

CSCI 558L
Internetwork and Distributed
Systems Laboratory

Laboratory 2
Rakesh Kumar Satvik
USC ID: 8772-6992-51

I have used 3 nodes in my experiment. NodeA is used as a server, whereas nodeB and nodeC were used as clients throughout the experiment.

Virtual Node Info:

| ID | Type | OS | Qualified Name |
|-------|------|----------|--|
| nodeA | pc | FBSD-STD | nodeA.RakeshLab2.USC558L.isi.deterlab.net |
| nodeB | pc | | nodeB.RakeshLab2.USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC.RakeshLab2.USC558L.isi.deterlab.net |

The screenshot shows the DeterLab web interface for experiment USC558L/RakeshLab2. The interface includes a sidebar with experiment options, a top navigation bar, and a main content area with tabs for Settings, Visualization, NS File, and Details. The Details tab is active, showing virtual node info, physical node mapping, and virtual LAN/link info.

Experiment (USC558L/RakeshLab2)

Experiment Options

- View Activity Logfile
- Swap Experiment Out
- Terminate Experiment
- Modify Experiment
- Make Experiment Risky
- Modify Traffic Shaping
- Modify Settings
- Link Tracing/Monitoring
- Event Viewer
- Update All Nodes
- Reboot All Nodes
- Run LinkTest
- Show History
- Duplicate Experiment

Virtual Node Info:

| ID | Type | OS | Qualified Name |
|-------|------|----------|---|
| nodeA | pc | FBSD-STD | nodeA.RakeshLab2.USC558L.isi.deterlab.net |
| nodeB | pc | | nodeB.RakeshLab2.USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC.RakeshLab2.USC558L.isi.deterlab.net |

Physical Node Mapping:

| ID | Type | OS | Physical |
|----------|---------|---------------------|----------|
| nodeA | bpc2133 | FBSD-STD | bpc223 |
| nodeB | bpc2133 | Ubuntu1204-64-STD | bpc212 |
| nodeC | bpc2133 | CentOS5 | bpc215 |
| tbdelay0 | bpc2133 | Ubuntu1204-64-Click | bpc217 |

Virtual Lan/Link Info:

| ID | Member/Proto | IP/Mask | Delay | BW (Kbs) | Loss Rate |
|-------|--------------|---------------|-------|----------|------------|
| lan0 | nodeB:1 | 10.1.2.3 | 0.00 | 100000 | 0.00000000 |
| | ethernet | 255.255.255.0 | 0.00 | 100000 | 0.00000000 |
| lan0 | nodeC:0 | 10.1.2.2 | 0.00 | 100000 | 0.00000000 |
| | ethernet | 255.255.255.0 | 0.00 | 100000 | 0.00000000 |
| link0 | nodeA:0 | 10.1.1.3 | 25.00 | 30000 | 0.00501256 |
| | ethernet | 255.255.255.0 | 25.00 | 30000 | 0.00501256 |
| link0 | nodeB:0 | 10.1.1.2 | 25.00 | 30000 | 0.00501256 |
| | ethernet | 255.255.255.0 | 25.00 | 30000 | 0.00501256 |

Physical Lan/Link Mapping:

| ID | Member | IP | MAC | NodeID |
|----|--------|----|-----|--------|
|----|--------|----|-----|--------|

Given that the target of the laboratory was to enhance the provided code such that the server can handle more than one client and respond to the same accordingly. The output of the codes are captured in screenshots and a brief explanation of each of them is provided alongside.

The basic enhancement is achieved by creating an infinite while loop where the server reads information from all the servers that is trying to get connected. To prove that I have started the server on nodeA with the port number of 51717 and sent across a message from nodeB and nodeC. I have captured the same information on different terminals. To show that they are happening simultaneously I am printing out the IP addresses of each of them (Server and clients, ie nodeA, nodeB and nodeC).

In the current setup while I did my experiment, the IP's captured

nodeA: Server: 192.168.3.223

nodeB: Client: 192.168.3.212

nodeC: Client: 192.168.3.215

You can observe the same on the screenshots pasted below. I have sent a message saying 'Hello from nodeB' and 'Hello from nodeC' to authenticate difference.

Starting the server code on nodeA with the port number of 51717.

The screenshot shows a terminal window on nodeA. The user is logged in as sc558ah. The terminal output shows the following commands and their results:

```
FreeBSD directory layout: man hier
Edit /etc/motd to change this login announcement.
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$ ssh nodeA.RakeshLab2.USC558L.isi.deterlab.net
FreeBSD 8.4-RELEASE-p5 (DETER) #3 r257875M: Fri Nov 8 19:15:22 PST 2013
Welcome to FreeBSD!
Need to quickly empty a file? Use ":> filename".
-- Dru <genesis@istar.ca>
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$ cd Lab2/
[sc558ah@nodea ~]$ ls
client      client.c      server        server.c
[sc558ah@nodea ~]$ rm client
[sc558ah@nodea ~]$ rm server
[sc558ah@nodea ~]$ gcc client.c -o client
[sc558ah@nodea ~]$ gcc server.c -o server
[sc558ah@nodea ~]$ ./server 51717
```

The background shows a sidebar with various application icons and a window titled "Experiment: USC558L/RakeshLab2" with state "active". It contains tables for Virtual Node Info and Physical Node Mapping.

| Virtual Node Info: | | | |
|--------------------|------|-------------------|---|
| ID | Type | OS | Qualified Name |
| nodeA | pc | FBSD8-STD | nodeA.RakeshLab2.USC558L.isi.deterlab.net |
| nodeB | pc | Ubuntu1204-64-STD | nodeB.RakeshLab2.USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC.RakeshLab2.USC558L.isi.deterlab.net |

| Physical Node Mapping: | | | |
|------------------------|---------|---------------------|----------|
| ID | Type | OS | Physical |
| nodeA | bpc2133 | FBSD8-STD | bpc223 |
| nodeB | bpc2133 | Ubuntu1204-64-STD | bpc212 |
| nodeC | bpc2133 | CentOS5 | bpc215 |
| tbdelay0 | bpc2133 | Ubuntu1204-64-Click | bpc217 |

Starting the client code on nodeB. You can see the print saying the IP of server and message of "Hello from nodeB"

The screenshot shows a terminal window on nodeB. The user is logged in as sc558ah. The terminal output shows the following commands and their results:

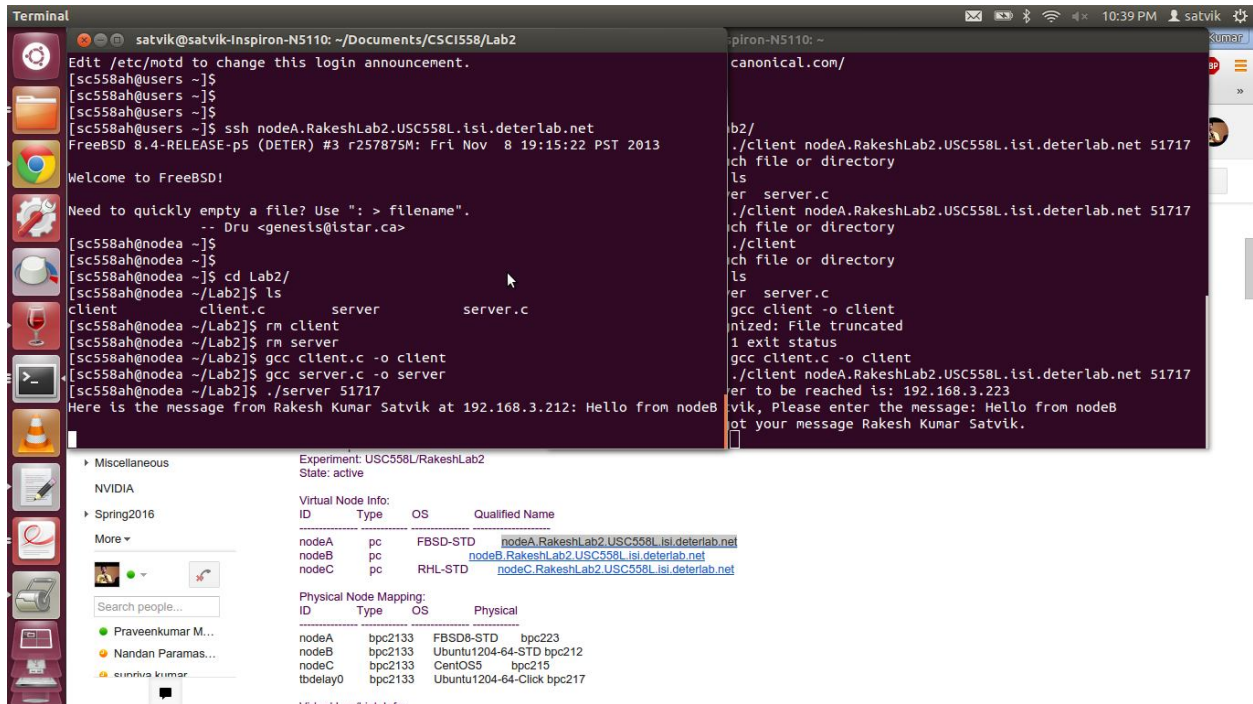
```
FreeBSD directory layout: man hier
Edit /etc/motd to change this login announcement.
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$ ssh nodeA.RakeshLab2.USC558L.isi.deterlab.net
FreeBSD 8.4-RELEASE-p5 (DETER) #3 r257875M: Fri Nov 8 19:15:22 PST 2013
Welcome to FreeBSD!
Need to quickly empty a file? Use ":> filename".
-- Dru <genesis@istar.ca>
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$ cd Lab2/
[sc558ah@nodea ~]$ ls
client      client.c      server        server.c
[sc558ah@nodea ~]$ rm client
[sc558ah@nodea ~]$ rm server
[sc558ah@nodea ~]$ gcc client.c -o client
[sc558ah@nodea ~]$ gcc server.c -o server
[sc558ah@nodea ~]$ ./server 51717
```

The background shows a sidebar with various application icons and a window titled "Experiment: USC558L/RakeshLab2" with state "active". It contains tables for Virtual Node Info and Physical Node Mapping.

| Virtual Node Info: | | | |
|--------------------|------|-------------------|---|
| ID | Type | OS | Qualified Name |
| nodeA | pc | FBSD8-STD | nodeA.RakeshLab2.USC558L.isi.deterlab.net |
| nodeB | pc | Ubuntu1204-64-STD | nodeB.RakeshLab2.USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC.RakeshLab2.USC558L.isi.deterlab.net |

| Physical Node Mapping: | | | |
|------------------------|---------|---------------------|----------|
| ID | Type | OS | Physical |
| nodeA | bpc2133 | FBSD8-STD | bpc223 |
| nodeB | bpc2133 | Ubuntu1204-64-STD | bpc212 |
| nodeC | bpc2133 | CentOS5 | bpc215 |
| tbdelay0 | bpc2133 | Ubuntu1204-64-Click | bpc217 |

This displays the message received by the server and still running the loop looking for more clients to connect. It also has the message from nodeB and its IP address along with it.



```
satvik@satvik-Inspiron-N5110: ~/Documents/CSCI558/Lab2
Edit /etc/motd to change this login announcement.
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$ ssh nodeA.RakeshLab2.USC558L.isi.deterlab.net
FreeBSD 8.4-RELEASE-p5 (DETER) #3 r257875M: Fri Nov  8 19:15:22 PST 2013
Welcome to FreeBSD!
Need to quickly empty a file? Use ": > filename".
-- Dru <genesis@istar.ca>
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$ cd Lab2/
[sc558ah@nodea ~Lab2]$ ls
client      server      server.c
[sc558ah@nodea ~Lab2]$ rm client
[sc558ah@nodea ~Lab2]$ rm server
[sc558ah@nodea ~Lab2]$ gcc client.c -o client
[sc558ah@nodea ~Lab2]$ gcc server.c -o server
[sc558ah@nodea ~Lab2]$ ./server 51717
Here is the message from Rakesh Kumar Satvik at 192.168.3.212: Hello from nodeB

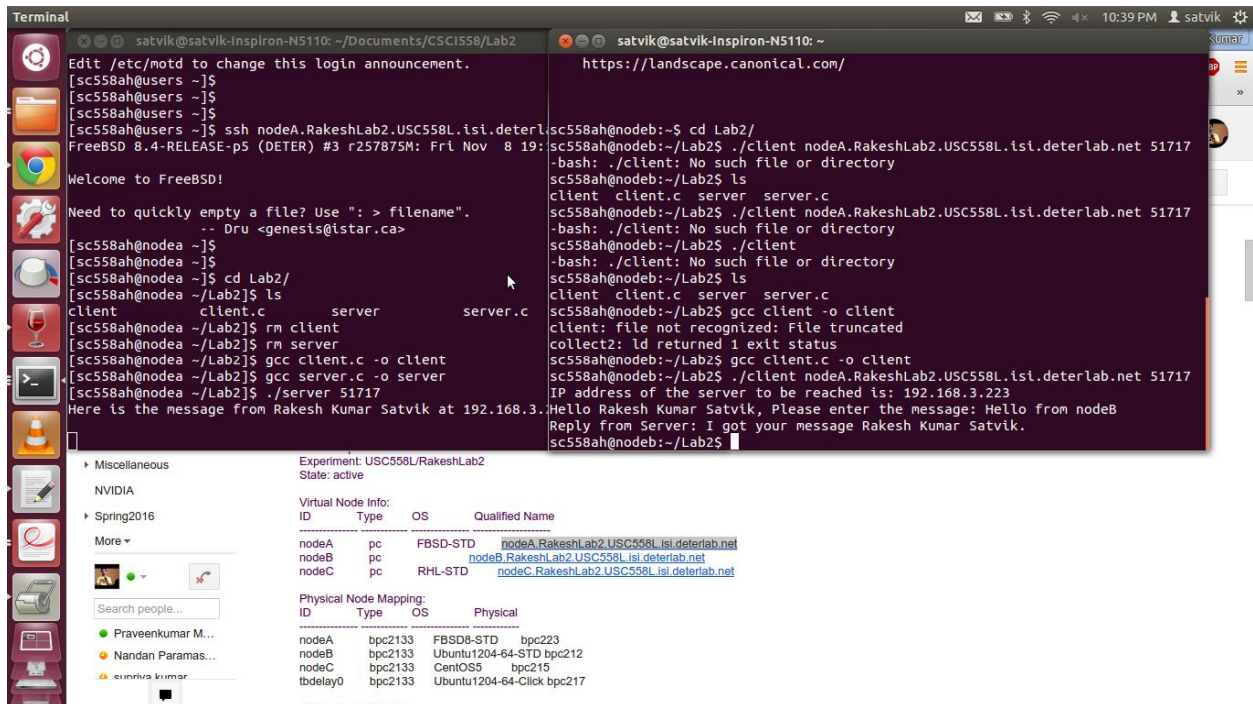
Miscellaneous
NVIDIA
Spring2016
More
Search people...
Praveenkumar M...
Nandan Paramas...
sunilkrumar...
```

| Virtual Node Info: | | | |
|--------------------|------|-------------------|---|
| ID | Type | OS | Qualified Name |
| nodeA | pc | FBSD-STD | nodeA.RakeshLab2.USC558L.isi.deterlab.net |
| nodeB | pc | Ubuntu1204-64-STD | nodeB.RakeshLab2.USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC.RakeshLab2.USC558L.isi.deterlab.net |

| Physical Node Mapping: | | | |
|------------------------|---------|---------------------|----------|
| ID | Type | OS | Physical |
| nodeA | bpc2133 | FBSD8-STD | bpc223 |
| nodeB | bpc2133 | Ubuntu1204-64-STD | bpc212 |
| nodeC | bpc2133 | CentOS5 | bpc215 |
| tbdelay0 | bpc2133 | Ubuntu1204-64-Click | bpc217 |

Virtual 1 node link info:

Once a message has been sent from nodeB the server sends an acknowledgement back saying that the message has been received.



```
satvik@satvik-Inspiron-N5110: ~/Documents/CSCI558/Lab2
Edit /etc/motd to change this login announcement.
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$ ssh nodeA.RakeshLab2.USC558L.isi.deterlab.net
FreeBSD 8.4-RELEASE-p5 (DETER) #3 r257875M: Fri Nov  8 19:15:22 PST 2013
Welcome to FreeBSD!
Need to quickly empty a file? Use ": > filename".
-- Dru <genesis@istar.ca>
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$ cd Lab2/
[sc558ah@nodea ~Lab2]$ ls
client      server      server.c
[sc558ah@nodea ~Lab2]$ rm client
[sc558ah@nodea ~Lab2]$ rm server
[sc558ah@nodea ~Lab2]$ gcc client.c -o client
[sc558ah@nodea ~Lab2]$ gcc server.c -o server
[sc558ah@nodea ~Lab2]$ ./server 51717
Here is the message from Rakesh Kumar Satvik at 192.168.3.212: Hello from nodeB

satvik@satvik-Inspiron-N5110: ~/Documents/CSCI558/Lab2
https://landscape.canonical.com/
[sc558ah@nodeb:~]$ cd Lab2/
[sc558ah@nodeb:~/Lab2]$ ./client nodeA.RakeshLab2.USC558L.isi.deterlab.net 51717
-bash: ./client: No such file or directory
[sc558ah@nodeb:~/Lab2]$ ls
client      client.c    server      server.c
[sc558ah@nodeb:~/Lab2]$ ./client nodeA.RakeshLab2.USC558L.isi.deterlab.net 51717
-bash: ./client: No such file or directory
[sc558ah@nodeb:~/Lab2]$ ./client
-bash: ./client: No such file or directory
[sc558ah@nodeb:~/Lab2]$ ls
client      client.c    server      server.c
[sc558ah@nodeb:~/Lab2]$ gcc client -o client
client: file not recognized: File truncated
collect2: ld returned 1 exit status
[sc558ah@nodeb:~/Lab2]$ gcc client.c -o client
[sc558ah@nodeb:~/Lab2]$ ./client nodeA.RakeshLab2.USC558L.isi.deterlab.net 51717
IP address of the server to be reached is: 192.168.3.223
Hello Rakesh Kumar Satvik, Please enter the message: Hello from nodeB
Reply from Server: I got your message Rakesh Kumar Satvik.
[sc558ah@nodeb:~/Lab2]$
```

| Virtual Node Info: | | | |
|--------------------|------|-------------------|---|
| ID | Type | OS | Qualified Name |
| nodeA | pc | FBSD-STD | nodeA.RakeshLab2.USC558L.isi.deterlab.net |
| nodeB | pc | Ubuntu1204-64-STD | nodeB.RakeshLab2.USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC.RakeshLab2.USC558L.isi.deterlab.net |

| Physical Node Mapping: | | | |
|------------------------|---------|---------------------|----------|
| ID | Type | OS | Physical |
| nodeA | bpc2133 | FBSD8-STD | bpc223 |
| nodeB | bpc2133 | Ubuntu1204-64-STD | bpc212 |
| nodeC | bpc2133 | CentOS5 | bpc215 |
| tbdelay0 | bpc2133 | Ubuntu1204-64-Click | bpc217 |

Virtual 1 node link info:

Similar steps have been followed by nodeC. It sends a message to server and gets a reply from the server as an acknowledgement.

```

Terminal
[no su x] [M.I.DE x] [Core x] [isi.de x] [myUS x] [S x] satvik@satvik-Inspiron-N5110: ~
FreeBSD directory layout: man hier
Edit /etc/motd to change this login announcement.
[sc558ah@users ~]$ ssh nodeC.RakeshLab2.USC558L.isi.deterlab.net.
The authenticity of host 'nodeC.RakeshLab2.usc558l.isi.deterlab.net. (192.168.3.215)' can't be established.
RSA key fingerprint is 4d:de:0a:0c:c0:20:3e:40:39:b3:a8:b1:f2:53:57:ff.
No matching host key fingerprint found in DNS.
Are you sure you want to continue connecting (yes/no)? ^C
[sc558ah@users ~]$ ssh nodeC.RakeshLab2.USC558L.isi.deterlab.net
The authenticity of host 'nodeC.RakeshLab2.usc558l.isi.deterlab.net (192.168.3.215)' can't be established.
RSA key fingerprint is 4d:de:0a:0c:c0:20:3e:40:39:b3:a8:b1:f2:53:57:ff.
No matching host key fingerprint found in DNS.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'nodeC.RakeshLab2.usc558l.isi.deterlab.net' (RSA) to the list of known hosts.
-bash-3.2$ cd Lab2/
-bash-3.2$ gcc client.c -o client
-bash-3.2$ ./client nodeA.RakeshLab2.USC558L.isi.deterlab.net 51717
IP address of the server to be reached is: 192.168.3.223
Hello Rakesh Kumar Satvik, Please enter the message: hello from nodeC
Reply from Server: I got your message Rakesh Kumar Satvik.
-bash-3.2$

```

Server still looking for more clients to connect.

```

Terminal
satvik@satvik-Inspiron-N5110: ~/Documents/CSCI558/Lab2
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$ ssh nodeA.RakeshLab2.USC558L.isi.deterlab.net
FreeBSD 8.4-RELEASE-p5 (DETER) #3 r257875M: Fri Nov 8 19:15:22 PST 2013
Welcome to FreeBSD!
Need to quickly empty a file? Use ": > filename".
-- Dru <genetis@istar.ca>
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$ cd Lab2/
[sc558ah@nodea ~]$ ls
client      server      server.c
[sc558ah@nodea ~]$ rm client
[sc558ah@nodea ~]$ rm server
[sc558ah@nodea ~]$ gcc client.c -o client
[sc558ah@nodea ~]$ gcc server.c -o server
[sc558ah@nodea ~]$ ./server 51717
Here is the message from Rakesh Kumar Satvik at 192.168.3.212: Hello from nodeB
Here is the message from Rakesh Kumar Satvik at 192.168.3.215: hello from nodeC

```

signal (SIGCHLD, SIG_IGN); was used to handle the Zombie processes. To authenticate that ps -aux of the server function was done and you can see that there are no zombie threads available. According to the manual the stats column of the process indicates the zombie threads present.

D Uninterruptible sleep (usually IO)
 R Running or runnable (on run queue)
 S Interruptible sleep (waiting for an event to complete)
 T Stopped, either by a job control signal or because it is being traced.
 W paging (not valid since the 2.6.xx kernel)
 X dead (should never be seen)
 Z Defunct ("zombie") process, terminated but not reaped by its parent.

So with the code handling zombie processes we do not see any zombie processes. (a Z+ in the stats column for any of the processes)

```

satvik@satvik-Inspiron-N5110: ~/Documents/CSCI558/Lab2
[sc558ah@users ~]$
[sc558ah@users ~]$
[sc558ah@users ~]$ ssh nodeA.RakeshLab2.USC558L.isi.deterlab.net
FreeBSD 8.4-RELEASE-p5 (DETER) #3 r257875M: Fri Nov 8 19:00:00 PST 2013; root:xnu-802.2~2/RELEASE_ARM_T8020
Welcome to FreeBSD!

Need to quickly empty a file? Use ":> filename".
-- Dru <genesis@istar.ca>
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$
[sc558ah@nodea ~]$ cd Lab2/
[sc558ah@nodea ~/Lab2]$ ls
client      server      server.c
[sc558ah@nodea ~/Lab2]$ rm client
[sc558ah@nodea ~/Lab2]$ rm server
[sc558ah@nodea ~/Lab2]$ gcc client.c -o client
[sc558ah@nodea ~/Lab2]$ gcc server.c -o server
[sc558ah@nodea ~/Lab2]$ ./server 51717
Here is the message from Rakesh Kumar Satvik at 192.168.3.
Here is the message from Rakesh Kumar Satvik at 192.168.3.
[sc558ah@nodea ~]$ ps -aux | grep 'server'
root      833    0.0  0.0  3300  1120  ??  S   10:26PM  0:00.01  nfsd: server (n
sc558ah   1194  0.0  0.0  1548    760  0  I+  10:35PM  0:00.00  ./server 51717
sc558ah   1234  0.0  0.0  3508   1240  1  S+  10:43PM  0:00.00  grep server
[sc558ah@nodea ~]$
  
```

Experiment: USC558L/RakeshLab2
 State: active

Virtual Node Info:

| ID | Type | OS | Qualified Name |
|-------|------|----------|---|
| nodeA | pc | FBSD-STD | nodeA_RakeshLab2_USC558L.isi.deterlab.net |
| nodeB | pc | FBSD-STD | nodeB_RakeshLab2_USC558L.isi.deterlab.net |
| nodeC | pc | RHL-STD | nodeC_RakeshLab2_USC558L.isi.deterlab.net |

Physical Node Mapping:

| ID | Type | OS | Physical |
|----------|---------|---------------------|----------|
| nodeA | bpc2133 | FBSD-STD | bpc223 |
| nodeB | bpc2133 | Ubuntu1204-64-STD | bpc212 |
| nodeC | bpc2133 | CentOS5 | bpc215 |
| tbdelay0 | bpc2133 | Ubuntu1204-64-Click | bpc217 |

Virtual Node Info:

Once the signal call is removed and the code is executed for the similar procedure we can see a zombie process for each of the client received where a new process was created for each of them.

```
satvik@satvik-Inspiron-N5110: ~  
root 1121 0.0 0.0 3396 1376 ?? Is 10:26PM 0:00.00 /usr/sbin/cron  
root 1176 0.0 0.1 9568 4656 ?? Is 10:35PM 0:00.02 sshd: sc558ah [  
sc558ah 1178 0.0 0.1 9568 4664 ?? S 10:35PM 0:00.01 sshd: sc558ah@p  
root 1268 0.0 0.0 0 8 ?? IL 10:50PM 0:00.00 [nfsiod 0]  
root 1282 0.0 0.1 9568 4680 ?? Ss 10:51PM 0:00.02 sshd: sc558ah [  
sc558ah 1284 0.0 0.1 9568 4680 ?? S 10:51PM 0:00.00 sshd: sc558ah@p  
root 855 0.0 0.1 6080 3568 u0- I 10:26PM 0:00.00 /usr/bin/perl -  
root 919 0.0 0.1 7240 5140 u0- S 10:26PM 0:00.01 /usr/bin/perl -  
root 1157 0.0 0.0 3368 1156 u0 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1158 0.0 0.0 3368 1156 v0 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1159 0.0 0.0 3368 1156 v1 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1160 0.0 0.0 3368 1156 v2 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1161 0.0 0.0 3368 1156 v3 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1162 0.0 0.0 3368 1156 v4 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1163 0.0 0.0 3368 1156 v5 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1164 0.0 0.0 3368 1156 v6 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
root 1165 0.0 0.0 3368 1156 v7 Is+ 10:26PM 0:00.00 /usr/libexec/ge  
sc558ah 1179 0.0 0.1 4584 2336 0 Is 10:35PM 0:00.01 -bash (bash)  
sc558ah 1279 0.0 0.0 1548 728 0 I+ 10:51PM 0:00.00 ./server 51717  
sc558ah 1280 0.0 0.0 0 0 0 Z+ 10:51PM 0:00.00 <defunct>  
sc558ah 1281 0.0 0.0 0 0 0 Z+ 10:51PM 0:00.00 <defunct>  
sc558ah 1285 0.0 0.1 4584 2428 1 Ss 10:51PM 0:00.01 -bash (bash)  
sc558ah 1288 0.0 0.0 3440 1208 1 R+ 10:51PM 0:00.00 ps -aux  
[sc558ah@nodea ~/Lab2]$
```