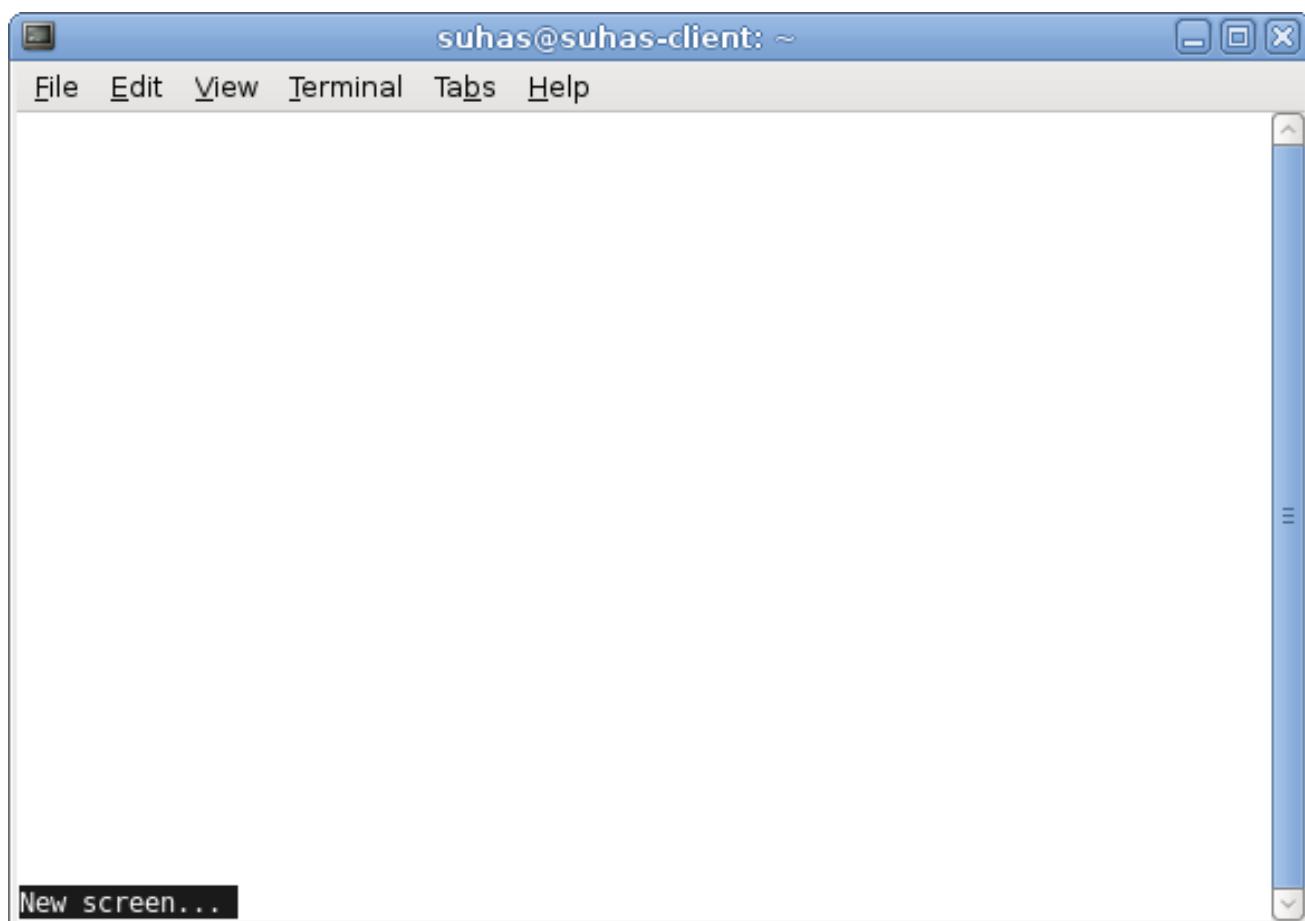
RAM size (in MB)	No. of clients tried	Clients initialized	System RAM occupied by clients(in MB)	Host system RAM (in GB)
10	60	~60 (Some screen phenomenon's/boot up error)	600	1.0 (307MB occupied)
11	60	<60 (More screen phenomenon as compared to above)	660	

*Screen phenomenon –

When trying to start UML clients with start script ,screen phenomenon occurs ,few no. of clients are getting initialized than desired.

When trying to access ith Uml client by -
screen -R H\$*i*

A new screen starts by screen command ,UML process is not loaded on the screen .



The lagging part is that script should be able to start ith screen in which command to start UML client is getting executed.,but UML boot process should be shown interrupted due to reason such as insufficient host system memory

*Boot up error -



The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window has a blue header bar with the title and standard window controls. Below the header is a menu bar with "File", "Edit", "View", "Terminal", "Tabs", and "Help". The main area of the terminal contains the following text:

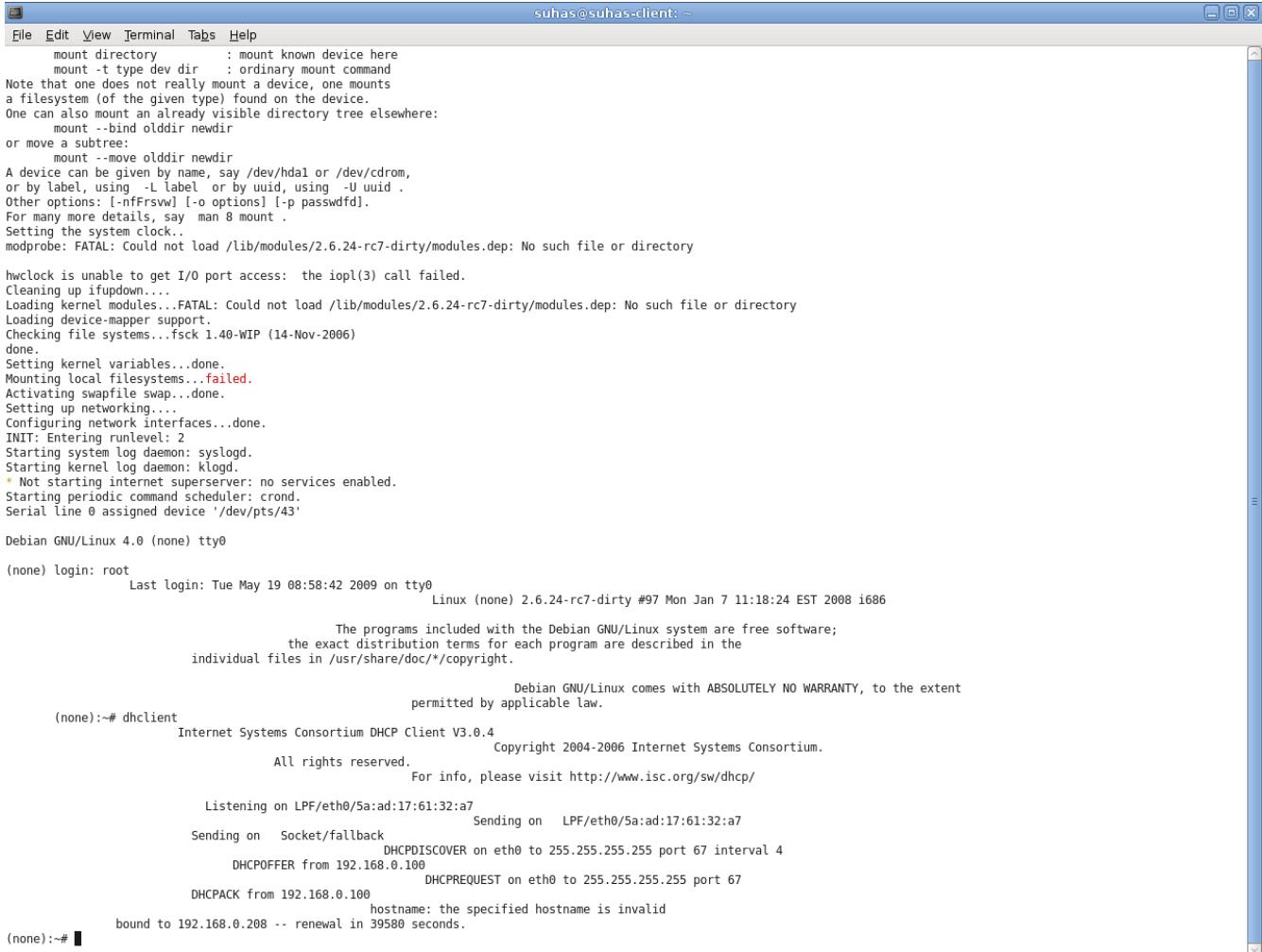
```
Core dump limits :  
soft - 0  
hard - NONE  
Checking that ptrace can change system call numbers...OK  
Checking syscall emulation patch for ptrace...OK  
Checking advanced syscall emulation patch for ptrace...OK  
Checking for tmpfs mount on /dev/shm...OK  
Checking PROT_EXEC mmap in /dev/shm/...OK  
Checking for the skas3 patch in the host:  
- /proc/mm...not found: No such file or directory  
- PTRACE_FAULTINFO...not found  
- PTRACE_LDT...not found  
UML running in SKAS0 mode  
Adding 22970368 bytes to physical memory to account for exec-shield gap  
root
```

UML boot process hangs.

13.Client simulation

1)30 Clients

Ram parameter size in UML start script – 16 MB



```
suhas@suhas-client: ~
File Edit View Terminal Tabs Help
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/43'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/5a:ad:17:61:32:a7
Sending on  LPF/eth0/5a:ad:17:61:32:a7
Sending on  Socket/fallback
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 4
DHCPoffer from 192.168.0.100
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.100
hostname: the specified hostname is invalid
bound to 192.168.0.208 -- renewal in 39580 seconds.

(none):~#
```

```

File Edit View Terminal Tabs Help
mount directory      : mount known device here
mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/32'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/02:6b:0a:ac:00:5e
Sending on   LPF/eth0/02:6b:0a:ac:00:5e
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 6
DHCPOffer from 192.168.0.100
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.100
        hostname: the specified hostname is invalid
        bound to 192.168.0.223 -- renewal in 36863 seconds.

(none):~# 

```

2

```

File Edit View Terminal Tabs Help suhas@suhas-client: ~
mount directory      : mount known device here
mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/38'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0          Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/76:18:91:21:d1
Sending on  LPF/eth0/76:18:91:21:d1
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 3
DHCPoffer from 192.168.0.100
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.100
        hostname: the specified hostname is invalid
        bound to 192.168.0.211 -- renewal in 40916 seconds.

(none):~#

```

3

```

File Edit View Terminal Tabs Help
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/41'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/be:64:fc:bd:71:33
Sending on  LPF/eth0/be:64:fc:bd:71:33
Sending on  Socket/fallback
DHCPOFFER from 192.168.0.100
DHCPREQUEST on eth0 to 255.255.255.255 port 67 interval 3
DHCPACK from 192.168.0.100
        hostname: the specified hostname is invalid
        bound to 192.168.0.201 -- renewal in 35152 seconds.

(none):~# 
```

4

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The terminal displays the following text:

```

File Edit View Terminal Tabs Help
mount directory      : mount known device here
mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/40'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/ce:3b:58:40:4d:5f
Sending on  LPF/eth0/ce:3b:58:40:4d:5f
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 3
DHCPoffer from 192.168.0.100
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 192.168.0.100
        hostname: the specified hostname is invalid
        bound to 192.168.0.213 -- renewal in 32432 seconds.

(none):~#

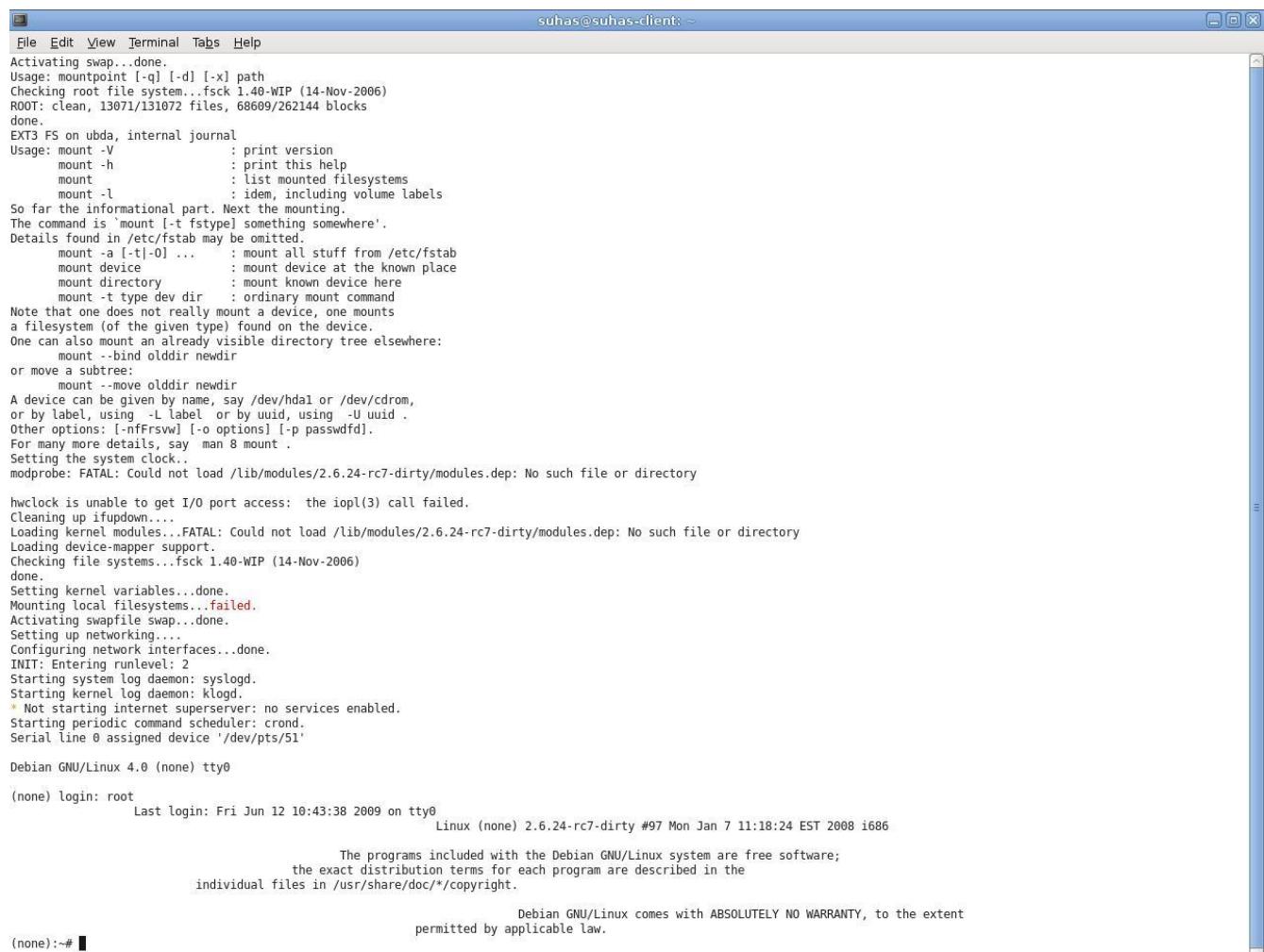
```

27

30 Clients simulated with network configured.

2)50 Clients

Ram parameter size in UML start script – 10MB



```
suhas@suhas-client: ~
File Edit View Terminal Tabs Help
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -t : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/51'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~#
```

Client 15....

```

File Edit View Terminal Tabs Help
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       mount -h : print this help
       mount : list mounted filesystems
       mount -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/56'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

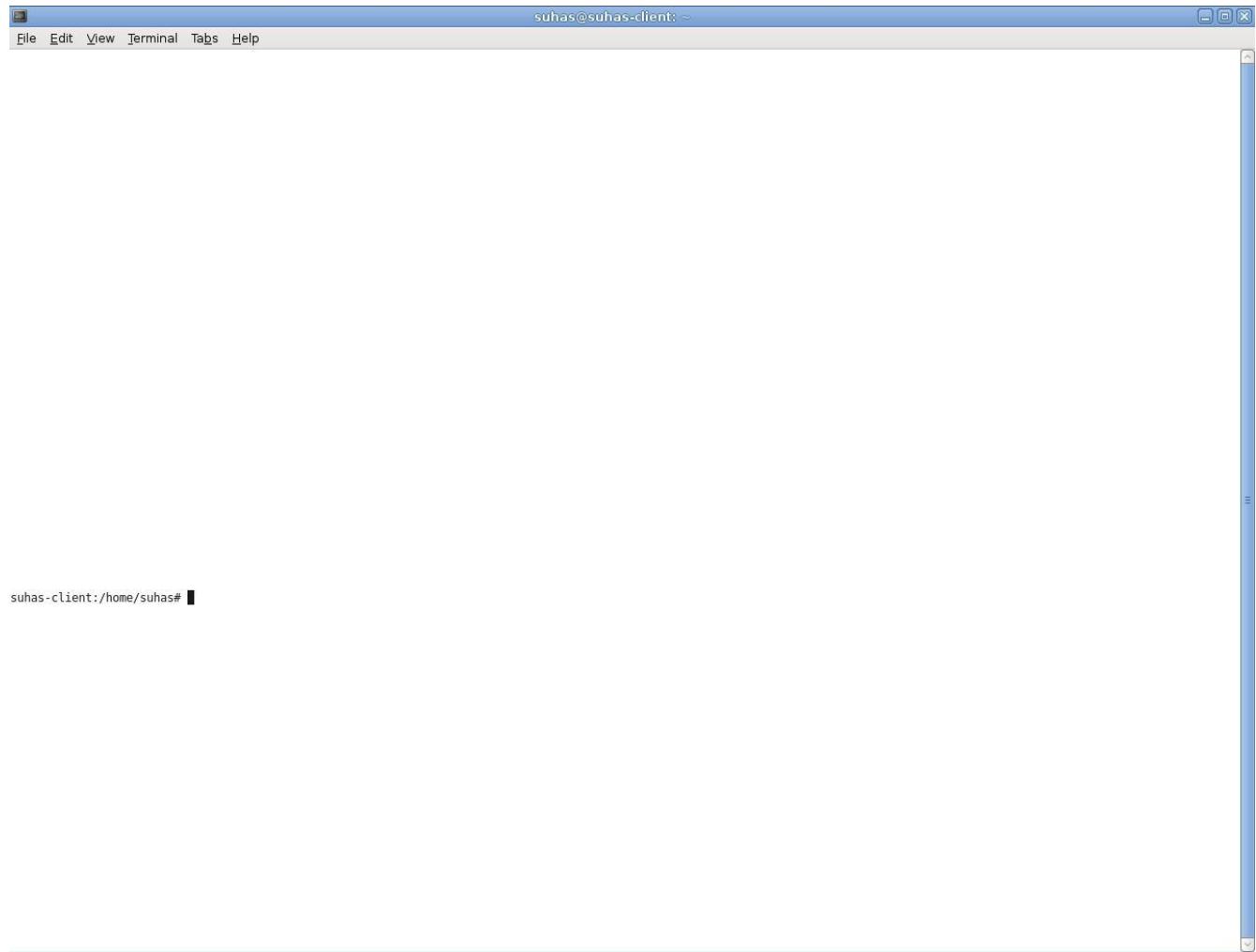
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# 

```

Client 25....



Client 28 did not start (screen phenomenon)

```

File Edit View Terminal Tabs Help
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -t : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-O] ... : mount all stuff from /etc/fstab
mount device : mount device at the known place
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hdal or /dev/cdrom,
or by label, using '-l label' or by uuid, using '-U uuid'.
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/68'.

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
(none):~# 

```

Client 35....

```
suhas@suhas-client: ~
File Edit View Terminal Tabs Help

Core dump limits :
soft - 0
hard - NONE
Checking that ptrace can change system call numbers...OK
Checking syscall emulation patch for ptrace...OK
Checking advanced syscall emulation patch for ptrace...OK
Checking for tmpfs mount on /dev/shm...OK
Checking PROT_EXEC mmap in /dev/shm/...OK
Checking for the skas3 patch in the host:
- /proc/mm...not found: No such file or directory
- PTRACE_FAULTINFO...not found
- PTRACE_LDT...not found
UML running in SKAS0 mode
Adding 22970368 bytes to physical memory to account for exec-shield gap
root
■
```

Client 42 did not start (boot up error)

```

suhas@suhas-client: ~
File Edit View Terminal Tabs Help
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-O] ... : mount all stuff from /etc/fstab
mount device : mount device at the known place
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hdal or /dev/cdrom,
or by label, using '-l label' or by uid, using '-U uid'.
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/70'.

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# 

```

Client 45...

```

File Edit View Terminal Tabs Help suhas@suhas-client: ~
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -t : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/94'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 10:43:38 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                         The programs included with the Debian GNU/Linux system are free software;
                                         the exact distribution terms for each program are described in the
                                         individual files in /usr/share/doc/*copyright.

                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                         permitted by applicable law.

(none):~# 
```

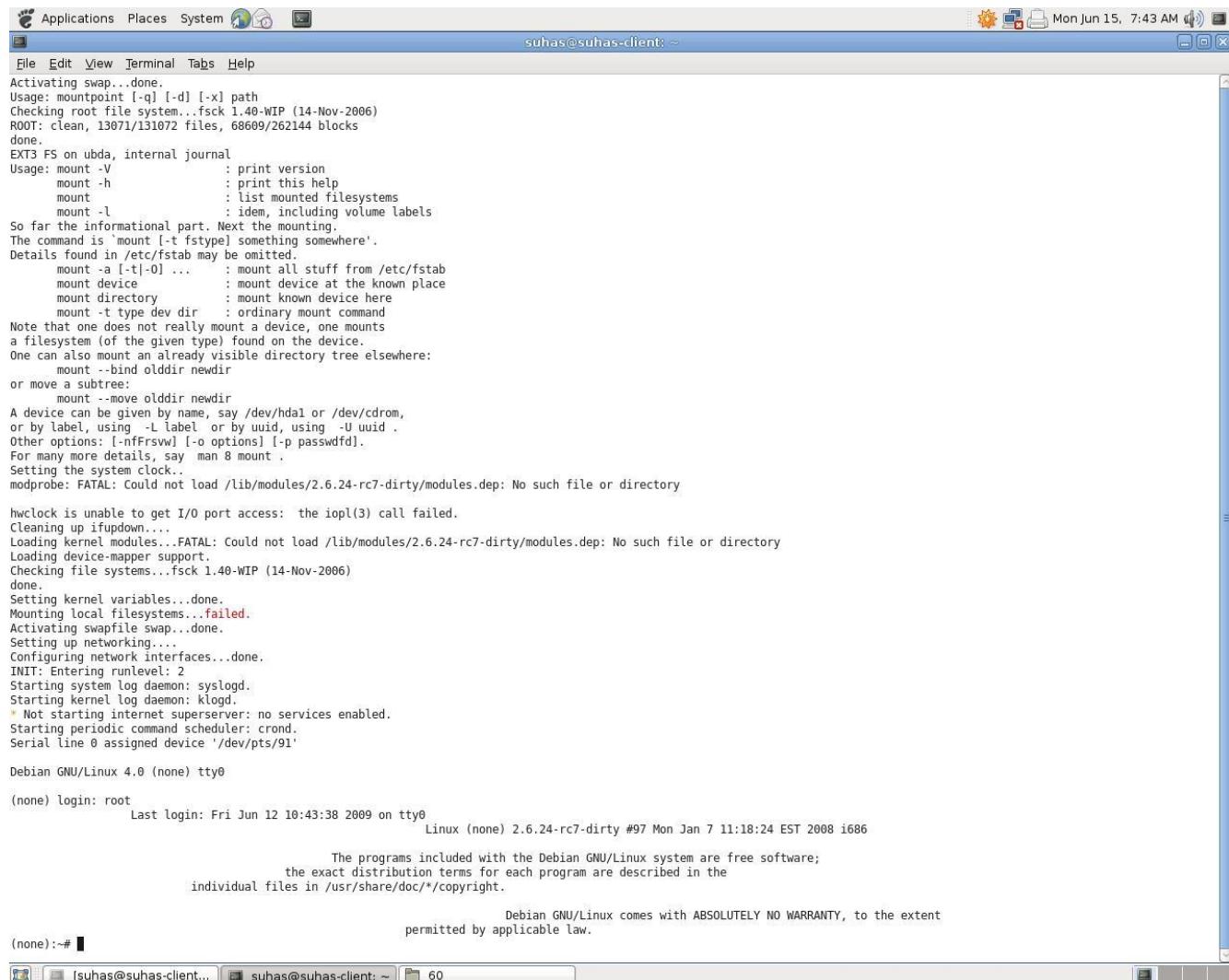
Client 49

No. of clients successfully started 47 out of 49.

3)Maximum no. of clients that can be started

N = 60

Ram parameter size in UML start script – 10MB



The screenshot shows a Linux desktop environment with a terminal window open. The terminal displays a detailed boot log for a Debian system. The log includes messages about mounting filesystems, loading kernel modules, and starting various services like networking and cron. It ends with the standard Debian copyright notice and a warning about warranty. The desktop interface at the top shows icons for Applications, Places, System, and a user icon. The desktop background is a light blue gradient.

```
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -t : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-O] ... : mount all stuff from /etc/fstab
mount device : mount device at the known place
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfFrswv] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/91'.

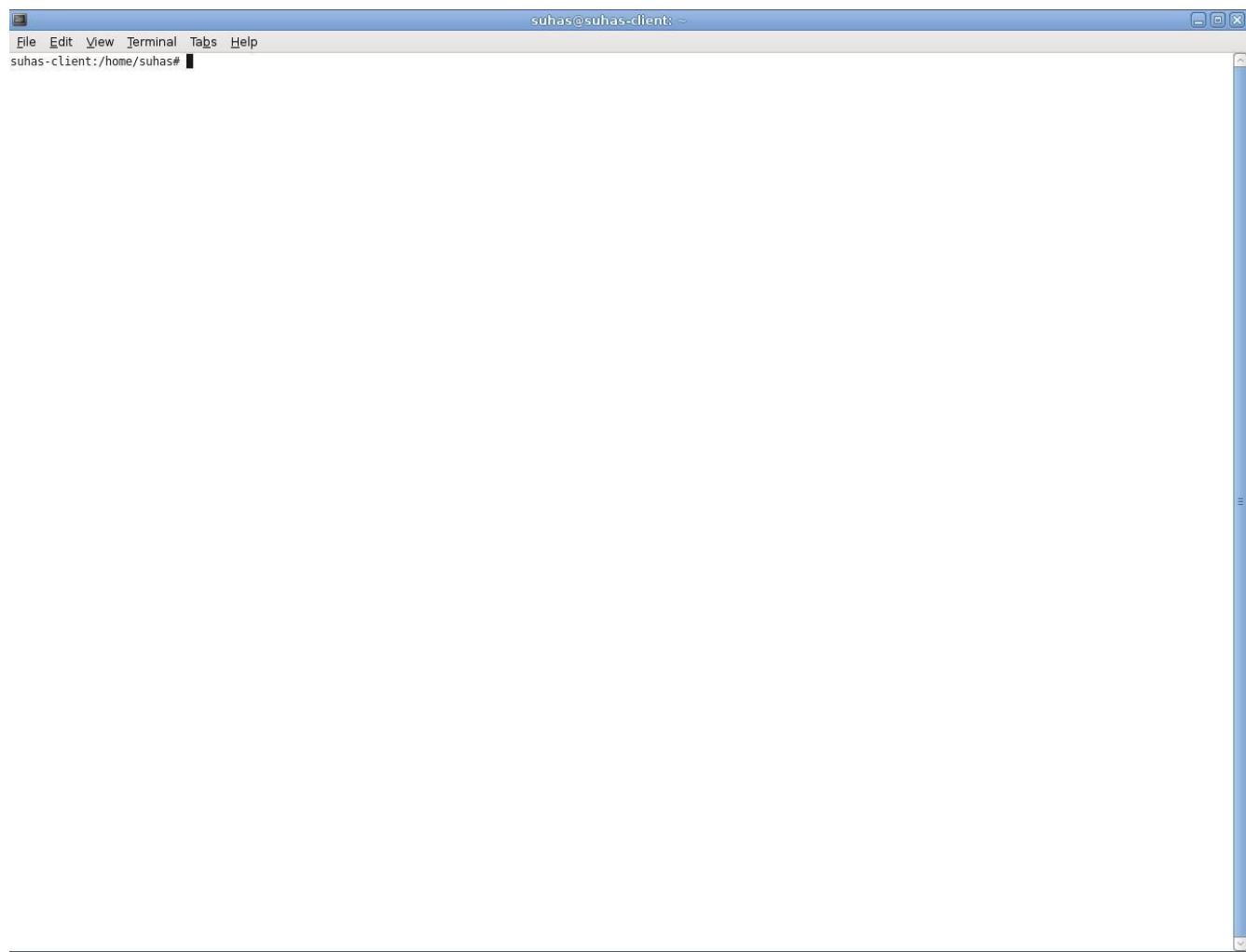
Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~#
```

Client 15....



Client 17 did not start (screen phenomenon)

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The session starts with the command "mount -t ext3 /dev/ubda1 /". It then displays the man page for the "mount" command, which includes details about mounting devices, files, and directories. The session continues with the command "modprobe" failing to load a module, followed by the configuration of the system clock and kernel modules. Finally, it logs in as root and displays the standard Debian copyright notice.

```

Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hdal or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/82'

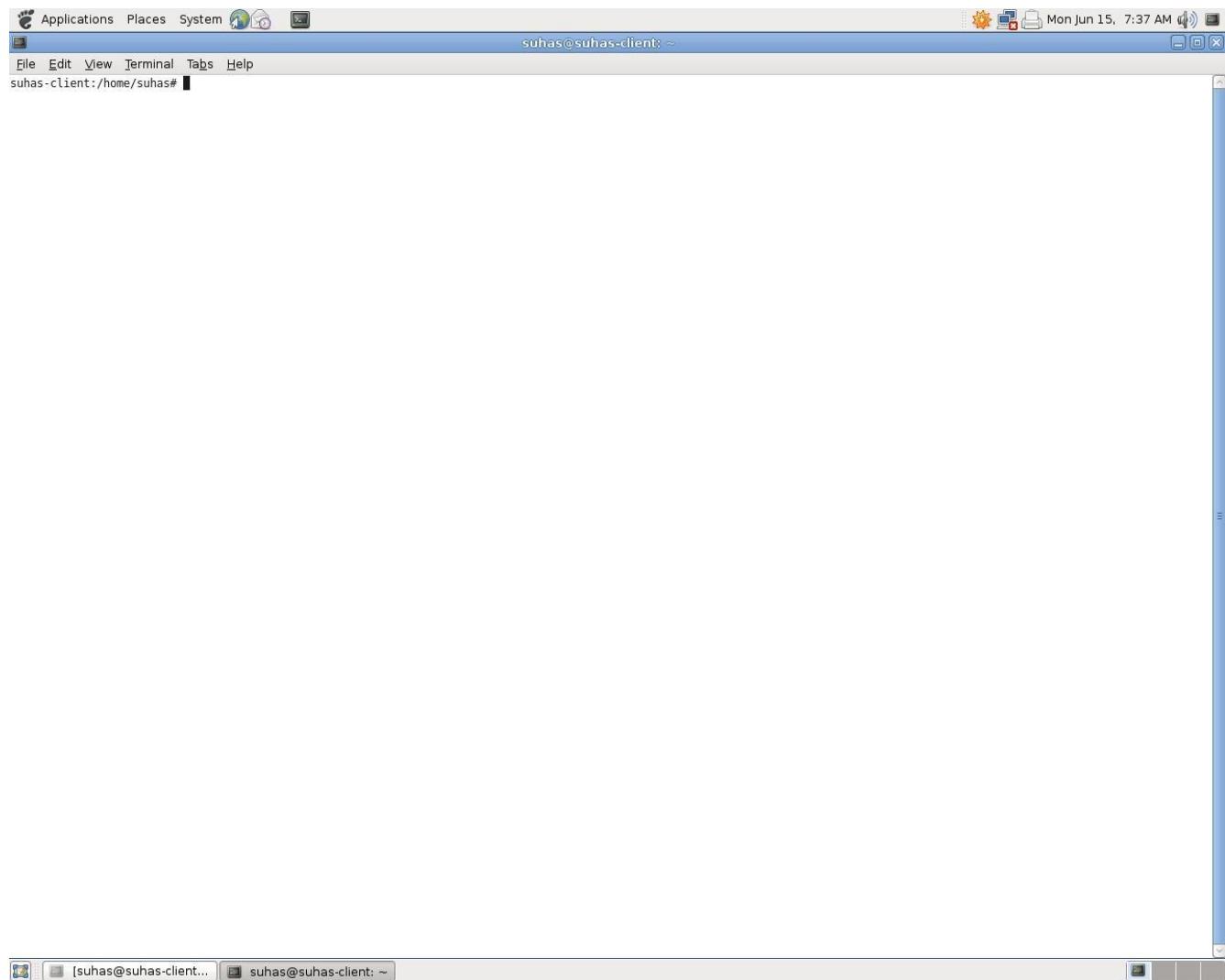
Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# 
```

Client 25....

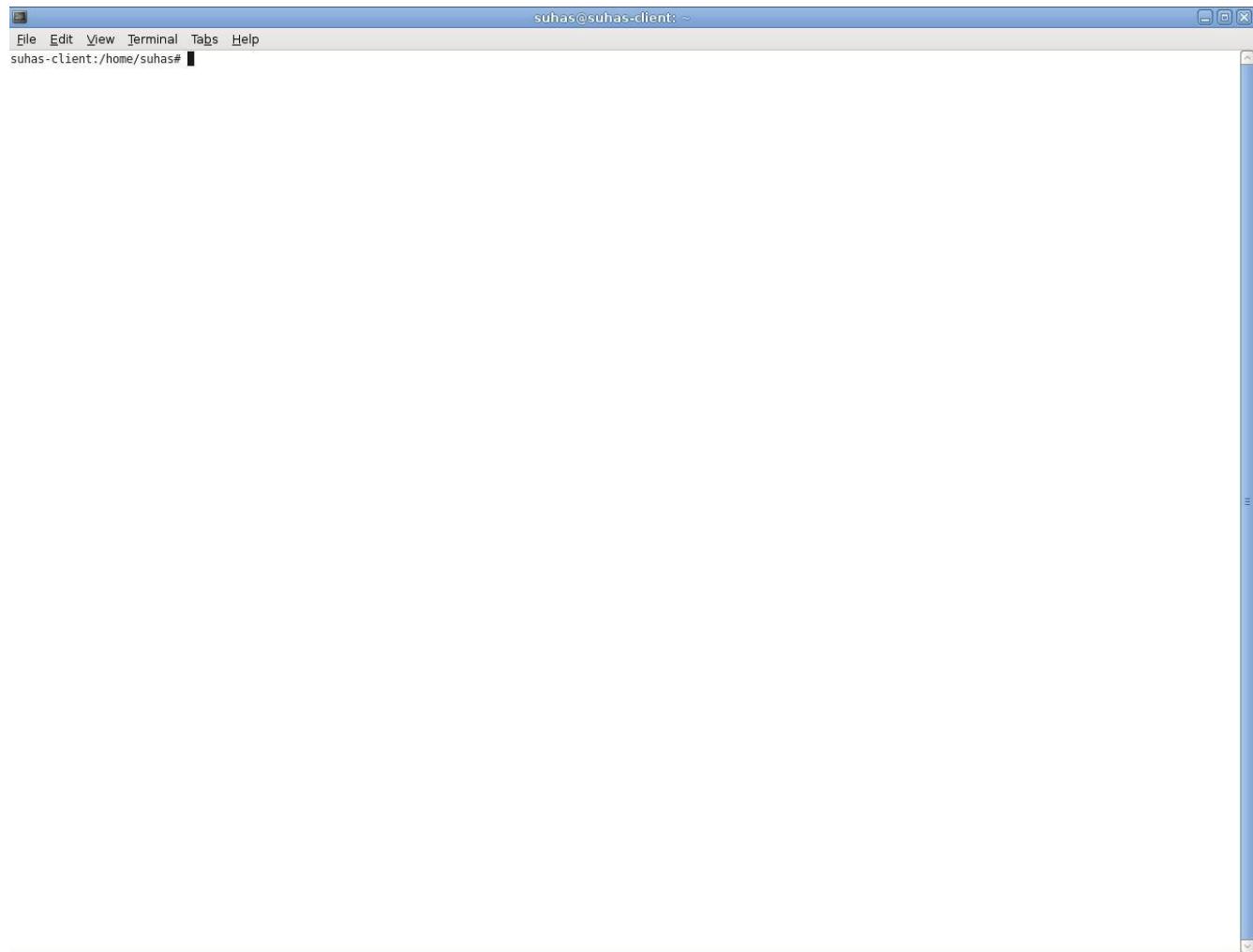


Client 29 did not start (screen phenomenon)

```
suhas@suhas-client: ~
File Edit View Terminal Tabs Help

Core dump limits :
soft - 0
hard - NONE
Checking that ptrace can change system call numbers...OK
Checking syscall emulation patch for ptrace...OK
Checking advanced syscall emulation patch for ptrace...OK
Checking for tmpfs mount on /dev/shm...OK
Checking PROT_EXEC mmap in /dev/shm/...OK
Checking for the skas3 patch in the host:
- /proc/mm...not found: No such file or directory
- PTRACE_FAULTINFO...not found
- PTRACE_LDT...not found
UML running in SKAS0 mode
Adding 22999040 bytes to physical memory to account for exec-shield gap
root
■
```

Client 31 did not start (boot up error)



Client 32 did not start (screen phenomenon)

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The window contains a log of system boot and configuration steps. Key entries include:

- Activating swap...done.
- Usage: mountpoint [-q] [-d] [-x] path
- Checking root file system.. fsck 1.40-WIP (14-Nov-2006)
- ROOT: clean, 13071/131072 files, 68609/262144 blocks done.
- EXT3 FS on ubda, internal journal
- Usage: mount -V : print version
- mount -h : print this help
- mount : list mounted filesystems
- mount -l : idem, including volume labels
- So far the informational part. Next the mounting.
- The command is 'mount [-t fstype] something somewhere'.
- Details found in /etc/fstab may be omitted.
- mount -a [-t|-O] ... : mount all stuff from /etc/fstab
- mount device : mount device at the known place
- mount directory : mount known device here
- mount -t type dev dir : ordinary mount command
- Note that one does not really mount a device, one mounts a filesystem (of the given type) found on the device.
- One can also mount an already visible directory tree elsewhere:
- mount --bind olddir newdir
- or move a subtree:
- mount --move olddir newdir
- A device can be given by name, say /dev/hd1 or /dev/cdrom, or by label, using -L label or by uuid, using -U uuid .
- Other options: [-nfRrsvw] [-o options] [-p passwdfd].
- For many more details, say man 8 mount .
- Setting the system clock..
- modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Cleaning up ifupdown....
- Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- Loading device-mapper support.
- Checking file systems..fsck 1.40-WIP (14-Nov-2006)
- done.
- Setting kernel variables...done.
- Mounting local filesystems...**failed**.
- Activating swapfile swap...done.
- Setting up networking....
- Configuring network interfaces...done.
- INIT: Entering runlevel: 2
- Starting system log daemon: syslogd.
- Starting kernel log daemon: klogd.
- * Not starting internet superserver: no services enabled.
- Starting periodic command scheduler: crond.
- Serial line 0 assigned device '/dev/pts/68'
- Debian GNU/Linux 4.0 (none) tty0
- (none) login: root
 - Last login: Fri Jun 12 10:43:38 2009 on tty0
 - Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
 - The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/*copyright.
 - Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.
- (none):~#

Client 35 ...

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The terminal content displays a series of system boot logs and configuration steps:

```

Applications Places System suhas@suhas-client: ~
File Edit View Terminal Tabs Help
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t]-0) ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/112'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

        The programs included with the Debian GNU/Linux system are free software;
        the exact distribution terms for each program are described in the
        individual files in /usr/share/doc/*copyright.

        Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
        permitted by applicable law.

(none):~#
```

Client 56...

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The session starts with system boot logs, including messages about mounting swap, fsck, and kernel modules. It then moves through various initialization steps like hwclock, device-mapper support, and networking. The user logs in as root and runs the standard Debian 4.0 (Etch) welcome message. The terminal window has a blue header bar with icons for Applications, Places, System, and a network connection. The desktop background is visible behind the terminal window.

```

Applications Places System suhas@suhas-client: ~
File Edit View Terminal Tabs Help
Activating swap...done.
Usage: mountpoint [-q] [-d] [-x] path
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/99'.

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

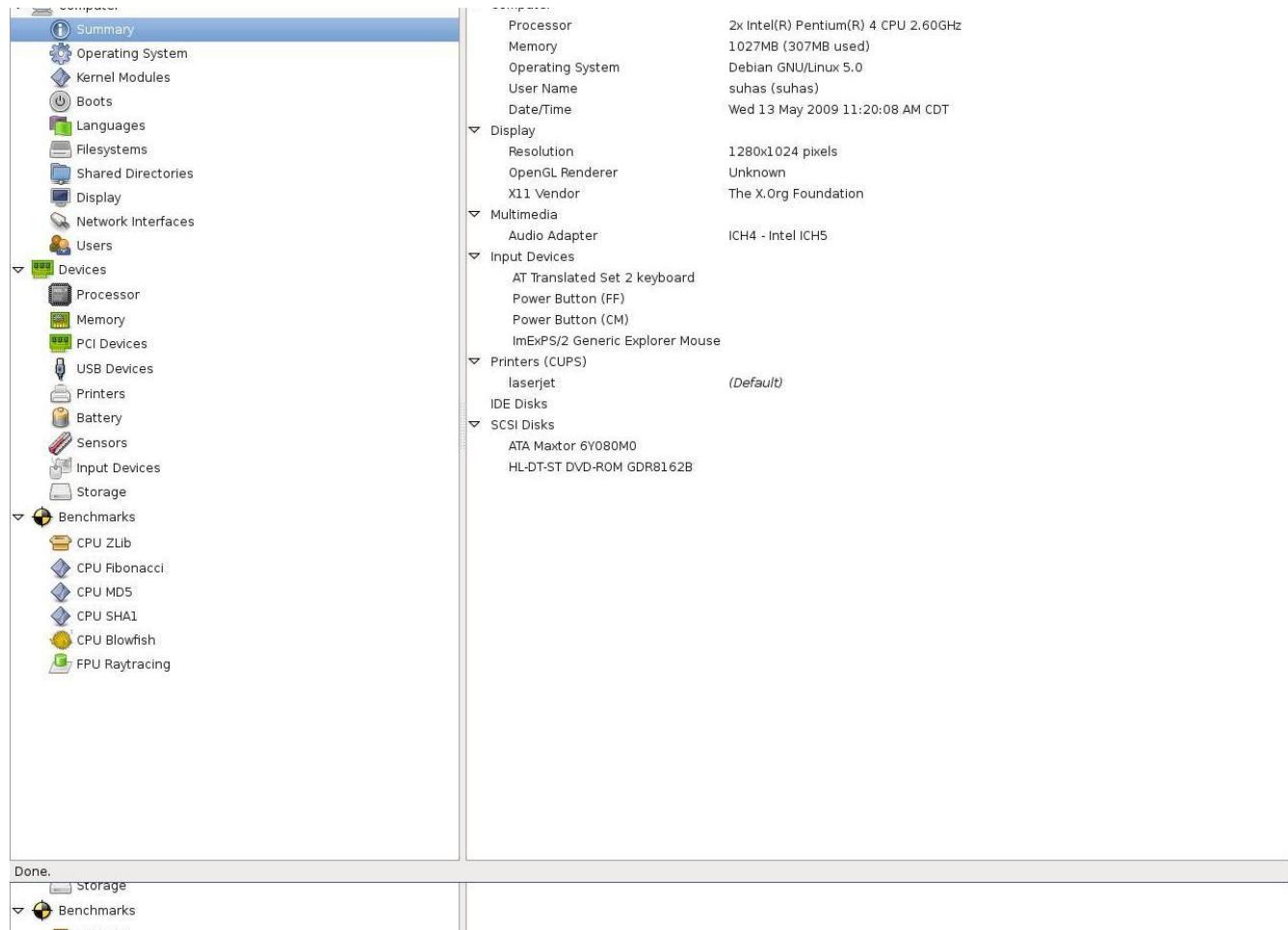
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~#
```

Client 59

No. of clients successfully started 55 out of 59

Host system statistics -



General memory consumption of host with 1 GB RAM in start up state is 307MB (697MB free)

No. of clients tried were not beyond 60 as they are started with RAM parameter in UML start script 10MB ,implies 60 virtual machines consume 600 MB of system memory

14.UML Client Network configuration on INS/HSR network

Network set up test on 20/5/2009 -

8 Client network -

```
a filesystem (of the given type) found on the device.  
One can also mount an already visible directory tree elsewhere:  
        mount --bind olddir newdir  
or move a subtree:  
        mount --move olddir newdir  
A device can be given by name, say /dev/hd1 or /dev/cdrom,  
or by label, using -L label or by uid, using -U uid .  
Other options: [-nffrsvw] [-o options] [-p passwdfd].  
For many more details, say man 8 mount.  
Setting the system clock..  
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory  
  
hwclock is unable to get I/O port access: the iopl(3) call failed.  
Cleaning up ifupdown...  
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory  
Loading device-mapper support.  
Checking file systems...fsck 1.40-WIP (14-Nov-2006)  
done.  
Setting kernel variables...done.  
Mounting local filesystems...failed.  
Activating swapfile swap...done.  
Setting up networking....  
Configuring network interfaces...done.  
INIT: Entering runlevel: 2  
Starting system log daemon: syslogd.  
Starting kernel log daemon: klogd.  
* Not starting internet superserver: no services enabled.  
Starting periodic command scheduler: crond.  
Serial line 0 assigned device '/dev/pts/11'  
  
Debian GNU/Linux 4.0 (none) tty0  
  
(none) login: root  
Last login: Tue May 19 08:58:42 2009 on tty0  
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686  
  
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
(none):~# dhclient  
Internet Systems Consortium DHCP Client V3.0.4  
Copyright 2004-2006 Internet Systems Consortium,  
All rights reserved.  
For info, please visit http://www.isc.org/sw/dhcp/  
  
Listening on LPF/eth0/5a:c2:3f:91:17:38  
Sending on  LPF/eth0/5a:c2:3f:91:17:38  
Sending on  Socket/fallback  
DHCPOFFER from 152.96.9.1  
DHCPREQUEST on eth0 to 255.255.255.255 port 67 interval 5  
DHCPACK from 152.96.9.1  
        hostname: the specified hostname is invalid  
        bound to 152.96.9.245 -- renewal in 41107 seconds.  
(none):~#
```

Filter: Expression...

No.	Time	Source	Destination	Protocol	Info
16	1.177582	152.96.9.1	152.96.9.235	DHCP	DHCP ACK - Transaction ID 0xecl26761
17	1.721424	Cisco_97:15:c2	Spanning-tree-(for-br STP		Conf. Root = 24699/00:1d:46:bf:22:00 Cost = 8 Port = 0x8002
18	1.938910	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x5d9a8b18
19	1.941008	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.245? Tell 152.96.9.1
20	2.054358	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x12f32f28
21	2.056421	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.239? Tell 152.96.9.1
22	2.097852	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xe0ca3c72
23	2.172085	152.96.9.1	152.96.9.245	DHCP	DHCP Offer - Transaction ID 0x5d9a8b18
24	2.173036	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x5d9a8b18
25	2.175822	152.96.9.1	152.96.9.239	DHCP	DHCP Offer - Transaction ID 0x12f32f28
26	2.176793	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x12f32f28
27	2.180575	152.96.9.1	152.96.9.245	DHCP	DHCP ACK - Transaction ID 0x5d9a8b18
28	2.188825	152.96.9.1	152.96.9.239	DHCP	DHCP ACK - Transaction ID 0x12f32f28
29	3.040265	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x3945e200
30	3.747897	Cisco_97:15:c2	Spanning-tree-(for-br STP		Conf. Root = 24699/00:1d:46:bf:22:00 Cost = 8 Port = 0x8002
31	5.095712	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xe0ca3c72

Your (client) IP address: 0.0.0.0 (0.0.0.0)
 Next server IP address: 0.0.0.0 (0.0.0.0)
 Relay agent IP address: 0.0.0.0 (0.0.0.0)
 Client MAC address: 5a:c2:3f:91:17:38 (5a:c2:3f:91:17:38)
 Server host name not given
 Boot file name not given
 Magic cookie: (OK)

- ▼ Option: (t=53,l=1) DHCP Message Type = DHCP Request
 - Option: (53) DHCP Message Type
 - Length: 1
 - Value: 03
- ▼ Option: (t=54,l=4) Server Identifier = 152.96.120.131
 - Option: (54) Server Identifier
 - Length: 4
 - Value: 98607883
- ▼ Option: (t=50,l=4) Requested IP Address = 152.96.9.245
 - Option: (50) Requested IP Address
 - Length: 4
 - Value: 986009F5
- ▼ Option: (t=55,l=10) Parameter Request List
 - Option: (55) Parameter Request List
 - Length: 10
 - Value: 011C02030F060C2C2F1A
 - 1 = Subnet Mask
 - 28 = Broadcast Address

```
0120 60 78 83 32 04 98 60 09 f5 37 0a 01 1c 02 03 0f  `x.2. . . . 7.....
0130 06 0c 2c 2f 1a ff 00 00 00 00 00 00 00 00 00 00 00 00  ...., /..., .....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ..... , ....., ..
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .....
```

Text item (), 6 bytes Packets: 2367 Displayed: 2367 Marked: 0 Profile: Default

Wireshark capture of DCHP request made by client 1

```

or move a subtree:
        mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/14'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Tue May 19 08:58:42 2009 on tty0
    Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

    The programs included with the Debian GNU/Linux system are free software;
    the exact distribution terms for each program are described in the
    individual files in /usr/share/doc/*copyright.

    Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
    permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/82:bb:f8:4f:cb:08
    Sending on   LPF/eth0/82:bb:f8:4f:cb:08
    Sending on   Socket/fallback
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 3
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 6
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 7
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 8
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 15
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 16
        DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 6
        No DHCPOFFERS received.

    No working leases in persistent database - sleeping.

(none):~# 
```

Filter: [] Expression... [] Clear [] Apply

No.	Time	Source	Destination	Protocol	Info
1	0.000000	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x9be0de29
2	0.001223	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.234? Tell 152.96.9.1
3	0.039095	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x3789546d
4	0.041191	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.240? Tell 152.96.9.1
5	0.172104	152.96.9.1	152.96.9.234	DHCP	DHCP Offer - Transaction ID 0x9be0de29
6	0.173244	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x9be0de29
7	0.196582	152.96.9.1	152.96.9.240	DHCP	DHCP Offer - Transaction ID 0x3789546d
8	0.198049	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x3789546d
9	0.201575	152.96.9.1	152.96.9.234	DHCP	DHCP ACK - Transaction ID 0x9be0de29
10	0.209831	152.96.9.1	152.96.9.240	DHCP	DHCP ACK - Transaction ID 0x3789546d
11	0.708202	152.96.9.1	224.0.0.1	IGMP	V2 Membership Query, general
12	1.053894	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xec126761
13	1.055923	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.235? Tell 152.96.9.1
14	1.171339	152.96.9.1	152.96.9.235	DHCP	DHCP Offer - Transaction ID 0xec126761
15	1.172264	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xec126761
16	1.177582	152.96.9.1	152.96.9.235	DHCP	DHCP ACK - Transaction ID 0xec126761

Hardware type: Ethernet
 Hardware address length: 6
 Hops: 0
 Transaction ID: 0x9be0de29
 Seconds elapsed: 0
 ▶ Bootp flags: 0x0000 (Unicast)
 Client IP address: 0.0.0.0 (0.0.0.0)
 Your (client) IP address: 0.0.0.0 (0.0.0.0)
 Next server IP address: 0.0.0.0 (0.0.0.0)
 Relay agent IP address: 0.0.0.0 (0.0.0.0)
 Client MAC address: ba:a8:00:3b:f0:4b (ba:a8:00:3b:f0:4b)
 Server host name not given
 Boot file name not given
 Magic cookie: (OK)
 ▶ Option: (t=53,l=1) DHCP Message Type = DHCP Discover
 Option: (53) DHCP Message Type
 Length: 1
 Value: 01
 ▶ Option: (t=50,l=4) Requested IP Address = 152.96.9.232
 Option: (50) Requested IP Address
 Length: 4
 Value: 986009E8
 ▶ Option: (t=55,l=10) Parameter Request List
 Option: (55) Parameter Request List
 Length: 10

```
0030 de 29 00 00 00 00 00 00 00 00 00 00 00 00 00 . . . .
0040 00 00 00 00 00 ba a8 00 3b f0 4b 00 00 00 00 . . . .
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 . . . .
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 . . . .
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 . . . .

Next server IP address (bootp.ip.ser... | Packets: 3284 Displayed: 3284 Marked: 0 | Profile: Default
```

Wireshark capture of DHCP request made by client 2 (client could not get the ip address)

```

a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
        mount --bind olddir newdir
or move a subtree:
        mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/12'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/6a:a2:89:30:48:00
Sending on   LPF/eth0/6a:a2:89:30:48:00
Sending on   Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 4
DHCPOffer from 152.96.9.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.9.1
        hostname: the specified hostname is invalid
        bound to 152.96.9.235 -- renewal in 41246 seconds.

(none):~# 
```

3

```

a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
        mount --bind olddir newdir
or move a subtree:
        mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/10'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Tue May 19 08:58:42 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/2e:03:dc:fd:01:66
          Sending on  LPF/eth0/2e:03:dc:fd:01:66
Sending on  Socket/fallback
          DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 4
          DHCPOffer from 152.96.9.1
          DHCPREQUEST on eth0 to 255.255.255.255 port 67
          DHCPACK from 152.96.9.1
          hostname: the specified hostname is invalid
          bound to 152.96.9.240 -- renewal in 32778 seconds.

(none):~#

```

```

a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
        mount --bind olddir newdir
or move a subtree:
        mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/11'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Tue May 19 08:58:42 2009 on tty0
                                          Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                          The programs included with the Debian GNU/Linux system are free software;
                                          the exact distribution terms for each program are described in the
                                          individual files in /usr/share/doc/*copyright.

                                          Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                          permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
                                         Copyright 2004-2006 Internet Systems Consortium.
                                         All rights reserved.
                                         For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/5a:c2:3f:91:17:38
                                         Sending on  LPF/eth0/5a:c2:3f:91:17:38
Sending on  Socket/fallback
DHCPOFFER from 152.96.9.1
                                         DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 5
                                         DHCPOFFER from 152.96.9.1
                                         DHCPREQUEST on eth0 to 255.255.255.255 port 67
                                         DHCPACK from 152.96.9.1
                                         hostname: the specified hostname is invalid
                                         bound to 152.96.9.245 -- renewal in 41107 seconds.

(none):~# 
```

```

a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
        mount --bind olddir newdir
or move a subtree:
        mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/11'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Tue May 19 08:58:42 2009 on tty0
                                              Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                              The programs included with the Debian GNU/Linux system are free software;
                                              the exact distribution terms for each program are described in the
                                              individual files in /usr/share/doc/*copyright.

                                              Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                              permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
                                              Copyright 2004-2006 Internet Systems Consortium.
                                              All rights reserved.
                                              For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/5a:c2:3f:91:17:38
                                              Sending on  LPF/eth0/5a:c2:3f:91:17:38
Sending on  Socket/fallback
                                              DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 5
                                              DHCPOFFER from 152.96.9.1
                                              DHCPREQUEST on eth0 to 255.255.255.255 port 67
                                              DHCPACK from 152.96.9.1
                                              hostname: the specified hostname is invalid
                                              bound to 152.96.9.245 -- renewal in 41107 seconds.

(none):~# 
```

```

mount --bind olddir newdir
or move a subtree:
mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/13'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Tue May 19 08:58:42 2009 on tty0
                                          Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                          The programs included with the Debian GNU/Linux system are free software;
                                          the exact distribution terms for each program are described in the
                                          individual files in /usr/share/doc/*copyright.

                                          Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/1a:f8:42:86:a1:e0
                                          Sending on  LPF/eth0/1a:f8:42:86:a1:e0
Sending on  Socket/fallback
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 3
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 7
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 15
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 8
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 16
DHCPCDISCOVER on eth0 to 255.255.255.255 port 67 interval 12
No DHCPOFFERS received.
No working leases in persistent database - sleeping.

(none):~# 
```

No.	Time	Source	Destination	Protocol	Info
19	1.941008	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.245? Tell 152.96.9.1
20	2.054358	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x12f32f28
21	2.056421	Cisco_bf:22:46	Broadcast	ARP	Who has 152.96.9.239? Tell 152.96.9.1
22	2.097852	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xe0ca3c72
23	2.172085	152.96.9.1	152.96.9.245	DHCP	DHCP Offer - Transaction ID 0x5d9a8b18
24	2.173036	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x5d9a8b18
25	2.175829	152.96.9.1	152.96.9.239	DHCP	DHCP Offer - Transaction ID 0x12f32f28
26	2.176793	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x12f32f28
27	2.180575	152.96.9.1	152.96.9.245	DHCP	DHCP ACK - Transaction ID 0x5d9a8b18
28	2.188824	152.96.9.1	152.96.9.239	DHCP	DHCP ACK - Transaction ID 0x12f32f28
29	3.040265	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x3945e200
30	3.747897	Cisco_97:15:c2	Spanning-tree-(for-br STP)	Conf.	Root = 24699/0:0:1d:46:bf:22:00 Cost = 8 Port = 0x8002
31	5.095712	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xe0ca3c72
32	5.747391	Cisco_97:15:c2	Spanning-tree-(for-br STP)	Conf.	Root = 24699/0:0:1d:46:bf:22:00 Cost = 8 Port = 0x8002
33	6.041304	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x3945e200
34	6.255500	Cisco_97:15:c2	Broadcast	ARP	Who has 152.96.9.252? Tell 152.96.9.252

Transaction ID: 0xe0ca3c72
 Seconds elapsed: 3

- ▶ Boot flags: 0x0000 (Unicast)
 Client IP address: 0.0.0.0 (0.0.0.0)
 Your (client) IP address: 0.0.0.0 (0.0.0.0)
 Next server IP address: 0.0.0.0 (0.0.0.0)
 Relay agent IP address: 0.0.0.0 (0.0.0.0)
 Client MAC address: 1a:f8:42:86:a1:e0 (1a:f8:42:86:a1:e0)
 Server host name not given
 Boot file name not given
 Magic cookie: (OK)
- ▽ Option: (t=53,l=1) DHCP Message Type = DHCP Discover
 - Option: (53) DHCP Message Type
 - Length: 1
 - Value: 01
- ▽ Option: (t=50,l=4) Requested IP Address = 152.96.9.232
 - Option: (50) Requested IP Address
 - Length: 4
 - Value: 986009E8
- ▽ Option: (t=55,l=10) Parameter Request List
 - Option: (55) Parameter Request List
 - Length: 10
 - Value: 011C02030F060C2C2F1A
 - 1 = Subnet Mask
 - 28 = Broadcast Address

0120 60 09 e8 37 0a 01 1c 02 03 0f 06 0c 26 2f 1a ff
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Text item (), 1 byte Packets: 2926 Displayed: 2926 Marked: 0 Profile: Default

Wireshark capture of DHCP request made by client 7(client could not get the ip address)

Observations -

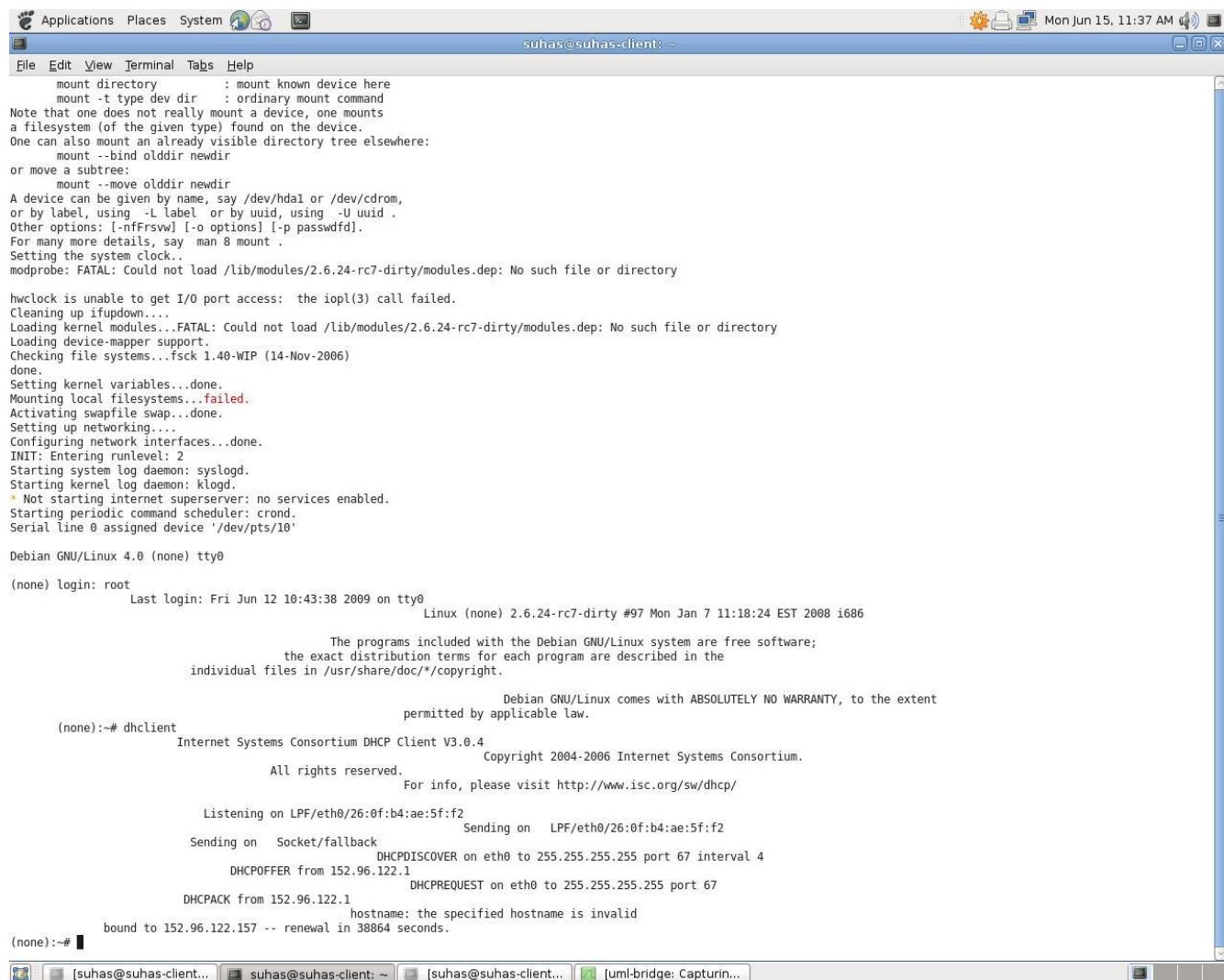
a)Client 1,5,6 got the same IP address

b)Client 2,7 are not able to obtain IP address from DHCP server.

Possible reason for this is that

- 1)IP address requested in Requested IP address option in DHCPDISCOVER message is not available
- 2)DHCP server is getting exhausted of all the IP addresses available in the subnet

UML Network set up test – 15/6/2009



The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The terminal content is a command-line session:

```
File Edit View Terminal Tabs Help
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/10'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/26:0f:b4:ae:5f:f2
Sending on  LPF/eth0/26:0f:b4:ae:5f:f2
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 4
DHCPOFFER from 152.96.122.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.122.1
        hostname: the specified hostname is invalid
        bound to 152.96.122.157 -- renewal in 38864 seconds.

(none):~#
```

Client 1

Applications Places System

uml-bridge: Capturing - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: Expression...

No.	Time	Source	Destination	Protocol	Info
39	2.640147	152.96.122.1	152.96.122.132	DHCP	DHCP ACK - Transaction ID 0x877f3a3c
40	3.545463	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.138? Tell 152.96.122.1
41	3.545938	86:42:85:80:5f:d3	Cisco_89:95:2c	ARP	152.96.122.138 is at 86:42:85:80:5f:d3
42	3.546214	152.96.120.131	152.96.122.138	ICMP	Echo (ping) request
43	3.546332	152.96.122.138	152.96.120.131	ICMP	Echo (ping) reply
44	4.010613	Cisco_97:15:c1	Spanning-tree-(for-br	STP	Conf. Root = 24698/00:1d:46:bf:22:00 Cost = 8 Port = 0x8001
45	4.540395	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xb14437
46	4.541213	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.134? Tell 152.96.122.1
47	4.545214	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.132? Tell 152.96.122.1
48	4.545607	46:77:4c:b9:4e:5f	Cisco_89:95:2c	ARP	152.96.122.132 is at 46:77:4c:b9:4e:5f
49	4.545956	152.96.120.131	152.96.122.132	ICMP	Echo (ping) request
50	4.546044	152.96.122.132	152.96.120.131	ICMP	Echo (ping) reply
51	4.570461	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xa099e3a
52	4.571191	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.157? Tell 152.96.122.1
53	4.630649	152.96.122.1	152.96.122.134	DHCP	DHCP Offer - Transaction ID 0xb14437
54	4.631148	152.96.122.1	152.96.122.157	DHCP	DHCP Offer - Transaction ID 0xa099e3a

Hops: 0
 Transaction ID: 0xa099e3a
 Seconds elapsed: 0

Boot flags: 0x0000 (Unicast)
 Client IP address: 0.0.0.0 (0.0.0.0)
 Your (client) IP address: 0.0.0.0 (0.0.0.0)
 Next server IP address: 0.0.0.0 (0.0.0.0)
 Relay agent IP address: 0.0.0.0 (0.0.0.0)
 Client MAC address: 26:0f:b4:ae:f5:f2 (26:0f:b4:ae:f5:f2)
 Server host name not given
 Boot file name not given
 Magic cookie: (OK)

Option: (t=53,l=1) DHCP Message Type = DHCP Discover
 Option: (53) DHCP Message Type
 Length: 1
 Value: 01

Option: (t=50,l=4) Requested IP Address = 152.96.9.235
 Option: (50) Requested IP Address
 Length: 4
 Value: 986009EB

Option: (t=55,l=10) Parameter Request List
 Option: (55) Parameter Request List
 Length: 10
 Value: 01C02030F060C2C2F1A
 1 = Subnet Mask

```
0110 00 00 00 00 00 00 63 82 53 63 35 01 01 32 04 98 .....c. Sc5.12..  

0120 60 09 eb 37 0a 01 1c 02 03 0f 06 0c 2f 1a ff ..7.... ....//...  

0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....,.....  

0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....,.....  

0150 00 00 00 00 00 00 .....
```

Bootp/Dhcp option value (bootp.opti... Packets: 1481 Displayed: 1481 Marked: 0 Profile: Default

[suhas@suh... [suhas@suh... [suhas@suh... uml-bridge: Capturin... uml-network15-6 1.png]

Wireshark capture of DHCPDISCOVER message—client 1

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window has a title bar "suhas@suhas-client: ~". The window contains a command-line session:

```

File Edit View Terminal Tabs Help
mount directory      : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/13'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

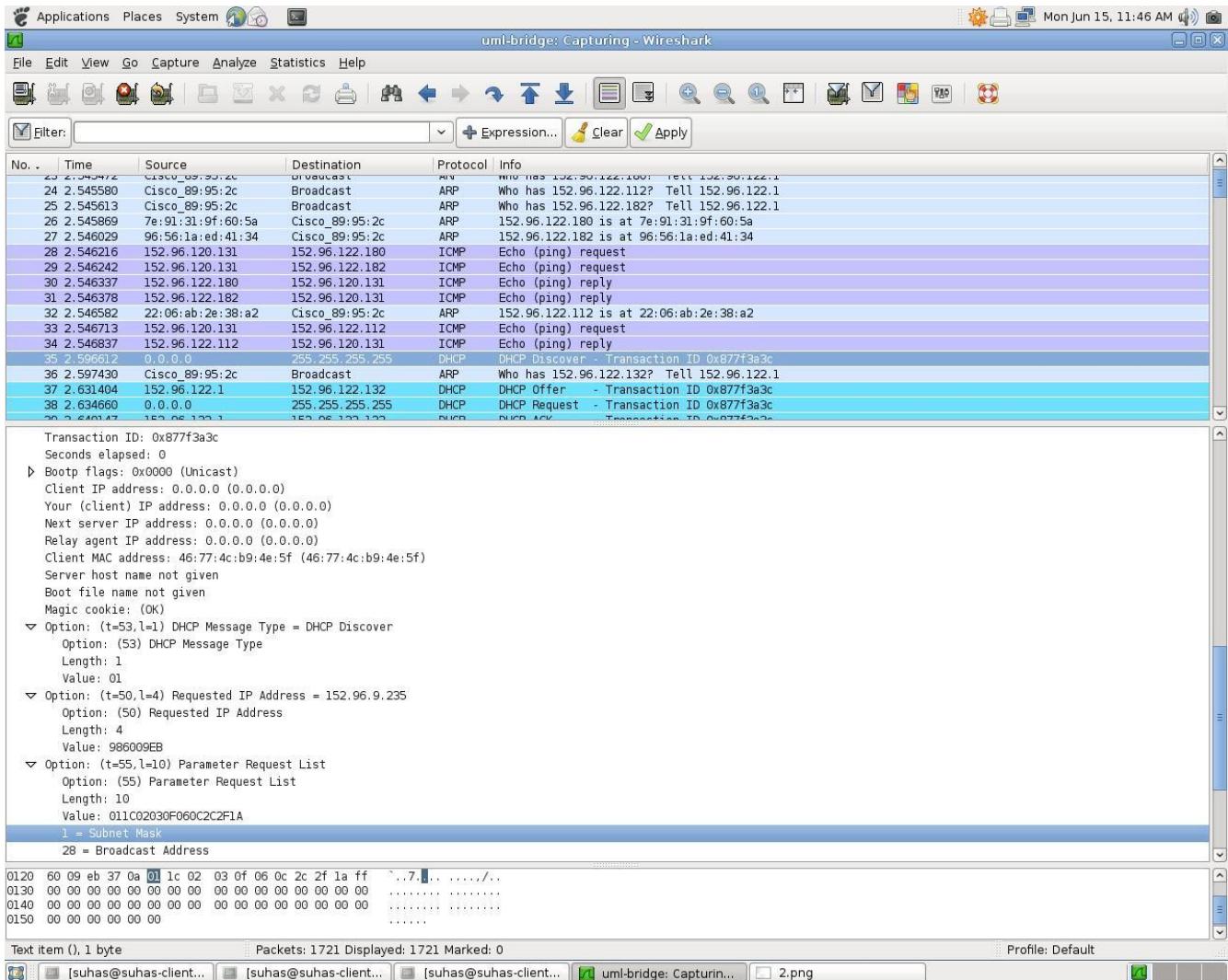
Listening on LPF/eth0/46:77:4c:b9:4e:5f
Sending on  LPF/eth0/46:77:4c:b9:4e:5f
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 5
DHCPoffer from 152.96.122.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.122.1
        hostname: the specified hostname is invalid
        bound to 152.96.122.132 -- renewal in 33673 seconds.

(none):~#

```

The terminal window has several tabs open at the bottom, including "suhas@suhas-client...", "suhas@suhas-client: ~", "suhas@suhas-client...", "uml-bridge: Capturin...", and others.

Client 2



Wireshark capture of DCHPDISCOVER –client 2

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The session starts with a man page for the "mount" command, followed by various system boot logs and configuration messages. It includes the Debian license notice and ends with a DHCP client log. The desktop interface at the top shows icons for Applications, Places, System, and Help, along with a date and time indicator.

```

Applications Places System suhas@suhas-client: ~ Mon Jun 15, 11:38 AM
File Edit View Terminal Tabs Help
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -l label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/9'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

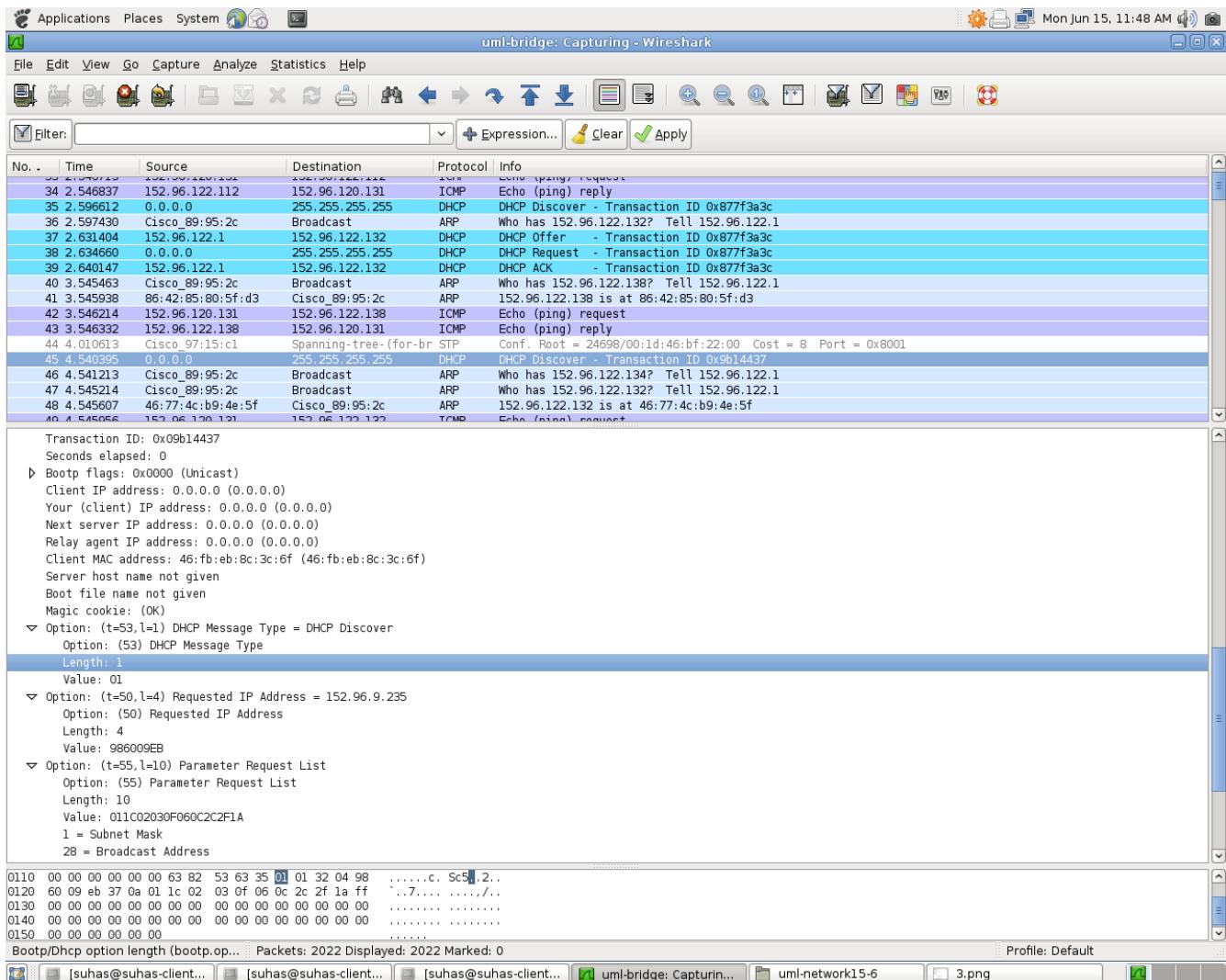
(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/46:fb:eb:8c:3c:6f
Sending on  LPF/eth0/46:fb:eb:8c:3c:6f
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 5
DHCPOFFER from 152.96.122.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.122.1
        hostname: the specified hostname is invalid
bound to 152.96.122.134 -- renewal in 36009 seconds.

(none):~#

```

Client 3



Wireshark capture of DHCPDISCOVER –client 3

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The session starts with a man page for the "mount" command, followed by error messages from the boot process. It then shows the root login, the Debian license, and the dhclient command output. The terminal window has tabs at the bottom labeled "suhas@suhas-client...".

```

Applications Places System suhas@suhas-client: ~ Mon Jun 15, 11:38 AM
File Edit View Terminal Tabs Help
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -l label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/11'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/86:42:85:80:5f:d3
Sending on  LPF/eth0/86:42:85:80:5f:d3
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 4
DHCPOFFER from 152.96.122.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.122.1
        hostname: the specified hostname is invalid
bound to 152.96.122.138 -- renewal in 37674 seconds.

(none):~#

```

Client 4

Filter: | Expression... | Clear | Apply |

No.	Time	Source	Destination	Protocol	Info
1	0.000000	Cisco_97:15:c1	Spanning-tree-(for-br) STP	Conf. Root = 24698/00:1d:46:bf:22:00 Cost = 8 Port = 0x8001	
2	1.435447	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x50338c59
3	1.436553	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.182? Tell 152.96.122.1
4	1.472369	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x4b80d96d
5	1.473023	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.112? Tell 152.96.122.1
6	1.531095	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0x94c44a20
7	1.531981	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.180? Tell 152.96.122.1
8	1.577519	0.0.0.0	255.255.255.255	DHCP	DHCP Discover - Transaction ID 0xe21f4606
9	1.578197	Cisco_89:95:2c	Broadcast	ARP	Who has 152.96.122.138? Tell 152.96.122.1
10	1.631905	152.96.122.1	152.96.122.182	DHCP	DHCP Offer - Transaction ID 0x50338c59
11	1.632149	152.96.122.1	152.96.122.112	DHCP	DHCP Offer - Transaction ID 0x4b80d96d
12	1.632655	152.96.122.1	152.96.122.180	DHCP	DHCP Offer - Transaction ID 0x94c44a20
13	1.632696	152.96.122.1	152.96.122.138	DHCP	DHCP Offer - Transaction ID 0xe21f4606
14	1.633177	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x50338c59
15	1.633944	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0x94c44a20
16	1.635045	0.0.0.0	255.255.255.255	DHCP	DHCP Request - Transaction ID 0xe21f4606

Client IP address: 0.0.0.0 (0.0.0.0)
Your (client) IP address: 0.0.0.0 (0.0.0.0)
Next server IP address: 0.0.0.0 (0.0.0.0)
Relay agent IP address: 0.0.0.0 (0.0.0.0)
Client MAC address: 86:42:85:80:5f:d3 (86:42:85:80:5f:d3)
Server host name not given
Boot file name not given
Magic cookie: (OK)

Option: (t=53,l=1) DHCP Message Type = DHCP Discover
 Option: (53) DHCP Message Type
 Length: 1
 Value: 01

Option: (t=50,l=4) Requested IP Address = 152.96.9.235
 Option: (50) Requested IP Address
 Length: 4
 Value: 986009EB

Option: (t=55,l=10) Parameter Request List
 Option: (55) Parameter Request List
 Length: 10
 Value: 011C02030F060C2C2F1A
 1 = Subnet Mask
 28 = Broadcast Address
 2 = Time Offset
 3 = Router
 15 = Domain Name
 6 = Domain Name Server

Text item (0, 3 bytes) Packets: 2271 Displayed: 2271 Marked: 0 Profile: Default

[suhas@suhas-client...]

Wireshark capture of DHCPDISCOVER – client 4

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window displays a long boot log from a Debian system. The log includes messages about mounting filesystems, loading modules, setting the system clock, and starting various services like cron and syslogd. It also shows the user logging in as root and running the dhclient command to obtain an IP address via DHCP.

```

Applications Places System suhas@suhas-client: ~
File Edit View Terminal Tabs Help
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/15'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

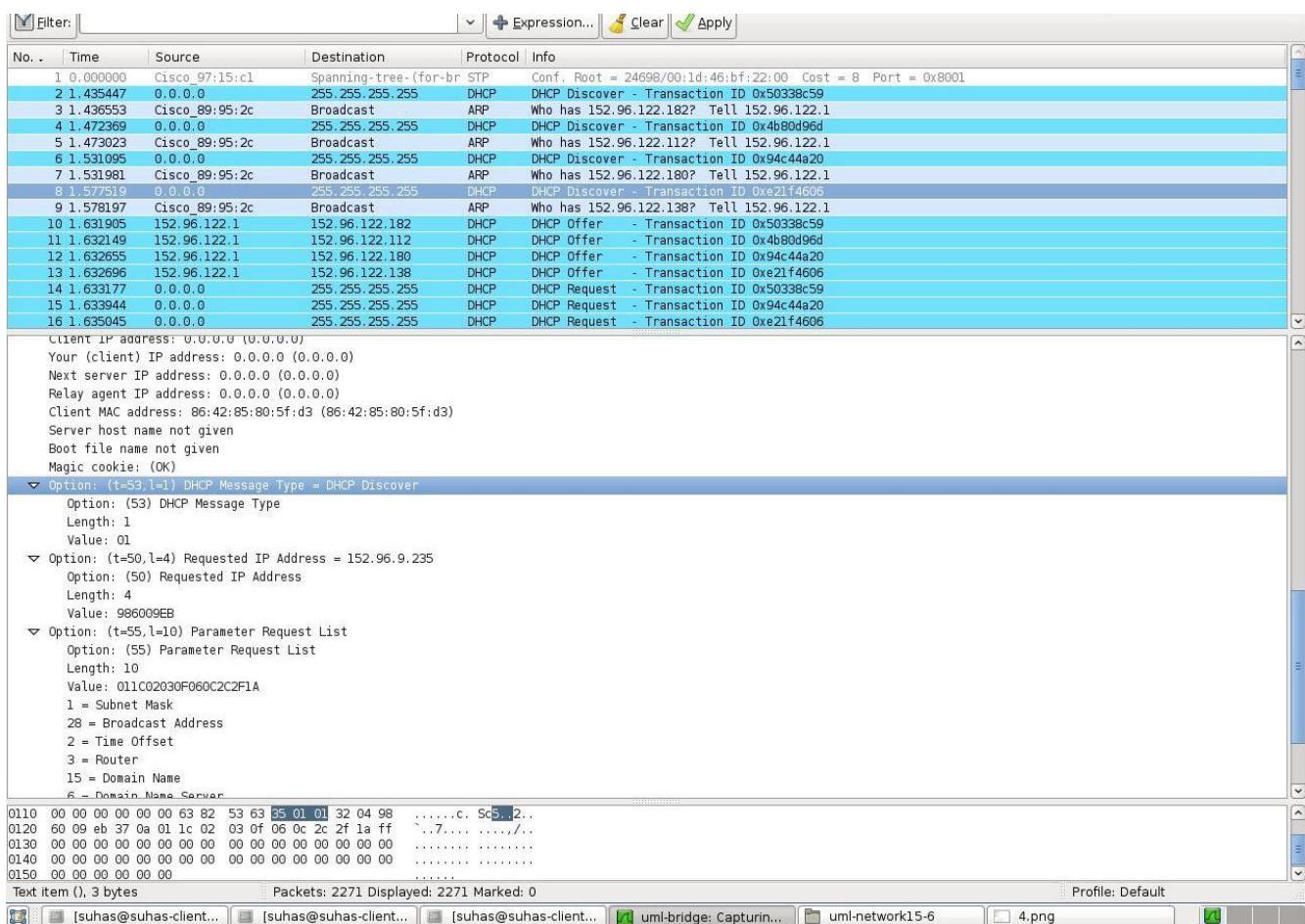
(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/7e:91:31:9f:60:5a
Sending on  LPF/eth0/7e:91:31:9f:60:5a
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 7
DHCPOFFER from 152.96.122.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.122.1
        hostname: the specified hostname is invalid
bound to 152.96.122.180 -- renewal in 38370 seconds.

(none):~#

```

Client 5



Wireshark capture of DHCPDISCOVER – client 5

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The session starts with the man page for the "mount" command, followed by error messages from the boot process. It then shows the root login, the Debian license, and the output of the "dhclient" command. The terminal window has tabs at the bottom labeled "suhas@suhas-client...".

```

Applications Places System suhas@suhas-client: ~ Mon Jun 15, 11:39 AM
File Edit View Terminal Tabs Help
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/12'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

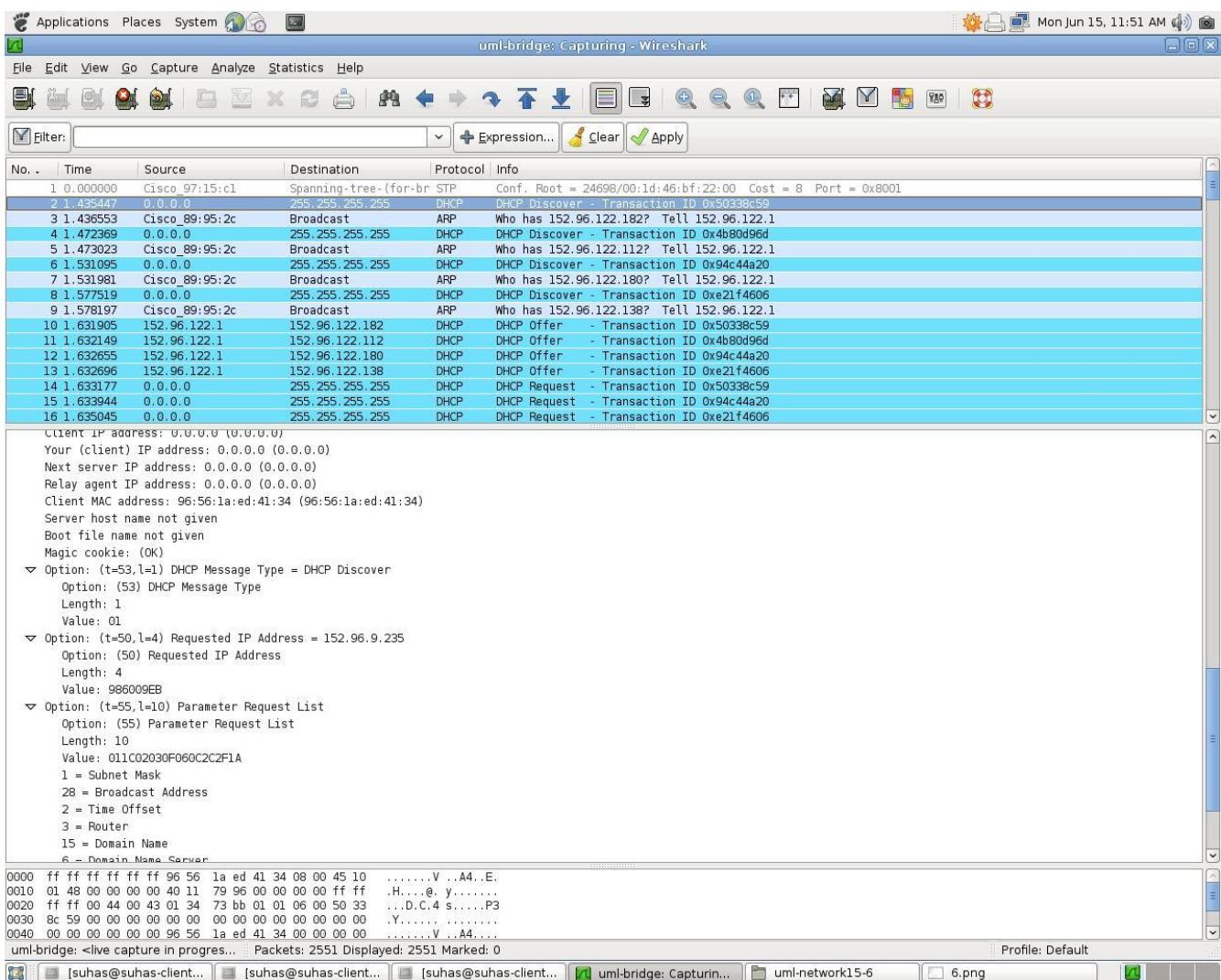
(none):~# dhclient
Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit http://www.isc.org/sw/dhcp/

Listening on LPF/eth0/96:56:1a:ed:41:34
Sending on  LPF/eth0/96:56:1a:ed:41:34
Sending on  Socket/fallback
DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 5
DHCPOFFER from 152.96.122.1
DHCPREQUEST on eth0 to 255.255.255.255 port 67
DHCPACK from 152.96.122.1
        hostname: the specified hostname is invalid
bound to 152.96.122.182 -- renewal in 43142 seconds.

(none):~#

```

Client 6



The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The session starts with the man page for the "mount" command, followed by a series of kernel boot messages. The messages include:

- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Cleaning up ifupdown....
- Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- Setting the system clock.
- modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Cleaning up ifupdown....
- Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- Setting the system clock.
- Setting the system clock.
- Setting kernel variables...done.
- Mounting local filesystems...failed.
- Activating swapfile swap...done.
- Setting up networking...
- Configuring network interfaces...done.
- INIT: Entering runlevel: 2
- Starting system log daemon: syslogd.
- Starting kernel log daemon: klogd.
- * Not starting internet superserver: no services enabled.
- Starting periodic command scheduler: crond.
- Serial line 0 assigned device '/dev/pts/14'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root

Last login: Fri Jun 12 10:43:38 2009 on tty0

Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# dhclient

Internet Systems Consortium DHCP Client V3.0.4
Copyright 2004-2006 Internet Systems Consortium.
All rights reserved.
For info, please visit <http://www.isc.org/sw/dhcp/>

Listening on LPF/eth0:22:06:ab:2e:38:a2

Sending on LPF/eth0:22:06:ab:2e:38:a2

Sending on Socket/fallback

DHCPDISCOVER on eth0 to 255.255.255.255 port 67 interval 4

DHCPOFFER from 152.96.122.1

DHCPREQUEST on eth0 to 255.255.255.255 port 67

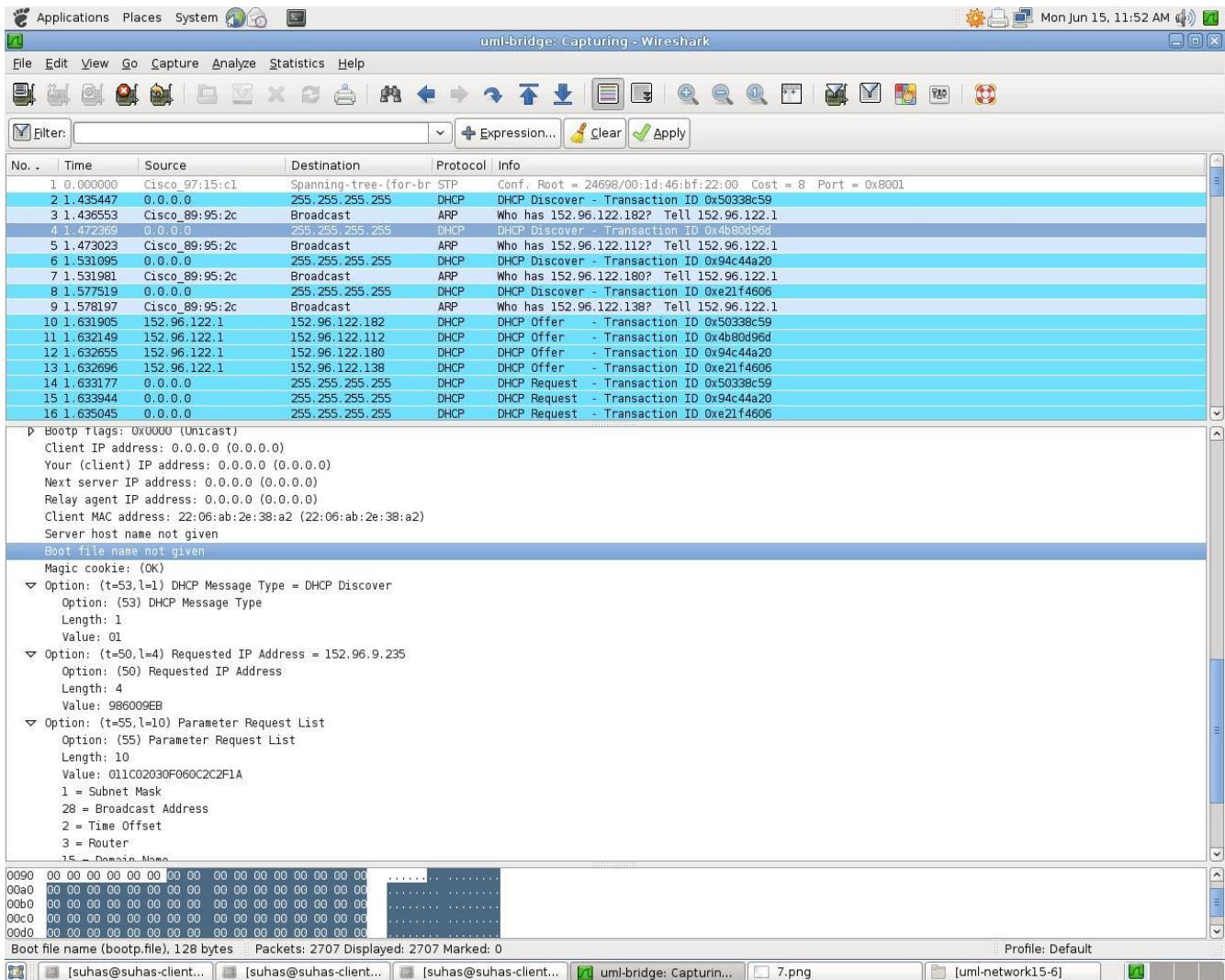
DHCPACK from 152.96.122.1

hostname: the specified hostname is invalid

bound to 152.96.122.112 -- renewal in 37858 seconds.

(none):~#

Client 7



15.Execute command on N* uml clients simultaneously

1)Use while loop -

For N=30

```
#!/bin/sh

execute_script() {

    i=1
    while [ $i -lt 30 ]
    do
        screen -S H$i -p 0 -X eval 'stuff date\012'
        i=`expr $i + 1`
    done

}

execute_script
```

* UML start script is used to start N uml clients

```

File Edit View Terminal Tabs Help
suhas@suhas-client: ~
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13076/131072 files, 68602/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules..FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support...
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/42'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Tue Jun  2 17:00:37 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan  7 11:18:24 EST 2008 i686

                                         The programs included with the Debian GNU/Linux system are free software;
                                         the exact distribution terms for each program are described in the
                                         individual files in /usr/share/doc/*copyright.

                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                         permitted by applicable law.

(none):~# date
Thu Jun  4 11:24:09 UTC 2009
(none):~# 
```

Client 4

```

File Edit View Terminal Tabs Help
suhas@suhas-client: ~
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13076/131072 files, 68602/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V           : print version
       mount -h           : print this help
       mount              : list mounted filesystems
       mount -l            : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
       mount device          : mount device at the known place
       mount directory        : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules..FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support...
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/54'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue Jun  2 17:00:37 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan  7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Thu Jun  4 11:24:09 UTC 2009
(none):~# 

```

Client 15

```

File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13076/131072 files, 68602/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       mount -h : print this help
       mount : list mounted filesystems
       mount -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/50'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Tue Jun 2 17:00:37 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Thu Jun 4 11:24:10 UTC 2009
(none):~#

```

Client 27

Delay of 1 second occurs in simultaneous command execution on Client 4 and Client 27

As, while loop executes command to start UML client in new screen starting with 1 to N , some delay is probable as iteration proceeds from 1 to N.So,delay in command execution on 1 and 27th UML client in the above test conducted is expected.

Executing command on N UML clients (Using while loop)

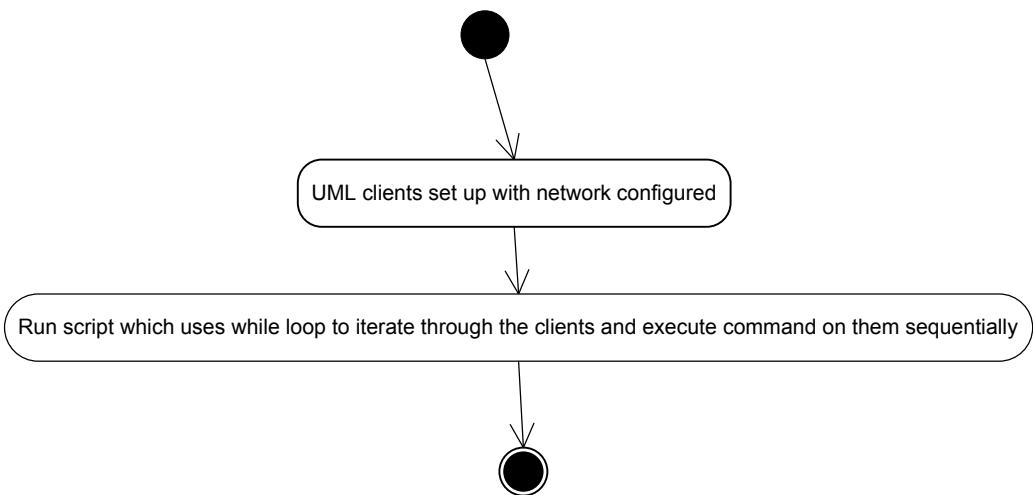


Figure 6: Execute command on N UML clients using while loop

2) Use cron for script scheduling on N uml clients -
Set same time for script execution on N uml clients.

a)

Script scheduling using cron daemon -

```
#!/bin/sh
#Using cron daemon to schedule script on UML clients

set_crontab() {

    i=1
    while [ $i -lt 30 ]
    do
        screen -S H$i -p 0 -X eval 'stuff
crontab\040/host/home/suhas/Desktop/cron.txt\012'
        i=`expr $i + 1`
    done

}

set_crontab
```

b)

Cron file – cron.txt

```
0 14 * * * date
```

16.Clock synchronisation for N UML clients

A)Method 1

For N=30

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window displays a series of "date" command outputs from 30 different clients, all synchronized to the same time: Mon Jun 15 10:00:01 UTC 2009. The clients are listed in a grid, with the last row partially cut off. A red box highlights the date command and its output in the bottom-left corner of the grid.

```
File Edit View Terminal Tabs Help
suhas@suhas-client: ~
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
Mount -a [-t|-O] ...      : mount all stuff from /etc/fstab
mount device              : mount device at the known place
mount directory           : mount known device here
mount -t type dev dir    : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/33'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:48 UTC 2009
(none):~# date
Mon Jun 15 09:59:00 UTC 2009
(none):~# date
Mon Jun 15 09:59:18 UTC 2009
(none):~# date
Mon Jun 15 09:59:49 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~#
```

Client 5

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains a series of system logs and command outputs. It starts with a detailed explanation of the "mount" command, followed by a note about hwclock failing to get I/O port access. The log continues through kernel module loading, device mapper support, file system checking (fsck), and various system initialization steps like setting variables, mounting local filesystems, activating swapfile, and setting networking. It then shows the Debian GNU/Linux 4.0 (none) tty0 login prompt for root, with the last login time being Fri Jun 12 10:43:38 2009. Below this, a standard copyright notice for the Debian system is displayed. Finally, several "date" commands are run at different times (Mon Jun 15 09:58:47 UTC 2009, Mon Jun 15 09:59:01 UTC 2009, Mon Jun 15 09:59:12 UTC 2009, Mon Jun 15 09:59:17 UTC 2009, Mon Jun 15 09:59:48 UTC 2009, Mon Jun 15 10:00:01 UTC 2009). A red rectangular box highlights the date command output from 10:00:01 UTC 2009.

```

File Edit View Terminal Tabs Help
File Edit View Terminal Tabs Help suhas@suhas-client: ~
mount -a [-t|-O] ...      : mount all stuff from /etc/fstab
mount device              : mount device at the known place
mount directory           : mount known device here
mount -t type dev dir    : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid.
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting Kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/52'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:47 UTC 2009          (none):~# date
                                                Mon Jun 15 09:59:01 UTC 2009
(none):~# date
Mon Jun 15 09:59:12 UTC 2009          (none):~# date
                                                Mon Jun 15 09:59:17 UTC 2009
(none):~# date
Mon Jun 15 09:59:48 UTC 2009          (none):~#
                                                (none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# 
```

Client 15

No time gap in clock .
Clocks of client 5 and client 15 are synchronised.

suhas@suhas-client: ~

```

File Edit View Terminal Tabs Help
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown.....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/33'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:48 UTC 2009
(none):~# date
Mon Jun 15 09:59:00 UTC 2009
(none):~# date
Mon Jun 15 09:59:18 UTC 2009
(none):~# date
Mon Jun 15 09:59:49 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~# date
Mon Jun 15 10:06:00 UTC 2009
(none):~# date
Mon Jun 15 10:06:08 UTC 2009
(none):~# date
Mon Jun 15 10:06:17 UTC 2009
(none):~# date
Mon Jun 15 10:06:24 UTC 2009
(none):~# date
Mon Jun 15 10:06:33 UTC 2009
(none):~# date
Mon Jun 15 10:06:41 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~# 
```

Client 5

```

File Edit View Terminal Tabs Help
mount device      : mount device at the known place
mount directory   : mount known device here
mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using '-L label' or by uid, using '-U uid'.
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/45'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:05:59 UTC 2009
(none):~# date
Mon Jun 15 10:06:07 UTC 2009
(none):~# date
Mon Jun 15 10:06:16 UTC 2009
(none):~# date
Mon Jun 15 10:06:23 UTC 2009
(none):~# date
Mon Jun 15 10:06:34 UTC 2009
(none):~# date
Mon Jun 15 10:06:42 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~# 

```

Client 20

Clocks of client 5 and client 20 are synchronized.

```
suhas@suhas-client: ~
File Edit View Terminal Tabs Help
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown.....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/33'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

        The programs included with the Debian GNU/Linux system are free software;
        the exact distribution terms for each program are described in the
        individual files in /usr/share/doc/*copyright.

        Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
        permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:48 UTC 2009
(none):~# date
Mon Jun 15 09:59:00 UTC 2009
(none):~# date
Mon Jun 15 09:59:18 UTC 2009
(none):~# date
Mon Jun 15 09:59:49 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~# date
Mon Jun 15 10:06:00 UTC 2009
(none):~# date
Mon Jun 15 10:06:08 UTC 2009
(none):~# date
Mon Jun 15 10:06:17 UTC 2009
(none):~# date
Mon Jun 15 10:06:24 UTC 2009
(none):~# date
Mon Jun 15 10:06:33 UTC 2009
(none):~# date
Mon Jun 15 10:06:41 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~#
```

Client 5

```

File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V      : print version
       mount -h      : print this help
       mount          : list mounted filesystems
       mount -l      : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-o] ...   : mount all stuff from /etc/fstab
       mount device        : mount device at the known place
       mount directory     : mount known device here
       mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/57'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~#

```

Client 28

Clocks of client 5 and client 28 are synchronized.

Clock synchronisation for clients of larger order -

For N=50

```
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-o] ...      : mount all stuff from /etc/fstab
mount device              : mount device at the known place
mount directory           : mount known device here
mount -t type dev dir    : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/86'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
    Last login: Fri Jun 12 11:05:16 2009 on tty0
                                                Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
                                                The programs included with the Debian GNU/Linux syst
em are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARR
ANTY, to the extent
permitted by applicable law.

(none):~# date
    Fri Jun 12 13:15:21 UTC 2009
(none):~# date
    Fri Jun 12 13:15:34 UTC 2009
(none):~#
```

Client 5

```

mount -n          : print this help
mount            : list mounted filesystems
mount -l          : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
  mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
  mount device          : mount device at the known place
  mount directory        : mount known device here
  mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvwl] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/60'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 11:22:16 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                         The programs included with the Debian GNU/Linux system are free software;
                                         the exact distribution terms for each program are described in the
                                         individual files in /usr/share/doc/*copyright.

                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                         permitted by applicable law.

(none):~# date
Fri Jun 12 13:15:22 UTC 2009
(none):~# date
Fri Jun 12 13:15:34 UTC 2009

```

client 49

Clock of client 5 and client 49 are synchronised

```

Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/86'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 11:05:16 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux syst
em are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARR
ANTY, to the extent
permitted by applicable law.

(none):~# date
Fri Jun 12 13:15:21 UTC 2009
(none):~# date
Fri Jun 12 13:15:34 UTC 2009
(none):~# date
Fri Jun 12 13:17:21 UTC 2009
(none):~# date
Fri Jun 12 13:17:32 UTC 2009
(none):~# date
Fri Jun 12 13:17:45 UTC 2009
(none):~# date
Fri Jun 12 13:18:07 UTC 2009
(none):~# date
Fri Jun 12 13:18:16 UTC 2009
(none):~# date
Fri Jun 12 13:18:28 UTC 2009
(none):~# date
Fri Jun 12 13:20:16 UTC 2009
(none):~# date
Fri Jun 12 13:21:09 UTC 2009
(none):~# date
Fri Jun 12 13:21:34 UTC 2009
(none):~# date
Fri Jun 12 13:22:53 UTC 2009
(none):~# date
Fri Jun 12 13:23:03 UTC 2009
(none):~# date
Fri Jun 12 13:23:21 UTC 2009
(none):~# date
Fri Jun 12 13:23:29 UTC 2009
(none):~# date
Fri Jun 12 13:23:38 UTC 2009
(none):~#

```

client 5

```

So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-O] ...      : mount all stuff from /etc/fstab
mount device              : mount device at the known place
mount directory           : mount known device here
mount -t type dev dir    : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/77'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 11:22:14 2009 on tty0
    Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

        The programs included with the Debian GNU/Linux system are free software;
        the exact distribution terms for each program are described in the
        individual files in /usr/share/doc/*copyright.

        Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
        permitted by applicable law.

(none):~# date
Fri Jun 12 13:23:24 UTC 2009
(none):~#
(none):~# date
Fri Jun 12 13:23:40 UTC 2009
(none):~#
```

Client 40

Gap of 2 second between clocks of client 5 and client 40.

```

or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvwl] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/86'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
    Last login: Fri Jun 12 11:05:16 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
                                         The programs included with the Debian GNU/Linux syst
em are free software;
                                         the exact distribution terms for each program are described in the
                                         individual files in /usr/share/doc/*copyright.
                                         Debian GNU/Linux comes with ABSOLUTELY NO WARR
ANTY, to the extent
                                         permitted by applicable law.

(none):~# date
    Fri Jun 12 13:15:21 UTC 2009
                                         (none):~# date
                                         Fri Jun 12 13:15:34 UTC 2009
(none):~# date
    Fri Jun 12 13:17:21 UTC 2009
                                         (none):~# date
                                         Fri Jun 12 13:17:32 UTC 2009
(none):~# date
    Fri Jun 12 13:17:45 UTC 2009
                                         (none):~# date
                                         Fri Jun 12 13:18:07 UTC 2009
                                         (none):~# date
                                         Fri Jun 12 13:18:16 UTC 2009
(none):~# date
    Fri Jun 12 13:18:28 UTC 2009
                                         (none):~#

```

Client 5

```

mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere;
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: {-nfFrsvw} [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/65'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
    Last login: Fri Jun 12 11:22:13 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                         The programs included with the Debian GNU/Linux system are free software;
                                         the exact distribution terms for each program are described in the
                                         individual files in /usr/share/doc/*copyright.

                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                         permitted by applicable law.

(none):~# date
    Fri Jun 12 13:17:23 UTC 2009
(none):~# date
    Fri Jun 12 13:17:34 UTC 2009
(none):~# date
    Fri Jun 12 13:17:48 UTC 2009
(none):~# date
    Fri Jun 12 13:18:10 UTC 2009
(none):~# date
    Fri Jun 12 13:18:19 UTC 2009
(none):~# date
    Fri Jun 12 13:18:30 UTC 2009
(none):~#

```

Client 35

Gap of 2 seconds is there in clock of client 5 and client 35

```

The programs included with the Debian GNU/Linux syst
em are free software; the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARR
ANTY, to the extent
permitted by applicable law.

(none):~# date
Fri Jun 12 13:15:21 UTC 2009
(none):~# date
Fri Jun 12 13:15:34 UTC 2009
(none):~# date
Fri Jun 12 13:17:21 UTC 2009
(none):~# date
Fri Jun 12 13:17:32 UTC 2009
(none):~# date
Fri Jun 12 13:17:45 UTC 2009
(none):~# date
Fri Jun 12 13:18:07 UTC 2009
(none):~# date
Fri Jun 12 13:18:16 UTC 2009
(none):~# date
Fri Jun 12 13:18:28 UTC 2009
(none):~# date
Fri Jun 12 13:20:16 UTC 2009
(none):~# date
Fri Jun 12 13:21:27 UTC 2009
(none):~# date
Fri Jun 12 13:21:34 UTC 2009
(none):~# date
Fri Jun 12 13:22:53 UTC 2009
(none):~# date
Fri Jun 12 13:23:03 UTC 2009
(none):~# date
Fri Jun 12 13:23:21 UTC 2009
(none):~# date
Fri Jun 12 13:23:29 UTC 2009
(none):~# date
Fri Jun 12 13:23:38 UTC 2009
(none):~# date
Fri Jun 12 13:24:51 UTC 2009
(none):~# date
Fri Jun 12 13:25:04 UTC 2009
(none):~# date
Fri Jun 12 13:25:12 UTC 2009
(none):~# date
Fri Jun 12 13:25:20 UTC 2009
(none):~#
(none):~# date
Fri Jun 12 13:25:32 UTC 2009
(none):~# date
Fri Jun 12 13:25:38 UTC 2009
(none):~# date
Fri Jun 12 13:25:48 UTC 2009

```

Client 5

```

----- mount -t type dev dir : ordinary mount command
ote that one does not really mount a device, one mounts
filesystem (of the given type) found on the device.
ne can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
r move a subtree:
  mount --move olddir newdir
device can be given by name, say /dev/hd1 or /dev/cdrom,
r by label, using -L label or by uuid, using -U uuid .
ther options: [-nfFrswl] [-o options] [-p passwdfd].
or many more details, say man 8 mount
etting the system clock.
odprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

clock is unable to get I/O port access: the iopl(3) call failed.
leaning up ifupdown...
adding kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
adding device-mapper support.
neking file systems...fsck 1.40-WIP (14-Nov-2006)
one.
etting kernel variables...done.
ounting local filesystems...failed.
ctivating swapfile swap...done.
etting up networking...
onfiguring network interfaces...done.
VIT: Entering runlevel: 2
tarting system log daemon: syslogd.
tarting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
tarting periodic command scheduler: crond;
erial line 0 assigned device '/dev/pts/79';

bian GNU/Linux 4.0 (none) tty0

none) login: root
      Last login: Fri Jun 12 11:22:11 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

      The programs included with the Debian GNU/Linux system are free software;
      the exact distribution terms for each program are described in the
      individual files in /usr/share/doc/*copyright.

      Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
      permitted by applicable law.

none):~# date
      Fri Jun 12 13:24:52 UTC 2009
none):~# date
      Fri Jun 12 13:25:05 UTC 2009
      (none):~# date
                                         Fri Jun 12 13:25:13 UTC 2009
none):~# date
      Fri Jun 12 13:25:34 UTC 2009
      (none):~# date
                                         Fri Jun 12 13:25:40 UTC 2009
none):~# date
      Fri Jun 12 13:25:49 UTC 2009
none):~# █

```

Client 30

Gap of 1 second between clock of client 5 and client 30

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains several lines of text from a Linux boot log and a series of date command outputs.

```

File Edit View Terminal Tabs Help suhas@suhas-client: ~
File Edit View Terminal Tabs Help suhas@suhas-client: ~
mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/86'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 11:05:16 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
The programs included with the Debian GNU/Linux syst
em are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARR
ANTY, to the extent
permitted by applicable law.

(none):~# date
Fri Jun 12 13:15:21 UTC 2009
(none):~# date
Fri Jun 12 13:15:34 UTC 2009
(none):~# date
Fri Jun 12 13:17:21 UTC 2009
(none):~# date
Fri Jun 12 13:17:32 UTC 2009
(none):~# date
Fri Jun 12 13:17:45 UTC 2009
(none):~# date
Fri Jun 12 13:18:07 UTC 2009
(none):~# date
Fri Jun 12 13:18:16 UTC 2009
(none):~# date
Fri Jun 12 13:18:28 UTC 2009
(none):~# date
Fri Jun 12 13:20:16 UTC 2009
(none):~#

```

Client 5

```

Usage: mount -V          : print version
       mount -h          : print this help
       mount              : list mounted filesystems
       mount -l          : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device        : mount device at the known place
       mount directory     : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvwl] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/61'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
      Last login: Fri Jun 12 11:22:13 2009 on tty0
      Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

      The programs included with the Debian GNU/Linux system are free software;
      the exact distribution terms for each program are described in the
      individual files in /usr/share/doc/*copyright.

      Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
      permitted by applicable law.

(none):~# date
      Fri Jun 12 13:20:16 UTC 2009
(none):~#

```

Client 25

Clock of client 5 and client 25 is synchronised

```

modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/86'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 11:05:16 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY;
ANY, to the extent
permitted by applicable law.

(none):~# date
Fri Jun 12 13:15:21 UTC 2009
(none):~# date
Fri Jun 12 13:15:34 UTC 2009
(none):~# date
Fri Jun 12 13:17:21 UTC 2009
(none):~# date
Fri Jun 12 13:17:32 UTC 2009
(none):~# date
Fri Jun 12 13:17:45 UTC 2009
(none):~# date
Fri Jun 12 13:18:07 UTC 2009
(none):~# date
Fri Jun 12 13:18:16 UTC 2009
(none):~# date
Fri Jun 12 13:18:28 UTC 2009
(none):~# date
Fri Jun 12 13:20:16 UTC 2009
(none):~# date
Fri Jun 12 13:21:27 UTC 2009
(none):~# date
Fri Jun 12 13:21:34 UTC 2009
(none):~# 

```

Client 5

```

mount -h          : print this help
mount            : list mounted filesystems
mount -l          : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
  mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
  mount device          : mount device at the known place
  mount directory        : mount known device here
  mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L [label] or by uuid, using -U [uuid].
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/75'.

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
      Last login: Fri Jun 12 11:22:11 2009 on tty0
      Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

      The programs included with the Debian GNU/Linux system are free software;
      the exact distribution terms for each program are described in the
      individual files in /usr/share/doc/*copyright.

      Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
      permitted by applicable law.

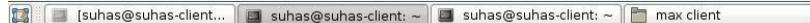
(none):~# date
      Fri Jun 12 13:21:26 UTC 2009
(none):~# date
      Fri Jun 12 13:21:34 UTC 2009
(none):~#
```

Client 15

Clock of client 5 and client 15 is synchronised

For N = 60

```
Other options: [-nfFrsvw] [-o options] [-p passwdfd].  
For many more details, say man 8 mount .  
Setting the system clock..  
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory  
hwclock is unable to get I/O port access: the iopl(3) call failed.  
Cleaning up ifupdown...  
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory  
Loading device-mapper support.  
Checking file systems...fsck 1.40-WIP (14-Nov-2006)  
done.  
Setting kernel variables...done.  
Mounting local filesystems...failed.  
Mounting swapfile swap...done.  
Setting up networking...  
Configuring network interfaces...done.  
INIT: Entering runlevel: 2  
Starting system log daemon: syslogd.  
Starting kernel log daemon: klogd.  
* Not starting internet superserver: no services enabled.  
Starting periodic command scheduler: crond.  
Serial line 0 assigned device '/dev/pts/101'  
  
Debian GNU/Linux 4.0 (none) tty0  
  
(none) login: root  
      Last login: Fri Jun 12 11:05:15 2009 on tty0  
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686  
                                         The programs included with the Debian GNU/Linux system are free software;  
                                         the exact distribution terms for each program are described in the  
                                         individual files in /usr/share/doc/*copyright.  
                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
                                         permitted by applicable law.  
  
(none):~# date  
      Fri Jun 12 12:30:59 UTC 2009  
(none):~# date  
      Fri Jun 12 12:32:01 UTC 2009  
(none):~# date  
      Fri Jun 12 12:33:45 UTC 2009  
(none):~#  
(none):~# date  
      Fri Jun 12 12:38:36 UTC 2009  
(none):~# date  
      Fri Jun 12 12:40:37 UTC 2009  
(none):~# date  
      Fri Jun 12 12:40:49 UTC 2009  
(none):~# date  
      Fri Jun 12 12:41:04 UTC 2009  
(none):~# date  
      Fri Jun 12 12:41:23 UTC 2009  
(none):~# date  
      Fri Jun 12 12:41:35 UTC 2009  
(none):~# date  
      Fri Jun 12 12:41:43 UTC 2009  
  
(none):~#
```



Client 5

```

A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/95'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
      Last login: Fri Jun 12 10:43:38 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                         The programs included with the Debian GNU/Linux system are free software;
                                         the exact distribution terms for each program are described in the
                                         individual files in /usr/share/doc/*copyright.

                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                         permitted by applicable law.

(none):~# date
      Fri Jun 12 11:37:41 UTC 2009
(none):~# date
      Fri Jun 12 11:37:58 UTC 2009
(none):~# date
      Fri Jun 12 12:31:02 UTC 2009
(none):~# date
      Fri Jun 12 12:32:04 UTC 2009
(none):~# date
      Fri Jun 12 12:40:39 UTC 2009
(none):~# date
      Fri Jun 12 12:40:52 UTC 2009
(none):~# date
      Fri Jun 12 12:41:07 UTC 2009
(none):~# date
      Fri Jun 12 12:41:26 UTC 2009
(none):~# date
      Fri Jun 12 12:41:38 UTC 2009
(none):~# date
      Fri Jun 12 12:41:45 UTC 2009
(none):~# 
```



Client 56

Gap of 2 seconds between clock of client 5 and client 56

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The window contains a large amount of text, which is a log of the system boot process. Key parts of the log include:

- Mounting:** The system mounts various filesystems, including /dev/hd1 and /dev/cdrom.
- Kernel Modules:** It attempts to load modules from /lib/modules/2.6.24-rc7-dirty/modules.dep but fails.
- System Configuration:** It configures the system clock, networking, and swapfile.
- Daemons:** It starts daemons like syslogd and klogd.
- Services:** It tries to start an internet superserver (which fails) and a periodic command scheduler (crond).
- Serial Line:** It configures serial line 0.
- Login:** A root login occurs at Fri Jun 12 11:05:15 2009.
- Debian License:** The standard Debian free software license is displayed.
- Date:** The date command is run multiple times, showing different timestamps (e.g., Fri Jun 12 12:30:59 UTC 2009, Fri Jun 12 12:32:01 UTC 2009, Fri Jun 12 12:33:45 UTC 2009).

Client 5

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The window contains a command-line session with the following text:

```

File Edit View Terminal Tabs Help
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
  mount -a [-t|-o] ...      : mount all stuff from /etc/fstab
  mount device             : mount device at the known place
  mount directory          : mount known device here
  mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere;
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support...
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/103'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
  Last login: Fri Jun 12 10:53:01 2009 on tty0
                                         Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

  The programs included with the Debian GNU/Linux system are free software;
  the exact distribution terms for each program are described in the
  individual files in /usr/share/doc/*copyright.

                                         Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
  permitted by applicable law.

(none):~# date
  Fri Jun 12 11:32:36 UTC 2009
(none):~# date
  Fri Jun 12 11:32:49 UTC 2009
  (none):~# date
  Fri Jun 12 11:33:23 UTC 2009
(none):~# date
  Fri Jun 12 11:34:29 UTC 2009
(none):~# date
  Fri Jun 12 12:33:45 UTC 2009
(none):~#

```

The terminal window has three tabs at the bottom, all labeled "suhas@suhas-client: ~". The desktop icons include a trash can, a terminal icon, and a file manager icon.

Client 35

Clock of client 5 and client 35 is synchronised.

```

Details found in /etc/fstab may be omitted.
mount -a [-t|-o] ...      : mount all stuff from /etc/fstab
mount device              : mount device at the known place
mount directory           : mount known device here
mount -t type dev dir    : ordinary mount command

Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/101'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
          Last login: Fri Jun 12 11:05:15 2009 on tty0
          Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

          The programs included with the Debian GNU/Linux system are free software;
          the exact distribution terms for each program are described in the
          individual files in /usr/share/doc/*copyright.

          Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
          permitted by applicable law.

(none):~# date
          Fri Jun 12 12:30:59 UTC 2009
(none):~# date
          Fri Jun 12 12:32:01 UTC 2009
(none):~# date
          Fri Jun 12 12:33:45 UTC 2009
(none):~# date
          Fri Jun 12 12:38:36 UTC 2009
(none):~# 
```

The terminal window shows a multi-line command-line interface. It starts with a series of kernel boot messages, followed by a root login. The user then runs several 'date' commands to show the time progression. The last 'date' command is highlighted with a red box.

Client 5

```

Applications Places System suhas@suhas-client: ~ Fri Jun 12, 7:39 AM
File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13075/131072 files, 68615/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t|-O] ... : mount all stuff from /etc/fstab
       device : mount device at the known place
       directory : mount known device here
       -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       --bind olddir newdir
or move a subtree:
       --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid.
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/68'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 11:05:17 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Fri Jun 12 12:38:36 UTC 2009
(none):~#

```

Client 25

Clock of client 5 and client 25 is synchronised.

Method 1 to test clock synchronization of UML clients –

- 1)Type date on the command prompt of two clients being tested for clock synchronization.
- 2)Try to press ENTER on the command prompt of both UML clients with very less time gap as possible.

Possible flaws –

1)A time gap of a second is possible in doing Step 2,consequently, if date command shows same output on prompts of both UML clients being tested for synchronisation,there is a chance that their clocks actually lag by 1 second and vice versa.

So,result interpretation in two cases –when date command shows gap of 1 second and when it gives the same output on both UML clients,it is difficult to judge in which case, clocks are synchronized.

2)There are chances that delay of 1 or even 2 second might occur in pressing ENTER on the command prompt of two UML clients,so even if date output on two clients shows a gap of 2 seconds,there clocks might be actually synchronized or vice versa.

3)Method is highly inconvenient.

But,still there are cases for in which clocks of one client is synchronized with some ith UML client but not with kth UML client.

For eg –

For N=30

Clocks of different clients tried are synchronized.

For N=50

Clock of client 5 and client 49 are synchronized.(No time gap in date command output)

Clock of client 5 and client 40 are not synchronized.(time gap in date command output 2 seconds)

Clock of client 5 and client 35 are not synchronized.(time gap in date command output 2 seconds)

Clock of client 5 and client 30 are not synchronized.(time gap in date command output 1 second)

Clock of client 5 and client 25 are synchronized.(No time gap in date command output)

Clock of client 5 and client 15 are synchronized.(No time gap in date command output)

For N=60

Clock of client 5 and client 56 are not synchronized.(time gap in date command output 2 seconds)

Clock of client 5 and client 35 are synchronized.(No time gap in date command output)

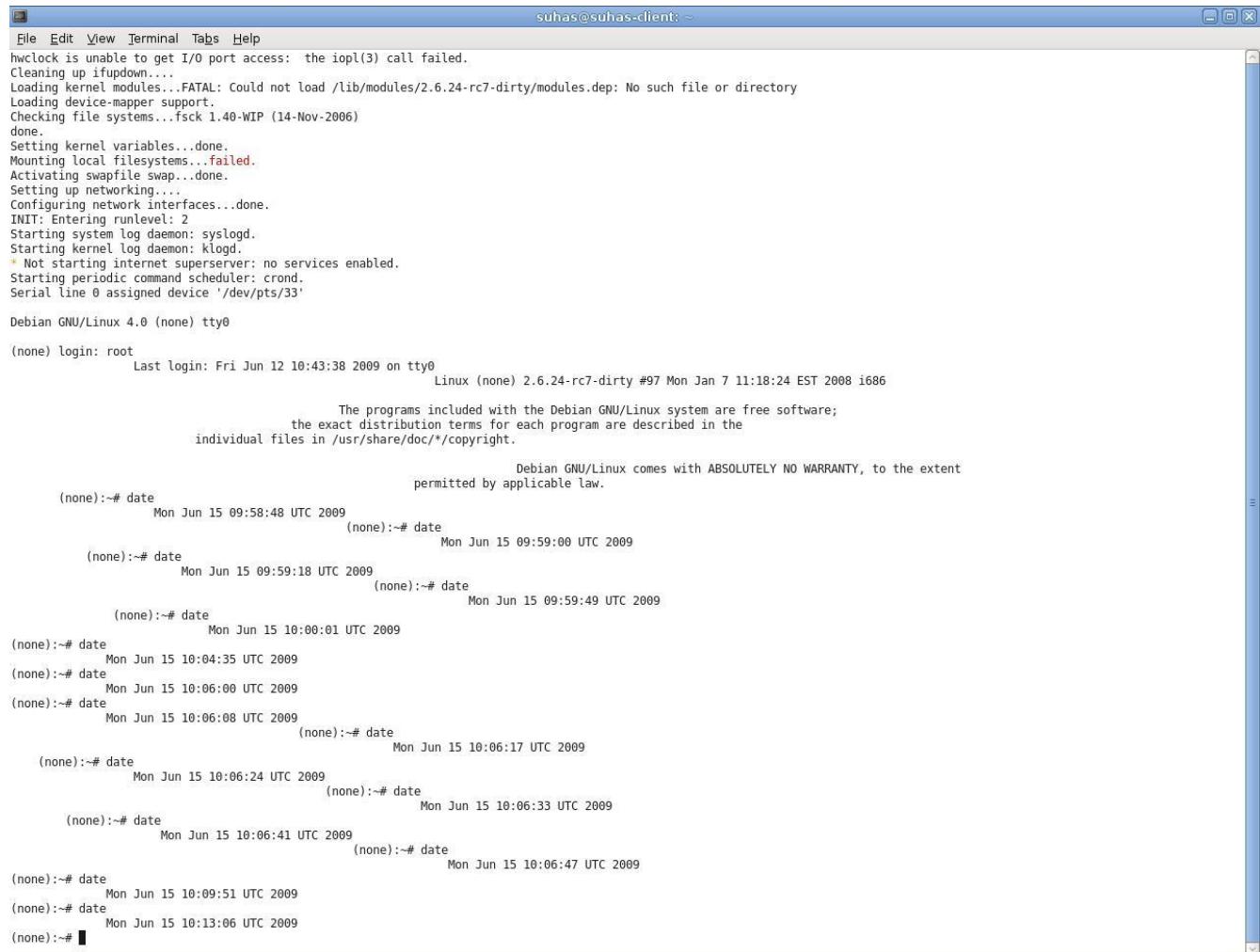
Clock of client 5 and client 25 are synchronized.(No time gap in date command output)

One can clearly observe that time gap occur in clocks of different UML clients

This shows that there are chances of time gap in clocks of different UML clients but this judgement lies on the assumption that this method was performed with same accuracy in each case.

B)
Method 2

For N = 30



```
File Edit View Terminal Tabs Help
File Edit View Terminal Tabs Help
suhas@suhas-client: ~
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/33'
Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:48 UTC 2009
(none):~# date
Mon Jun 15 09:59:00 UTC 2009
(none):~# date
Mon Jun 15 09:59:18 UTC 2009
(none):~# date
Mon Jun 15 09:59:49 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~# date
Mon Jun 15 10:06:00 UTC 2009
(none):~# date
Mon Jun 15 10:06:08 UTC 2009
(none):~# date
Mon Jun 15 10:06:17 UTC 2009
(none):~# date
Mon Jun 15 10:06:24 UTC 2009
(none):~# date
Mon Jun 15 10:06:33 UTC 2009
(none):~# date
Mon Jun 15 10:06:41 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~# date
Mon Jun 15 10:09:51 UTC 2009
(none):~# date
Mon Jun 15 10:13:06 UTC 2009
(none):~#
```

Client 5

```

File Edit View Terminal Tabs Help
suhas@suhas-client: ~
mount directory      : mount known device here
mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/52'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:47 UTC 2009
(none):~# date
Mon Jun 15 09:59:01 UTC 2009
(none):~# date
Mon Jun 15 09:59:12 UTC 2009
(none):~# date
Mon Jun 15 09:59:17 UTC 2009
(none):~# date
Mon Jun 15 09:59:48 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# date
Mon Jun 15 10:13:21 UTC 2009
(none):~#

```

Client 15

Gap of 15 seconds between clock of client 5 and client 15

```

Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/33'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:48 UTC 2009
(none):~# date
Mon Jun 15 09:59:00 UTC 2009
(none):~# date
Mon Jun 15 09:59:18 UTC 2009
(none):~# date
Mon Jun 15 09:59:49 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~# date
Mon Jun 15 10:06:00 UTC 2009
(none):~# date
Mon Jun 15 10:06:08 UTC 2009
(none):~# date
Mon Jun 15 10:06:17 UTC 2009
(none):~# date
Mon Jun 15 10:06:24 UTC 2009
(none):~# date
Mon Jun 15 10:06:33 UTC 2009
(none):~# date
Mon Jun 15 10:06:41 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~# date
Mon Jun 15 10:09:51 UTC 2009
(none):~# date

```

Clock 5

```

suhas@suhas-client: ~
File Edit View Terminal Tabs Help
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock.
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/45'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:05:59 UTC 2009
(none):~# date
Mon Jun 15 10:06:07 UTC 2009
(none):~# date
Mon Jun 15 10:06:16 UTC 2009
(none):~# date
Mon Jun 15 10:06:23 UTC 2009
(none):~# date
Mon Jun 15 10:06:34 UTC 2009
(none):~# date
Mon Jun 15 10:06:42 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~# date
Mon Jun 15 10:10:05 UTC 2009
(none):~#

```

Client 20

Gap of 14 seconds between clock of client 5 and clock 20

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains a series of system logs and command outputs. At the top, there's a message about kernel module loading: "Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory". Below this, the system performs various initialization steps like mounting filesystems and activating swap. The INIT: section shows it entering runlevel 2. It then starts the system log daemon (syslogd) and the kernel log daemon (klogd). A note indicates no internet superserver services are enabled. The cron daemon (crond) is also started. A serial line device is assigned. The system then boots into Debian GNU/Linux 4.0 (wheezy) on tty0. A root login is recorded from Friday, June 12, 2009, at 10:43:38 UTC. The root shell prompt "(none) login: root" is followed by the command "Last login: Fri Jun 12 10:43:38 2009 on tty0". The system then displays the standard Debian copyright notice. Following this, the terminal shows numerous instances of the "date" command being run simultaneously, each outputting a different timestamp between Mon Jun 15 09:58:48 UTC 2009 and Mon Jun 15 10:16:50 UTC 2009. The last few "date" commands are highlighted with a red rectangular selection.

```
File Edit View Terminal Tabs Help suhas@suhas-client: ~
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/33'

Debian GNU/Linux 4.0 (wheezy) tty0

(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 09:58:48 UTC 2009
(none):~# date
Mon Jun 15 09:59:00 UTC 2009
(none):~# date
Mon Jun 15 09:59:18 UTC 2009
(none):~# date
Mon Jun 15 09:59:49 UTC 2009
(none):~# date
Mon Jun 15 10:00:01 UTC 2009
(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~# date
Mon Jun 15 10:06:00 UTC 2009
(none):~# date
Mon Jun 15 10:06:08 UTC 2009
(none):~# date
Mon Jun 15 10:06:17 UTC 2009
(none):~# date
Mon Jun 15 10:06:24 UTC 2009
(none):~# date
Mon Jun 15 10:06:33 UTC 2009
(none):~# date
Mon Jun 15 10:06:41 UTC 2009
(none):~# date
Mon Jun 15 10:06:47 UTC 2009
(none):~# date
Mon Jun 15 10:09:51 UTC 2009
(none):~# date
Mon Jun 15 10:13:06 UTC 2009
(none):~# date
Mon Jun 15 10:16:50 UTC 2009
(none):~#
```

Client 5

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains a large amount of text, which is a boot log for a Debian system. The log includes messages from the kernel, such as "hwclock is unable to get I/O port access: the iopl(3) call failed.", and various initialization steps like "Setting up ifupdown...", "Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory", and "Mounting local filesystems...failed.". It also shows the root login and the standard Debian copyright notice. At the bottom, there are two entries for the "date" command: one at Mon Jun 15 10:04:35 UTC 2009 and another at Mon Jun 15 10:17:05 UTC 2009, with the second entry highlighted by a red rectangle.

```

File Edit View Terminal Tabs Help
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-O] ... : mount all stuff from /etc/fstab
mount device : mount device at the known place
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/57'.

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:04:35 UTC 2009
(none):~# date
Mon Jun 15 10:17:05 UTC 2009
(none):~#

```

Client 28

Gap of 15 seconds between clock of client 5 and client 28

For N=50

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window displays the boot logs of a Debian system. The logs include:

- Checking root file system...fsck 1.40-WIP (14-Nov-2006)
- ROOT: clean, 13071/131072 files, 68609/262144 blocks
- done.
- EXT3 FS on ubda, internal journal
- Usage: mount -V : print version
- mount -h : print this help
- mount : list mounted filesystems
- mount -l : idem, including volume labels
- So far the informational part. Next the mounting.
- The command is 'mount [-t fstype] something somewhere'.
- Details found in /etc/fstab may be omitted.
- mount -a [-t|-O] ... : mount all stuff from /etc/fstab
- mount device : mount device at the known place
- mount directory : mount known device here
- mount -t type dev dir : ordinary mount command
- Note that one does not really mount a device, one mounts a filesystem (of the given type) found on the device.
- One can also mount an already visible directory tree elsewhere:
- mount --bind olddir newdir
- or move a subtree:
- mount --move olddir newdir
- A device can be given by name, say /dev/hd1 or /dev/cdrom,
- or by label, using -L label or by uid, using -U uid.
- Other options: [-nfRrsw] [-o options] [-p passwdfd].
- For many more details, say man 8 mount .
- Setting the system clock.
- modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Cleaning up ifupdown...
- Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- Loading device-mapper support.
- Checking file systems...fsck 1.40-WIP (14-Nov-2006)
- done.
- Setting kernel variables...done.
- Mounting local filesystems...failed.
- Activating swapfile swap...done.
- Setting up networking....
- Configuring network interfaces...done.
- INIT: Entering runlevel: 2
- Starting system log daemon: syslogd.
- Starting kernel log daemon: klogd.
- * Not starting internet superserver: no services enabled.
- Starting periodic command scheduler: crond.
- Serial line 0 assigned device '/dev/pts/52'
- Debian GNU/Linux 4.0 (none) tty0
- (none) login: root
- Last login: Fri Jun 12 10:43:38 2009 on tty0
- Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
- The programs included with the Debian GNU/Linux system are free software;
- the exact distribution terms for each program are described in the
- individual files in /usr/share/doc/*copyright.
- Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
- permitted by applicable law.
- (none):~# date
- Mon Jun 15 10:57:10 UTC 2009
- (none):~#

Clock 6

```

File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V      : print version
       mount -h      : print this help
       mount          : list mounted filesystems
       mount -l      : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
  mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
  mount device           : mount device at the known place
  mount directory        : mount known device here
  mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
  mount --bind olddir newdir
or move a subtree:
  mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfRrsw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock.
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/61'

Debian GNU/Linux 4.0 (none) tty0

(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:57:25 UTC 2009
(none):~#

```

Clock 16

Gap of 15 seconds between clock of client 6 and client 16

```

File Edit View Terminal Tabs Help
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t|-O] ... : mount all stuff from /etc/fstab
       device : mount device at the known place
       directory : mount known device here
       -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       -bind olddir newdir
or move a subtree:
       --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/52'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 10:43:38 2009 on tty0
                                                Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                                The programs included with the Debian GNU/Linux system are free software;
                                                the exact distribution terms for each program are described in the
                                                individual files in /usr/share/doc/*copyright.

                                                Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                                permitted by applicable law.

(none):~# date
Mon Jun 15 10:57:10 UTC 2009
(none):~# date
Mon Jun 15 10:58:50 UTC 2009
(none):~#

```

Clock 6

suhas@suhas-client: ~

```

File Edit View Terminal Tabs Help
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       mount : list mounted filesystems
       mount -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-o] ... : mount all stuff from /etc/fstab
mount device : mount device at the known place
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hdal or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/56'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 10:43:38 2009 on tty0
                                                Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                                The programs included with the Debian GNU/Linux system are free software;
                                                the exact distribution terms for each program are described in the
                                                individual files in /usr/share/doc/*copyright.

                                                Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                                permitted by applicable law.

(none):~# date
Mon Jun 15 10:49:34 UTC 2009
(none):~# date
Mon Jun 15 10:59:04 UTC 2009
(none):~# 
```

Clock 25

Gap of 14 seconds between clock of client 6 and client 25

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains a large amount of text, which is a boot log for a Debian system. The log includes messages from the kernel, init scripts, and userland utilities like hwclock, modprobe, and fsck. It also shows the configuration of network interfaces and the start of various services like syslogd and cron. The log ends with a root login and a date command being run.

```

File Edit View Terminal Tabs Help
Usage: mount -V          : print version
       mount -h          : print this help
       mount              : list mounted filesystems
       mount -l          : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
       mount device         : mount device at the known place
       mount directory      : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount -move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/52'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
        Mon Jun 15 10:57:10 UTC 2009
(none):~# date
        Mon Jun 15 10:58:50 UTC 2009
(none):~# date
        Mon Jun 15 11:01:35 UTC 2009
(none):~#

```

Clock 6

```

File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V      : print version
       mount -h      : print this help
       mount          : list mounted filesystems
       mount -l      : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
       mount device        : mount device at the known place
       mount directory     : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nfRrsw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock.
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/91'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 11:01:49 UTC 2009
(none):~#

```

Clock 30

Gap of 14 seconds between clock of client 6 and clock 30

```

suhas@suhas-client: ~
File Edit View Terminal Tabs Help
mount          : list mounted filesystems
mount -l       : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted:
mount -a [-t|-o] ...   : mount all stuff from /etc/fstab
mount device      : mount device at the known place
mount directory   : mount known device here
mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/52'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:57:10 UTC 2009
(none):~# date
Mon Jun 15 10:58:50 UTC 2009
(none):~# date
Mon Jun 15 11:01:35 UTC 2009
(none):~# date
Mon Jun 15 11:03:20 UTC 2009
(none):~#

```

Clock 6

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains a large amount of text, which is a Linux boot log. The log includes messages from the kernel, such as "hwclock is unable to get I/O port access: the iopl(3) call failed.", and various system initialization steps like "Setting up ifupdown...", "Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory", and "Mounting local filesystems...failed.". It also shows the root login at "Debian GNU/Linux 4.0 (none) tty0" and the output of the "date" command twice, showing different times: "Mon Jun 15 10:51:18 UTC 2009" and "Mon Jun 15 11:03:33 UTC 2009". A red box highlights the second "date" command and its output.

```

File Edit View Terminal Tabs Help
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/68'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 10:51:18 UTC 2009
(none):~# date
Mon Jun 15 11:03:33 UTC 2009
(none):~#

```

Clock 35

Gap of 13 seconds between clock of client 6 and client 35

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains a large amount of text, likely a boot log or system status report. Key sections include:

- Mounting:** Describes the "mount" command, noting it mounts a filesystem (not a device) and can move subtrees.
- Device Handling:** Mentions mounting by name (e.g., /dev/hd1), label, or UUID.
- System Initialization:** Shows the system loading kernel modules, device-mapper support, and file systems, including fsck 1.40-WIP (14-Nov-2006).
- Networking:** Configures network interfaces, sets runlevel to 2, starts syslogd, and klogd.
- Services:** Starts cron and sets up serial port 0.
- Login:** Shows a root login at Fri Jun 12 10:43:38 2009.
- Copyright Notice:** Displays the Debian GNU/Linux copyright notice.
- Date Command:** A series of "date" commands showing the time progression from Mon Jun 15 10:57:10 UTC 2009 to Mon Jun 15 11:05:35 UTC 2009.

Clock 6

```

File Edit View Terminal Tabs Help suhas@suhas-client: ~
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       mount -h : print this help
       mount : list mounted filesystems
       mount -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
mount -a [-t|-O] ... : mount all stuff from /etc/fstab
mount device : mount device at the known place
mount directory : mount known device here
mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
        mount --bind olddir newdir
or move a subtree:
        mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfFrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/92'.

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
    Last login: Fri Jun 12 10:43:38 2009 on tty0
                                                Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

                                                The programs included with the Debian GNU/Linux system are free software;
                                                the exact distribution terms for each program are described in the
                                                individual files in /usr/share/doc/*copyright.

                                                Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
                                                permitted by applicable law.

(none):~# date
Mon Jun 15 11:05:47 UTC 2009
(none):~#

```

Clock 40

Gap of 12 seconds between clocks of client 6 and client 40

The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window contains the following text:

```

File Edit View Terminal Tabs Help
Details found in /etc/fstab may be omitted.
mount -a [-t|-o] ...      : mount all stuff from /etc/fstab
mount device             : mount device at the known place
mount directory          : mount known device here
mount -t type dev dir   : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
    mount --bind olddir newdir
or move a subtree:
    mount --move olddir newdir
A device can be given by name, say /dev/hda1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/52'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
        Mon Jun 15 10:57:10 UTC 2009
(none):~# date
        Mon Jun 15 10:58:50 UTC 2009
(none):~# date
        Mon Jun 15 11:01:35 UTC 2009
(none):~# date
        Mon Jun 15 11:03:20 UTC 2009
(none):~# date
        Mon Jun 15 11:05:35 UTC 2009
(none):~# date
        Mon Jun 15 11:07:35 UTC 2009
(none):~#

```

Clock 6

```

File Edit View Terminal Tabs Help suhas@suhas-client: ~
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       -l : list mounted filesystems
       -t : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock..
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown....
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/94'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

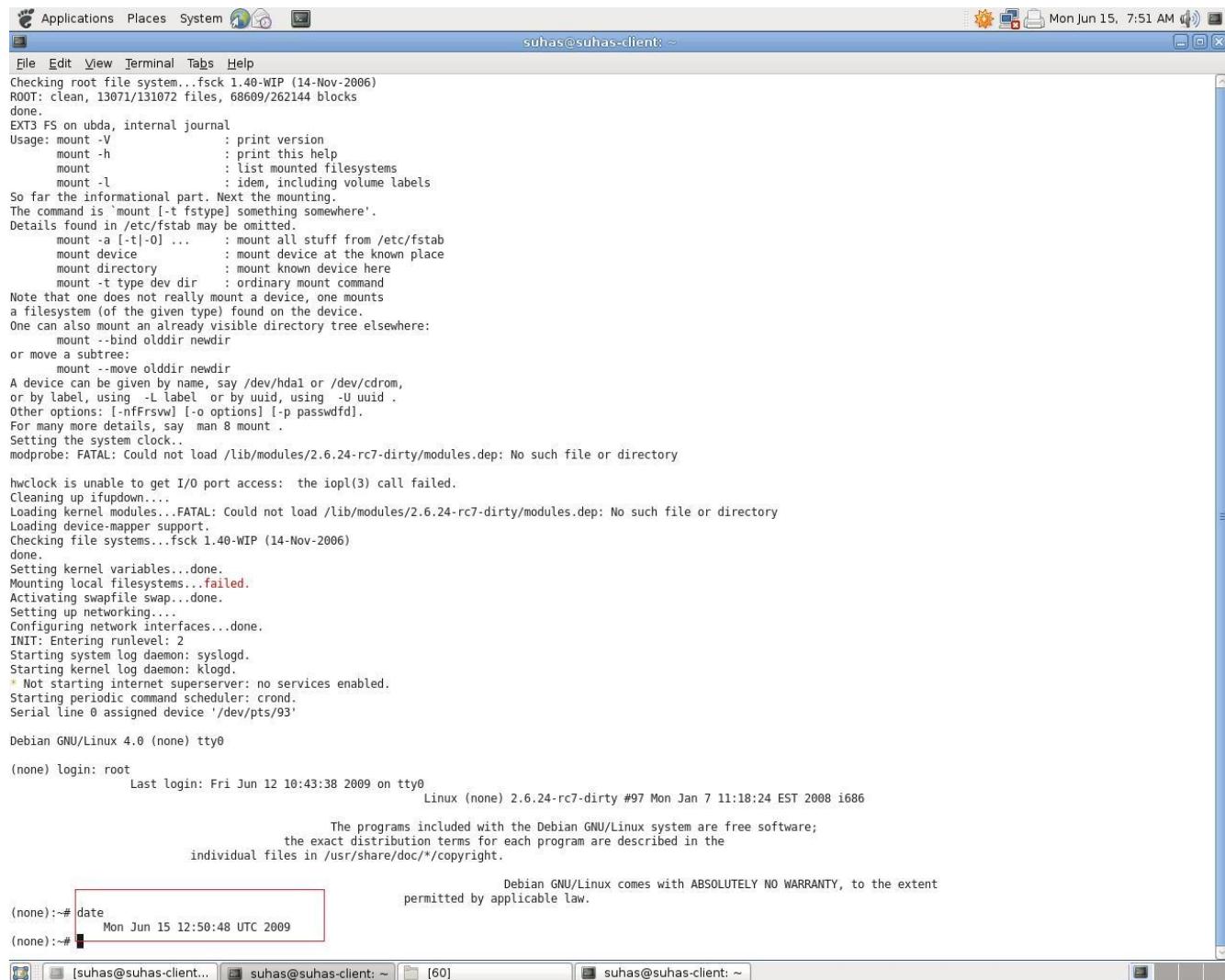
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 11:07:47 UTC 2009
(none):~#
```

Clock 49

Gap of 12 seconds between clock of client 6 and client 49

For N=60



The screenshot shows a terminal window titled "suhas@suhas-client: ~". The window displays a detailed log of a Linux system boot process. The log includes messages from fsck, mount, hwclock, ifupdown, kernel modules, and various system daemons like syslogd, klogd, and crond. It also shows the Debian license and the output of the date command. The terminal has tabs at the bottom labeled "[suhas@suhas-client...]", "suhas@suhas-client: ~", "[60]", and "suhas@suhas-client: ~".

```
File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       mount : list mounted filesystems
       mount -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid.
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/93'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 12:50:48 UTC 2009
(none):~#
```

Clock 6

The screenshot shows a Linux desktop environment with a terminal window open. The terminal displays a detailed log of system boot and configuration steps. Key entries include:

- Checking root file system...fsck 1.40-WIP (14-Nov-2006)
- EXT3 FS on ubda, internal journal
- Usage: mount -V : print version
- So far the informational part. Next the mounting.
- The command is `mount [-t fstype] something somewhere`.
- Details found in /etc/fstab may be omitted.
- Note that one does not really mount a device, one mounts a filesystem (of the given type) found on the device.
- One can also mount an already visible directory tree elsewhere:
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Cleaning up ifupdown....
- Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- Setting the system clock..
- modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- INIT: Entering runlevel: 2
- Starting system log daemon: syslogd.
- Starting kernel log daemon: klogd.
- Activating swapfile swap...done.
- Setting up networking....
- Configuring network interfaces...done.
- Debian GNU/Linux 4.0 (none) tty0
- (none) login: root
- Last login: Fri Jun 12 10:43:38 2009 on tty0
- Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
- The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/*copyright.
- Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.
- (none):~# date
- Mon Jun 15 12:51:03 UTC 2009

The desktop interface includes a menu bar (Applications, Places, System), a toolbar, and a status bar indicating the date and time (Mon Jun 15, 7:51 AM). The taskbar at the bottom shows multiple windows, with the terminal window being the active one.

Clock 25

Gap of 15 seconds between clock of client 6 and client 25

The screenshot shows a Linux desktop environment with a terminal window open. The terminal displays the following text:

```

done.
EXT3 FS on ubda, internal journal
Usage: mount -V           : print version
       mount -h           : print this help
       mount              : list mounted filesystems
       mount -l           : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ...   : mount all stuff from /etc/fstab
       mount device         : mount device at the known place
       mount directory      : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nfRrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
* Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/93'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
Mon Jun 15 12:50:48 UTC 2009
(none):~# date
Mon Jun 15 12:52:48 UTC 2009
(none):~#

```

The terminal window has tabs labeled "suhas@suhas-client..." and "suhas@suhas-client: ~". The bottom status bar shows the date and time as "Mon Jun 15, 7:53 AM".

Clock 6

The screenshot shows a Linux desktop environment with a terminal window open. The terminal displays the system boot process, including kernel module loading, device mounting, and system initialization. Key log entries include:

- Checking root file system...fsck 1.40-WIP (14-Nov-2006)
- EXT3 FS on ubda, internal journal
- Usage: mount -V : print version
- So far the informational part. Next the mounting.
- Note that one does not really mount a device, one mounts a filesystem (of the given type) found on the device.
- One can also mount an already visible directory tree elsewhere:
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Cleaning up ifupdown...
- Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- Setting the system clock..
- modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
- hwclock is unable to get I/O port access: the iopl(3) call failed.
- Setting up networking...
- Configuring network interfaces...done.
- INIT: Entering runlevel: 2
- Starting system log daemon: syslogd.
- Starting kernel log daemon: klogd.
- > Not starting internet superserver: no services enabled.
- Starting periodic command scheduler: crond.
- Serial line 0 assigned device '/dev/pts/68'
- Debian GNU/Linux 4.0 (none) tty0
- (none) login: root
- Last login: Fri Jun 12 10:43:38 2009 on tty0
- Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686
- The programs included with the Debian GNU/Linux system are free software;
- Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
- permitted by applicable law.
- (none):~# date
- Mon Jun 15 12:53:03 UTC 2009
- (none):~#

Clock 35

Gap of 15 seconds between clock of client 6 and client 35

The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "suhas@suhas-client: ~". The window contains a command-line session:

```

File Edit View Terminal Tabs Help
Usage: mount -V      : print version
       -h      : print this help
       -l      : list mounted filesystems
       -l      : idem, including volume labels
So far the informational part. Next the mounting.
The command is 'mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       -a [-t]-O ...   : mount all stuff from /etc/fstab
       mount device    : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir  : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uid, using -U uid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For many more details, say man 8 mount.
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.
Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking....
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/93'

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):~# date
        Mon Jun 15 12:50:48 UTC 2009
(none):~# date
        Mon Jun 15 12:52:48 UTC 2009
(none):~# date
        Mon Jun 15 12:54:33 UTC 2009
(none):~# 
```

The terminal window has three tabs labeled "[suhas@suhas-client...]", "[suhas@suhas-client: ~]", and "[60]". The desktop background shows icons for Applications, Places, System, and a terminal.

Clock 6

The screenshot shows a Linux desktop environment with a terminal window open. The terminal displays a series of log messages and command outputs. At the top of the terminal, there is a header bar with icons for Applications, Places, System, and Help. The date and time 'Mon Jun 15, 7:55 AM' are also shown. The terminal window has tabs labeled 'suhas@suhas-client: ~'. The log messages include:

```

File Edit View Terminal Tabs Help
Checking root file system...fsck 1.40-WIP (14-Nov-2006)
ROOT: clean, 13071/131072 files, 68609/262144 blocks
done.
EXT3 FS on ubda, internal journal
Usage: mount -V : print version
       -h : print this help
       mount : list mounted filesystems
       mount -l : idem, including volume labels
So far the informational part. Next the mounting.
The command is `mount [-t fstype] something somewhere'.
Details found in /etc/fstab may be omitted.
       mount -a [-t|-O] ... : mount all stuff from /etc/fstab
       mount device : mount device at the known place
       mount directory : mount known device here
       mount -t type dev dir : ordinary mount command
Note that one does not really mount a device, one mounts
a filesystem (of the given type) found on the device.
One can also mount an already visible directory tree elsewhere:
       mount --bind olddir newdir
or move a subtree:
       mount --move olddir newdir
A device can be given by name, say /dev/hd1 or /dev/cdrom,
or by label, using -L label or by uuid, using -U uuid .
Other options: [-nffrsvw] [-o options] [-p passwdfd].
For more details, say man 8 mount .
Setting the system clock...
modprobe: FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory

hwclock is unable to get I/O port access: the iopl(3) call failed.
Cleaning up ifupdown...
Loading kernel modules...FATAL: Could not load /lib/modules/2.6.24-rc7-dirty/modules.dep: No such file or directory
Loading device-mapper support.
Checking file systems...fsck 1.40-WIP (14-Nov-2006)
done.

Setting kernel variables...done.
Mounting local filesystems...failed.
Activating swapfile swap...done.
Setting up networking...
Configuring network interfaces...done.
INIT: Entering runlevel: 2
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
> Not starting internet superserver: no services enabled.
Starting periodic command scheduler: crond.
Serial line 0 assigned device '/dev/pts/112'.

Debian GNU/Linux 4.0 (none) tty0
(none) login: root
Last login: Fri Jun 12 10:43:38 2009 on tty0
Linux (none) 2.6.24-rc7-dirty #97 Mon Jan 7 11:18:24 EST 2008 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(none):# date
Mon Jun 15 12:54:41 UTC 2009
(none):#

```

Client 56

Gap of 8 seconds between clock of client 6 and client 56.

Method 2 –

- 1)Type date on the command prompt of two UML clients which are being tested for clock synchronization.
- 2)Press Enter on command prompt of one UML client ,date command will be executed on one UML Client,Wait for 15 seconds,press Enter on command prompt of 2nd UML client,right after 15th second.

Comparison with method 1 –

- 1)More convenient and easy than method 1
- 2)Still a time gap of 1 extra second or more might occur on pressing ENTER on 2nd UML client.
So,if date command shows a gap of 15 seconds ,between UML clients being tested for synchronization, there is a chance that their clocks lag by 1 second,of if a time gap of 14 or 13 seconds is displayed,there is a chance that clocks of different UML clients are synchronized.
So,result interpretation in two cases –when date command shows gap of 15 seconds and when it shows the gap of 13 or 14 seconds between two UML clients,it is difficult to judge in which case, clocks are synchronized.

But,still there are cases for in which clocks of one client is synchronized with some ith UML client but not with kth UML client .

For eg-

For N=30,

- Clock of client 5 and client 15 are synchronized.(time gap in date command output 15 seconds)
- Clock of client 5 and client 20 are not synchronized.(time gap in date command output 14 seconds)
- Clock of client 5 and client 28 are synchronized. (time gap in date command output 15 seconds)

For N=50,

- Clock of client 6 and client 16 are synchronized.(time gap in date command output 15 seconds)
- Clock of client 6 and client 25 are not synchronized.(time gap in date command output 14 seconds)
- Clock of client 6 and client 30 are not synchronized.(time gap in date command output 14 seconds)
- Clock of client 6 and client 35 are not synchronized.(time gap in date command output 13 seconds)
- Clock of client 6 and client 40 are not synchronized.(time gap in date command output 12 seconds)
- Clock of client 6 and client 49 are not synchronized.(time gap in date command output 12 seconds)

For N=60,

- Clock of client 6 and client 25 are synchronized.(time gap in date command output 15 seconds)
- Clock of client 6 and client 35 are synchronized.(time gap in date command output 15 seconds)
- But ,clock of client 6 and client 56 are not synchronized.(time gap in date command output of 8 seconds)

One can clearly observe that time gap occur in clocks of different UML clients.

This shows that there are chances of time gap in clocks of different UML clients but this judgement lies on the assumption that this method was performed with same accuracy in each case

Both the experiments with method 1 and method 2 ,reveal that there are possibilities of time gap between clocks of different UML clients running on same host.

17.Clock synchronization in UML clients

UML clients clock derive its time from host system clock ,so as far as UML clients are running on same host,their clocks should be synchronized ,as they have common source.

But still above results show,there are slight time gap (1-2 seconds) between clocks of some UML clients running on same host.

For performing simultaneous command execution using cron daemon,first clock of each UML client must be synchronized from a NTP server,then a script should be scheduled to run at the same time on different UML clients.

**Execute command on N UML clients simultaneously
(Use Cron daemon)**

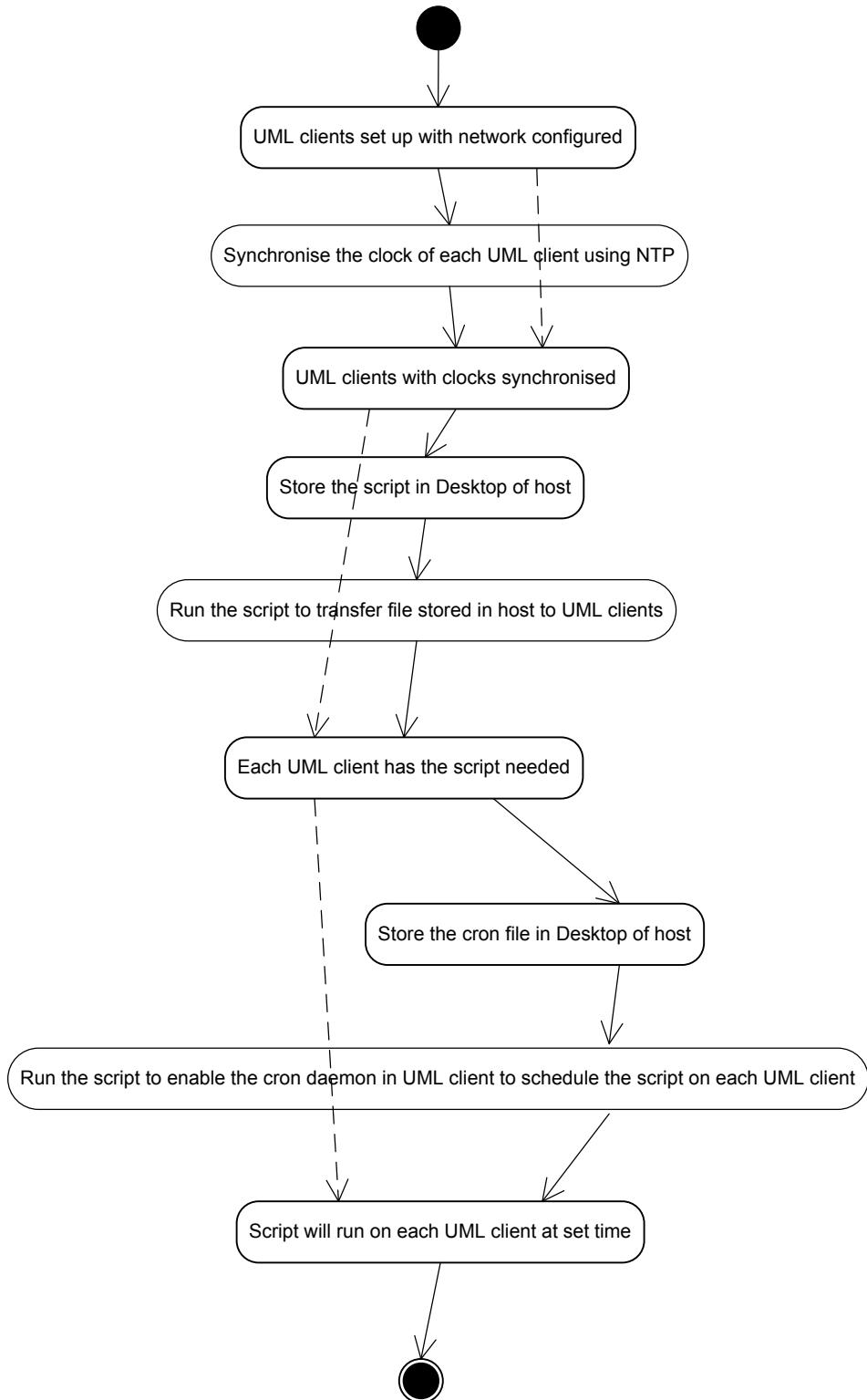


Figure 7: Execute command on N UML clients simultaneously using cron daemon

18.Simulation of more no. of clients

1) Increase RAM size of host -

a) Host system RAM size -2GB

Ram parameter size in script (in MB)	No. of clients that can be simulated	System Memory consumed (in GB)
10	100	1.0 (Half system memory exhausted)
10	200	2.0 (Full system memory exhausted)

b) Host system RAM size -3GB

Ram parameter size in script (in MB)	No. of clients that can be simulated	System Memory consumed (in GB)
10	200	2.0 (1GB system memory unoccupied)
10	300	3.0 (Full system memory occupied)

19.An Observation

More no. of UML processes start when starting UML by UML start command
./linux-2.6.24-rc7 ubd0=Debian-4.0-x86-root_fs mem=128M eth0=tuntap

Ideally,only one UML process should be initiated ,but on running ps aux and pstree following output is obtained -

```
File Edit View Terminal Tabs Help
106 2527 0.0 0.0 2272 884 ? S 05:10 0:00 halmd-addon-acpi
root 2528 0.0 0.1 3388 1032 ? S 05:10 0:00 halmd-addon-stor
root 2533 0.0 0.1 3388 1044 ? S 05:10 0:00 halmd-addon-stor
root 2541 0.0 0.2 12976 2068 ? Ssl 05:10 0:00 /usr/sbin/Netwo
root 2551 0.0 0.1 3508 1320 ? Ss 05:10 0:00 /usr/sbin/Netwo
root 2578 0.0 0.1 14860 1596 ? Ss 05:10 0:00 /usr/sbin/gdm
root 2584 0.0 0.2 14440 3040 ? S 05:10 0:00 /usr/sbin/gdm
root 2587 5.2 0.9 21632 9288 tty7 R+ 05:10 0:04 /usr/X11R6/bin/
root 2591 0.0 0.0 3852 1024 ? Ss 05:10 0:00 /usr/bin/system
daemon 2611 0.0 0.0 2048 436 ? Ss 05:10 0:00 /usr/sbin/atd
root 2633 0.0 0.0 3456 988 ? Ss 05:10 0:00 /usr/sbin/cron
root 2650 0.0 0.0 1764 508 tty1 Ss+ 05:10 0:00 /sbin/getty 384
root 2651 0.0 0.0 1764 508 tty2 Ss+ 05:10 0:00 /sbin/getty 384
root 2652 0.0 0.0 1764 508 tty3 Ss+ 05:10 0:00 /sbin/getty 384
root 2653 0.0 0.0 1764 508 tty4 Ss+ 05:10 0:00 /sbin/getty 384
root 2654 0.0 0.0 1764 504 tty5 Ss+ 05:10 0:00 /sbin/getty 384
root 2655 0.0 0.0 1764 508 tty6 Ss+ 05:10 0:00 /sbin/getty 384
suhas 2707 0.8 0.3 6820 3800 ? S 05:11 0:00 /usr/lib/libgco
suhas 2709 0.0 0.2 14508 2124 ? S 05:11 0:00 /usr/bin/gnome-
suhas 2710 0.3 0.6 27896 6800 ? Ssl 05:11 0:00 x-session-manag
suhas 2758 0.0 0.0 3100 688 ? S 05:11 0:00 /usr/bin/dbus-l
suhas 2759 0.0 0.0 2620 964 ? Ss 05:11 0:00 /usr/bin/dbus-d
suhas 2765 0.7 0.7 23592 7408 ? Ss 05:11 0:00 /usr/bin/seahor
suhas 2768 0.5 0.9 40176 9592 ? Sl 05:11 0:00 gnome-settings-
suhas 2786 1.2 0.9 18048 9460 ? S 05:11 0:00 /usr/bin/metaci
suhas 2787 1.9 1.6 33764 17296 ? S 05:11 0:01 gnome-panel -s
suhas 2790 0.3 0.2 15244 2588 ? Ss 05:11 0:00 gnome-screensav
suhas 2791 8.5 2.1 73696 21764 ? S 05:11 0:05 nautilus --no-d
suhas 2797 0.4 0.2 42288 3072 ? Ssl 05:11 0:00 /usr/lib/bonobo
suhas 2799 0.0 0.5 14536 5576 ? S 05:11 0:00 bluetooth-apple
suhas 2802 0.0 0.3 10052 3788 ? S 05:11 0:00 /usr/lib/gnome-
suhas 2804 0.1 0.7 21156 8004 ? S 05:11 0:00 update-notifier
suhas 2810 1.0 1.7 30572 18244 ? S 05:11 0:00 /usr/bin/python
suhas 2814 0.0 0.4 13828 4940 ? S 05:11 0:00 kerneloops-appl
suhas 2815 0.7 1.0 22268 10732 ? S 05:11 0:00 nm-applet --sm-
suhas 2816 0.0 0.4 19700 4856 ? Ss 05:11 0:00 /usr/lib/gnome-
suhas 2817 0.1 0.7 22360 7260 ? Ss 05:11 0:00 gnome-power-man
suhas 2831 0.0 0.0 2880 936 ? S 05:11 0:00 /usr/lib/nautil
suhas 2839 0.4 1.3 35048 13756 ? Sl 05:11 0:00 /usr/lib/gnome-
suhas 2849 1.8 1.3 37264 14212 ? Sl 05:11 0:00 gnome-terminal
suhas 2852 0.0 0.0 2880 744 ? S 05:11 0:00 gnome-pty-helpe
suhas 2853 0.4 0.2 5668 2936 pts/0 Ss 05:11 0:00 bash
root 2865 0.0 0.1 3772 1132 pts/0 S 05:11 0:00 su
root 2866 0.0 0.1 4252 1680 pts/0 S 05:11 0:00 bash
root 2870 0.0 0.0 2180 356 ? Ss 05:11 0:00 dhclient3 -pf /
root 2896 10.6 1.9 132836 19736 pts/0 S+ 05:11 0:02 ./linux-2.6.24-
root 2902 0.0 1.9 132836 19736 pts/0 S+ 05:11 0:00 ./linux-2.6.24-
root 2903 0.1 1.9 132836 19736 pts/0 S+ 05:11 0:00 ./linux-2.6.24-
root 2904 0.0 1.9 132836 19736 pts/0 S+ 05:11 0:00 ./linux-2.6.24-
root 2905 0.0 0.0 660 612 pts/0 T+ 05:11 0:00 [linux-2.6.24-]
suhas 3276 1.6 0.2 5708 2984 pts/1 Ss 05:12 0:00 bash
root 3471 0.0 0.0 700 700 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3481 0.0 0.0 380 380 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3513 0.0 0.0 772 760 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3554 0.0 0.0 508 508 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3556 0.0 0.0 512 512 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3557 0.2 0.1 3772 1132 pts/1 S 05:12 0:00 su
root 3558 0.0 0.1 4252 1684 pts/1 S 05:12 0:00 bash
suhas 3559 82.0 1.5 19948 15940 ? RN 05:12 0:01 /usr/bin/python
root 3560 0.0 0.1 3716 1032 pts/1 R+ 05:12 0:00 ps aux
suhas-client:/home/suhas#
```

Output of ps aux

```

File Edit View Terminal Tabs Help
suhas@suhas-client: ~
root 3554 0.0 0.0 508 508 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3556 0.0 0.0 512 512 pts/0 T+ 05:12 0:00 [linux-2.6.24-]
root 3557 0.2 0.1 3772 1132 pts/1 S 05:12 0:00 su
root 3558 0.0 0.1 4252 1684 pts/1 S 05:12 0:00 bash
suhas 3559 82.0 1.5 19948 15940 ?
root 3560 0.0 0.1 3716 1032 pts/1 R+ 05:12 0:00 ps aux
suhas-client:/home/suhas# pstree
init─ NetworkManager─{NetworkManager}
    └─ NetworkManagerD
        ├ acpid
        ├ atd
        ├ avahi-daemon─ avahi-daemon
        ├ bonobo-activati─{bonobo-activati}
        ├ cron
        ├ cupsd─ foomatic-rip─ foomatic-rip─ foomatic-rip
            ├ hp
            └─ pstop
        ├ 2*[dbus-daemon]
        ├ dbus-launch
        ├ dhcddb
        ├ dhclient3
        ├ exim4
        ├ gconfd-2
        ├ gdm─ gdm─ Xorg
            ├ x-session-manag─ bluetooth-apple
                ├ gnome-panel
                ├ gnome-settings─{gnome-settings-}
                ├ kerneloops.appl
                ├ metacity
                ├ nautilus
                ├ nm-applet
                ├ seahorse-agent
                ├ system-config-p
                ├ update-notifier
                └─{x-session-manag}
        ├ 6*[getty]
        ├ gnome-keyring-d
        ├ gnome-power-man
        ├ gnome-screensav
        ├ gnome-terminal─ bash─ su─ bash─ linux-2.6.24-rc─ 9*[linux-2.6.24-rc]
            ├ bash─ su─ bash─ pstree
            └─{gnome-terminal}
        ├ gnome-vfs.daemo
        ├ gnome-volume.ma
        ├ hald─ hald-runner─ hald-addon-acpi
            ├ hald-addon-inpu
            └─ 2*[hald-addon-stor]
        ├ kerneloops
        ├ mapping-daemon
        ├ mixer_applet2─{mixer_applet2}
        ├ notification-da
        ├ portmap
        ├ rpc.statd
        ├ rsyslogd─ 3*[{rsyslogd}]
        ├ system-tools-ba
        ├ udevd
        └─ uml_switch
suhas-client:/home/suhas#

```

Output of pstree

One can observe more no .of UML processes – [linux-2.6.24-]

One observation that came is that these extra UML processes that are displayed in the output are not consuming host system memory,so they don't hinder starting large no. of UML clients with the help of start script.

20.A Question..

Finally ,a question yet to be explored remains,it was observed that RAM size had an impact on no. of UML clients that can be simulated.For starting large no. of clients of order 50/60 ,Ram parameter of 10MB was ideal in start script,but there were some UML start errors , screen phenomenon/boot up error which came ,these errors didn't occur when 30 UML clients were started with RAM parameter size 16MB.

Later on, when performing clock synchronization experiment for different UML clients ,there was an observation which came ,when using method 1 ,For N=30,30 Clients started with RAM parameter size 16MB ,clocks of different UML clients were synchronised.

All the results of method 1 are based on the assumption that it was performed with same accuracy in each case.

But for larger no. of UML clients,clients of order 50/60 started with RAM parameter size 10MB,clocks of different UML clients were not synchronized.

All the results of method 1 are based on the assumption that it was performed with same accuracy in each case.

A question which came from this scenario was that ,what are possible consequences of RAM size different UML virtual machines get ,on the performance of UML clients running on same host.

Does it affect their clock synchronization ?

What are the other impacts it can have on UML clients performance?

21. Personal Statement

This stage had various substages-

First one dealt with automating various aspects of UML studied, included automating –

- 1)Starting N Uml clients with the help of script.
- 2)Setting up the Network in UML clients with the help of script.
- 3)Performing command execution in UML client with the help of script.
- 4)Automating transfer of files from host to UML client.
- 5)Starting up scripts transferred from host to UML clients automatically.

Second,dealt with doing a study of various aspects of UML –

- 1)First one ,included studying client simulation with the help of start script.

This had various stages –

- a)Included studying the impact of RAM size on Client simulation.

This included designing Client limit test to check various no. of clients that can be initialized on varying RAM parameter in the start script ,whether the no. of clients tried are getting initialized successfully,or there are some errors coming in initializing some UML clients.

- b)Also,there was a problem of finding maximum no. of clients that can be simulated for given host system memory.

- 2)Configuring UML clients on INS/HSR network ,whether all the clients are getting IP address successfully from DHCP server on the subnet.

Two network setup tests were conducted.

- 3)Performing simultaneous command execution on different UML clients.

There were two ways –

1)Using while loop to perform command execution in N UML clients

There were issues related to time delay that occur in simultaneous command execution ,as loop iterates through 1 to N UML clients.

2)Using cron daemon to schedule command in N UML clients.

This included exploring clock synchronization issues in different UML clients running on same host.It was found there are chances of slight time gaps in different UML clients and there clocks might need to be synchronized from a NTP server before trying to run a command at the same time on different UML clients.

Finally,a way to simulate more no. of UML clients was devised.

Also ,there was a problem which came into observation ,when starting a single UML client with the help of UML start command,more no. of UML processes were starting as obtained from output of ps aux and pstree,it was obvious to study their impact on performance of software to start N UML clients,when fixed RAM is allocated to each UML client.

Finally ,a question yet to be explored remains,it was observed that RAM size had an impact on no. of UML clients that can be simulated.For starting large no. of clients of order 50/60 ,Ram parameter of 10MB was ideal in start script,but there were some UML start errors , screen phenomenon/boot up error which came ,these errors didn't occur when 30 UML clients were started with RAM parameter size 16MB.

Later on, when performing clock synchronization experiment for different UML clients ,there was an observation which came ,when using method 1 ,For N=30,30 Clients started with RAM parameter size 16MB ,clocks of different UML clients were synchronised.

All the results of method 1 are based on the assumption that it was performed with same accuracy in each case.

But for larger no. of UML clients,clients of order 50/60 started with RAM parameter size 10MB,clocks of different UML clients were not synchronized.

All the results of method 1 are based on the assumption that it was performed with same accuracy in each case.

A question which came from this scenario was that ,what are possible consequences of RAM size different UML virtual machines get ,on the performance of UML clients running on same host,

Does it affect their clock synchronization ?

What are the other impacts it can have on UML clients performance?

This work was carried between 1/5/2009 to 20/6/2009

22. References

- 1) Screen man pages
- 2) <http://fbsdtest.pvp.se/index.php?f=gnu-screen>
- 3) <http://www.linuxquestions.org/>

How to send a command to screen session?

- 4) https://www.os3.nl/2008-2009/students/stefan_roelofs/umlauto
- 5) <http://blogs.technet.com/teamdhcp/archive/2006/10/26/when-is-dhcp-nak-issued.aspx>
- 6) <http://www.freesoft.org/CIE/RFC/2131/23.htm>
- 7) http://cssh.sourceforge.net/docs/cssh_man.html
- 8) http://www.akadia.com/services/ntp_synchronize.html
- 9) <http://marc.info/?l=user-mode-linux-user&m=117448523820348&w=2>

23.Project Plan

In this project,a slightly modified Rational Unified Process ,an iterative software development process was followed. RUP defines a process in means of cycles,phases iterations and milestones.According to RUP, the lifecycle of a particular product is broken into several development cycles.In most of the cases,the completion of a cycle results in a new software release.Each cycle consists of the following four phases:

- Inception Phase
- Elaboration phase
- Construction phase
- Transition phase

Process consisted of following phases and iterations:

- Inception phase

In this part of the project the initial documentation is set up,an understanding of problem domain is acquired,fundamental requirements are coarsely defined and an initial risk assessment is carried out.

It was decided ,we will use UML to develop software which simulates N clients.

A thorough study of UML was carried out.

- Elaboration phase

The elaboration phase is where project starts to take shape.In this phase problem, domain analysis is made and the architecture of the project gets its basic form,essential design decisions towards the overall the software architecture are made.

This phase involved setting up plan to automate User mode linux set up,basically develop a software to simulate N clients.

It was decided to use shell scripts ,use of screen command for UML automation.

- Construction phase

The primary objective is to build the software system.In this phase,the main focus goes to the development of components and other features of the system being designed.This is the phase when bulk of coding takes place .

1. Iteration 1 –Shell script to configure network set up for UML on host was made.
2. Iteration 2 - Shell script to start N UML clients was developed.
3. Iteration 3 – Shell script to login to N UML clients.
4. Iteration 4 - Shell script to configure network in UML clients was made.

Above iterations were followed by a stage in which main problem that is of simulating large no. of clients was once again thought upon,code developed was analysed,usage analysis of

code was done. Problem of simulating maximum no. of clients was explored. Client limit test was designed.

5. Iteration 5 - Shell script to transfer file stored in host to UML clients was made.

This stage was followed by further problem analysis stage.

In this stage problem to execute commands on N UML clients simultaneously was explored. Use of for loop and cron daemon to execute command simultaneously was compared. Use of cron daemon led to further exploration of a problem.

Clock synchronization in N UML clients hosted on the same host was studied .

Two methods were designed to study clock synchronization.

After ,this analysis it was further decided that NTP is needed to synchronise clock of UML clients and futher code need to be developed.

- Transition phase

In this phase ,product is moved from development organization to end user. Quality level set in the Inception phase is checked. Maximum no. of clients which are possible to simulate right now are to be explored whether they are sufficient for MPP usage.

24.Meetings

Meetings held were mostly informal where we discussed project progress and created a brief outline of project plan.

23/3/2009

Discussed the working of basic components of UML.

6/4/2009

Discussed the problem which was occurring with UML network.

10/4/2009

Changed the set up with 4 PCs.Experiment with creating own subnet and setting up DHCP server and studying use of bridging.

30/4/2009

Discussed documentation

3/5/2009

Outlined the project plan of automating components of UML studying,automating script execution in UML.configuring MPP environment,start with MPP test script.What are the maximum no. of concurrent UML clients on one host.Experiment with RAM size 8MB,16MB,32MB .

20/5/2009

Showed scripts developed for UML automation,UML start ,UML network set up.Showed Client limit test.Discussed the problem of simultaneous command execution on UML clients needed for MPP.

1/6/2009

Showed ,the script for automating transfer of files from host to UML client and for performing simultaneous command execution on UML client.

18/6/2009

Discussed the update on document and study of problem of executing command on N uml clients simultaneously.

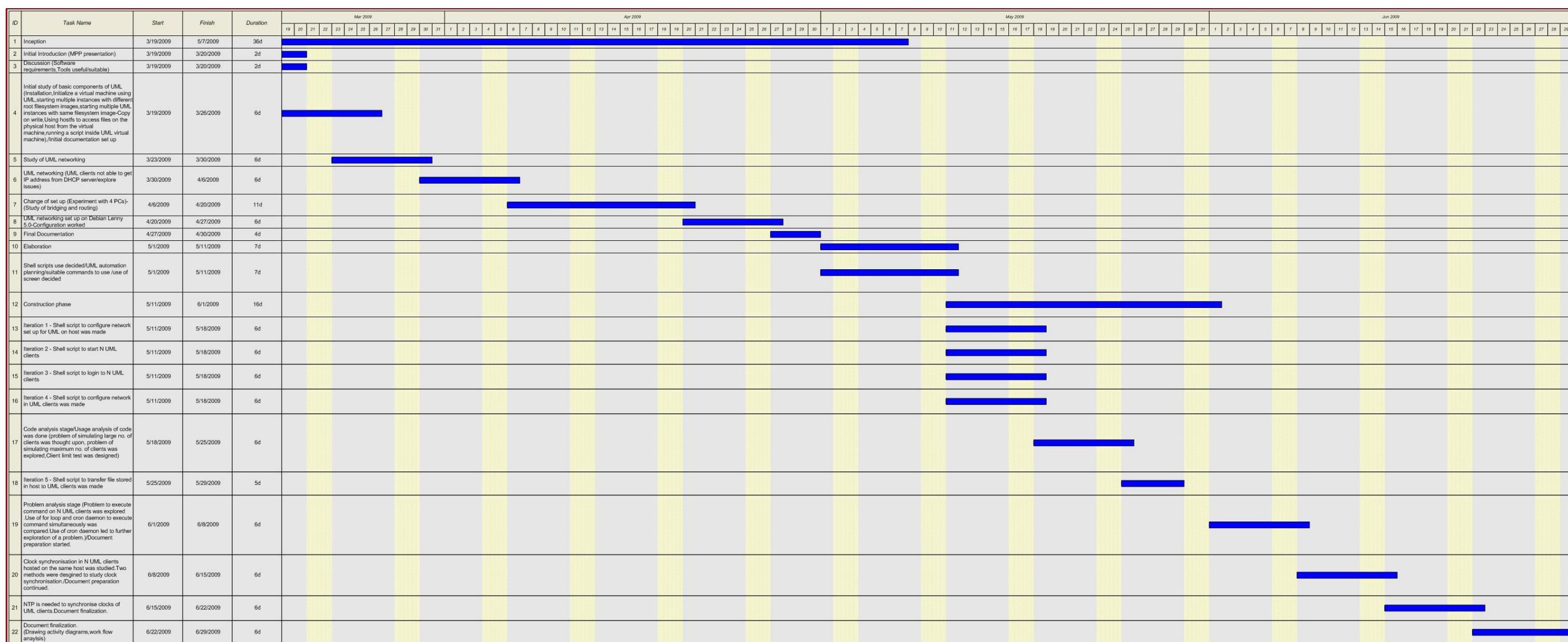
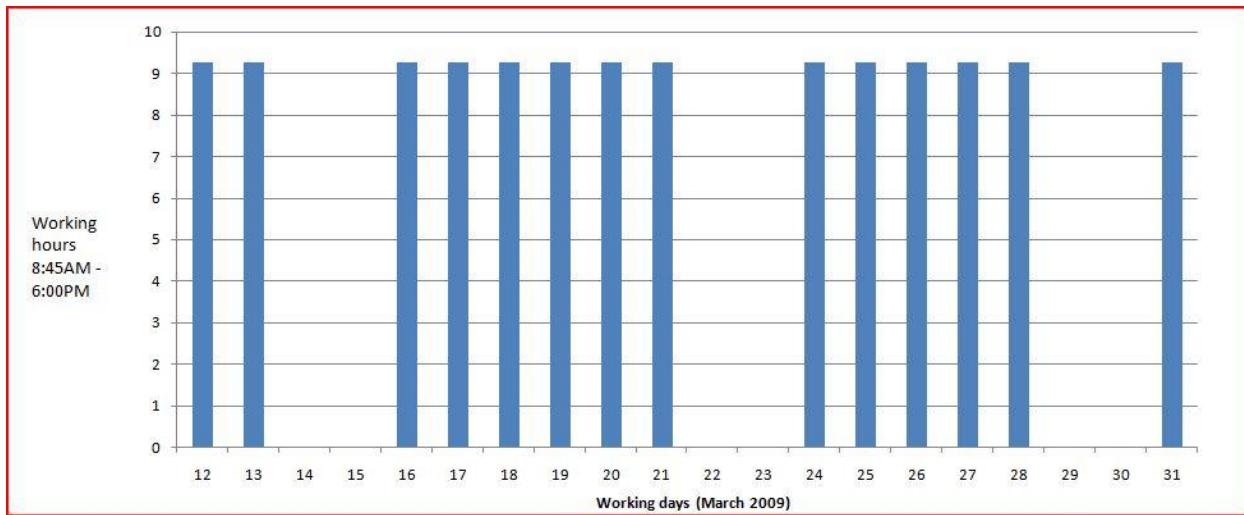
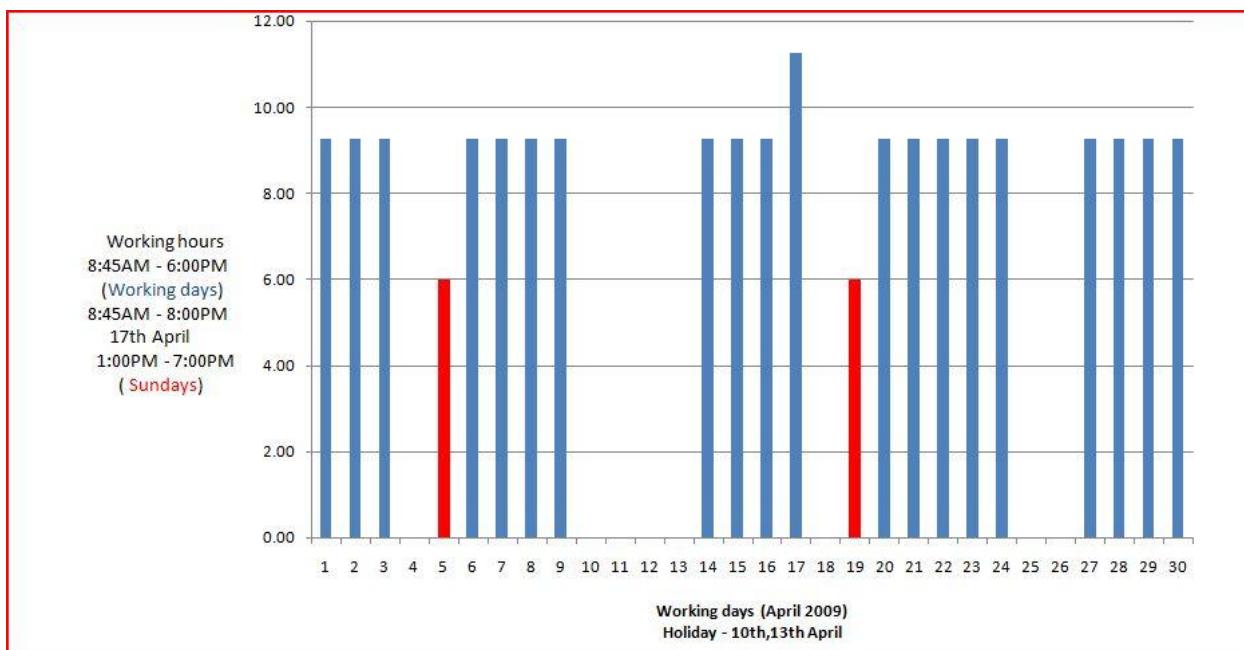


Figure 8: Project progression Gantt chart

Working hours

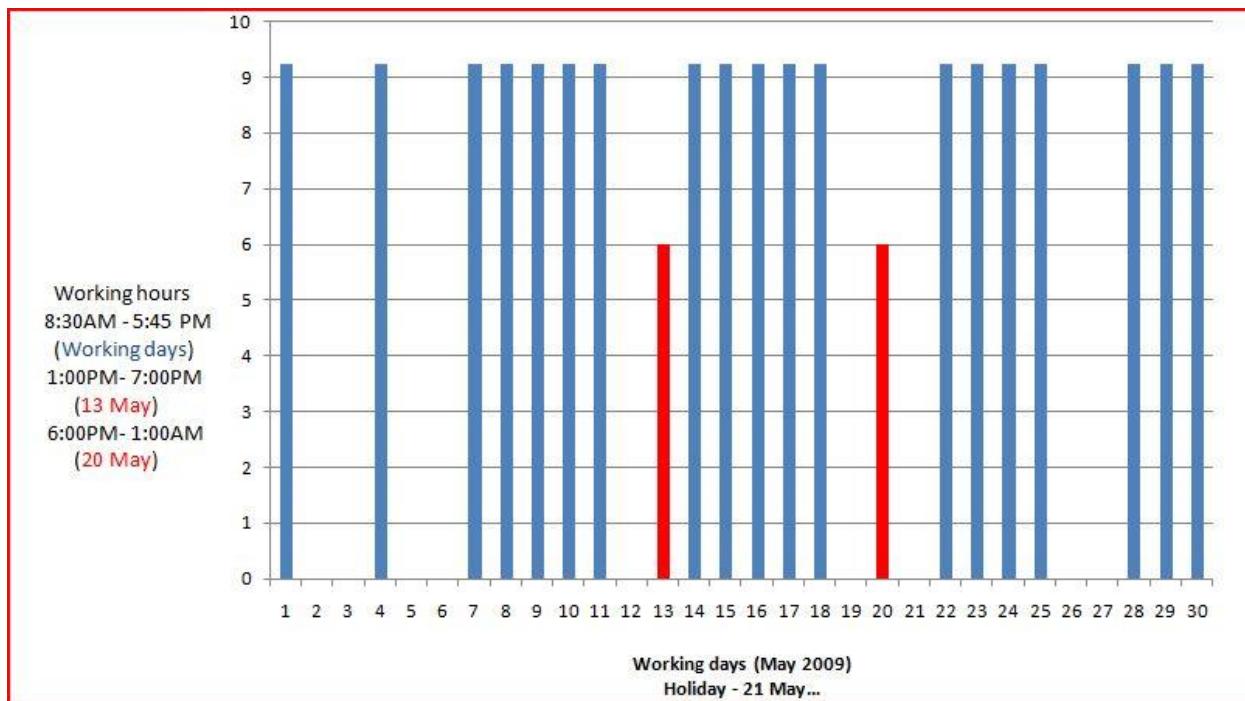


March 2009



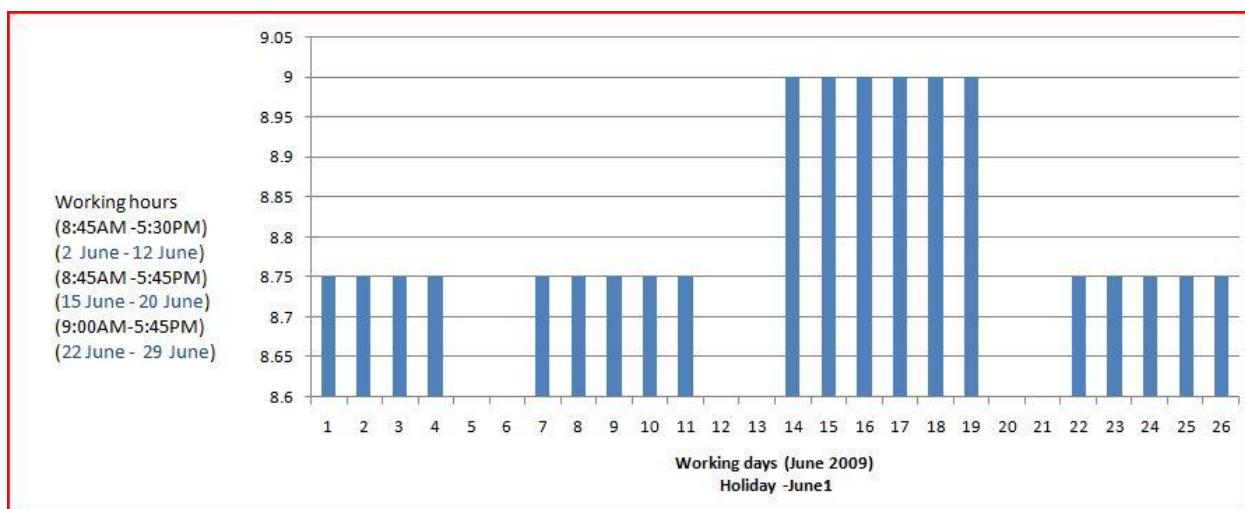
April 2009

(10th – Good Friday, 13th – Easter Monday)



May 2009

(21st – Ascension Day)



June 2009

(1st - Whit Monday)

25.Experience

Entire project work was carried smoothly. There was one thing that was lagging as always. I felt the need for more data ,data especially for proving clock synchronization issues for N =30 case seemed to be insufficient ,but time always seemed to be against me.

Further work –

Synchronising time of UML clients using NTP –

Solution-

It would be convenient to set ntpd to use local clock (clock of host) as a reference driver.

Configuration file for UML clients – /etc/ntp.conf

Server 127.127.1.1

Fudge 127.127.1.1 stratum 4

