

# Assignment 2 – FIT9137 S1 2020

Name: Sai Ram Gitte

Student ID: 31009751

## Network Design and bug fixing

Task a):

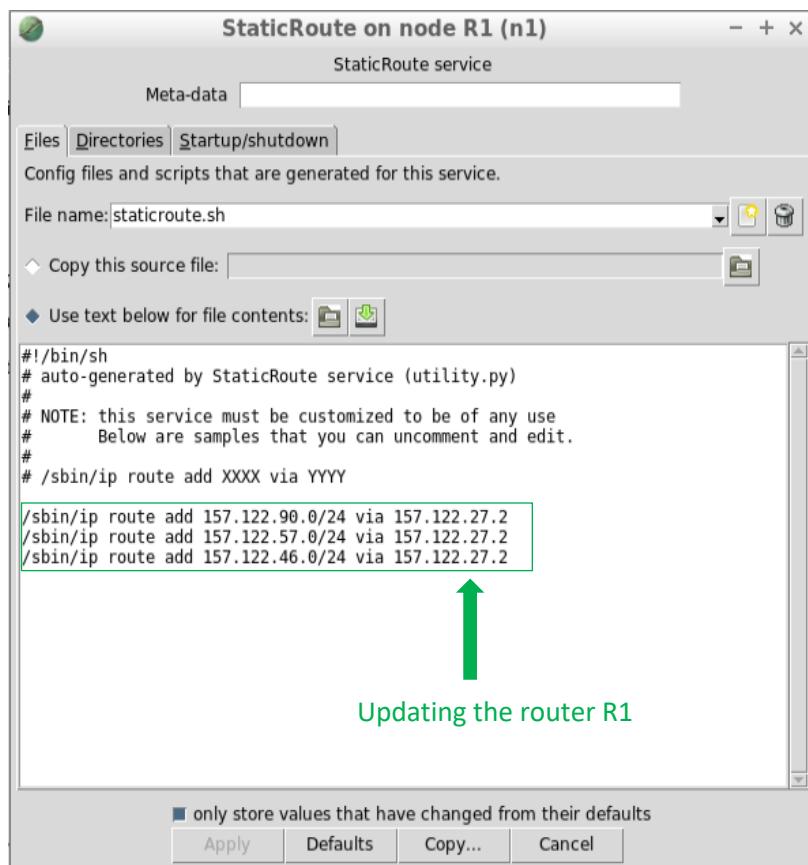
Before:

```
root@client1:/tmp/pycore.38826/client1.conf# ping -c 3 157.122.46.12 ↗
PING 157.122.46.12 (157.122.46.12) 56(84) bytes of data.
From 157.122.33.1 icmp_seq=1 Destination Net Unreachable Client1 pinging server
From 157.122.33.1 icmp_seq=2 Destination Net Unreachable
From 157.122.33.1 icmp_seq=3 Destination Net Unreachable

--- 157.122.46.12 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2053ms
root@client1:/tmp/pycore.38826/client1.conf# ↗
```

Packets are transmitted  
but acknowledgement  
isn't received

Updating R1:



LXTerminal

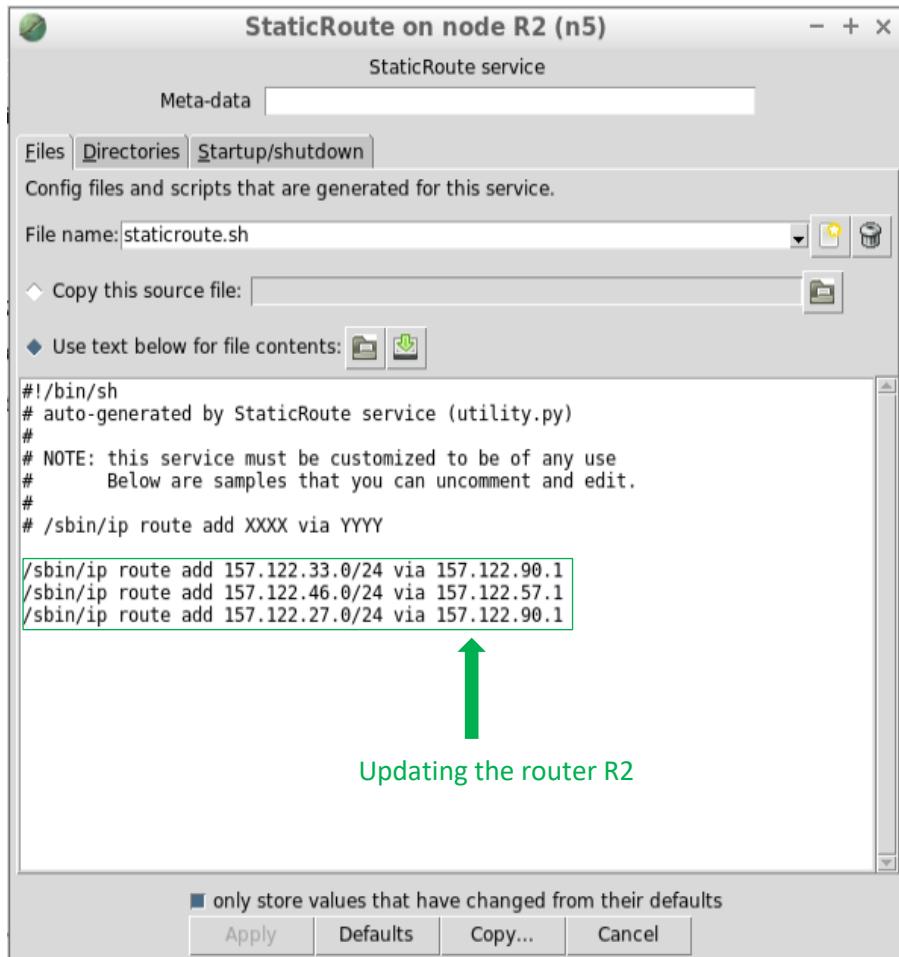
File Edit Tabs Help

```
root@R1:/tmp/pycore.58782/R1.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.18.0   *               255.255.255.0 U     0      0        0 eth3
157.122.27.0   *               255.255.255.0 U     0      0        0 eth2
157.122.33.0   *               255.255.255.0 U     0      0        0 eth1
157.122.46.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.57.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.90.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.95.0   *               255.255.255.0 U     0      0        0 eth0
root@R1:/tmp/pycore.58782/R1.conf#
```



Checking the routes that were added

### Updating R2:



LXTerminal

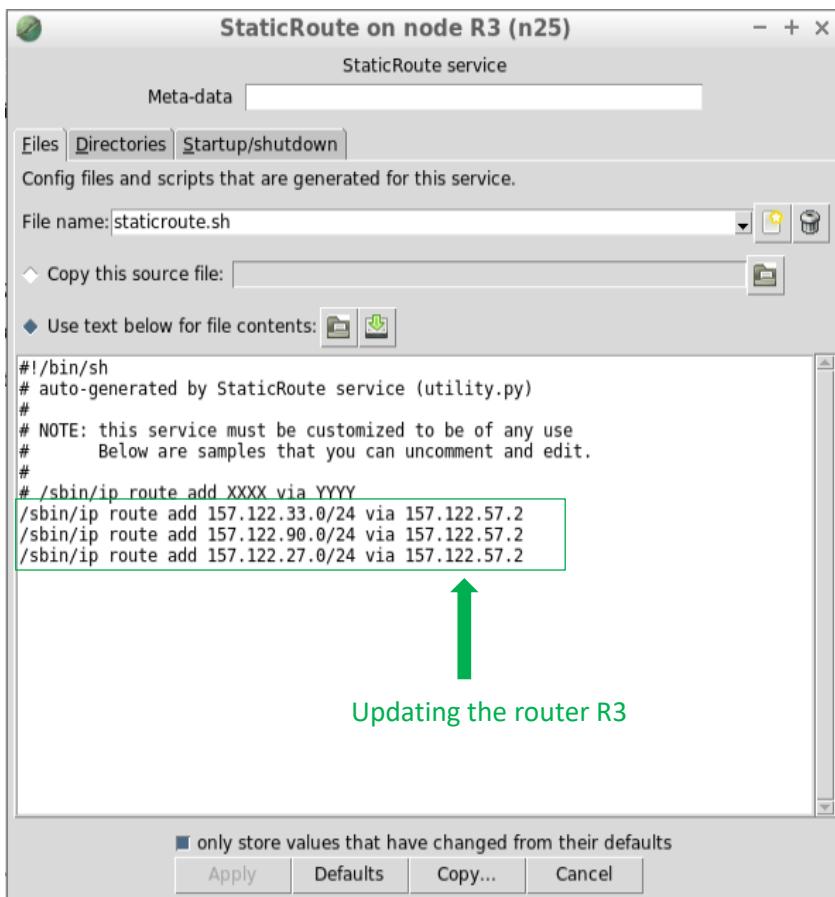
File Edit Tabs Help

```
root@R2:/tmp/pycore.58782/R2.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.18.0   *               255.255.255.0 U     0      0      0 eth2
157.122.27.0   157.122.90.1   255.255.255.0 UG    0      0      0 eth3
157.122.33.0   157.122.90.1   255.255.255.0 UG    0      0      0 eth3
157.122.42.0   *               255.255.255.0 U     0      0      0 eth1
157.122.46.0   157.122.57.1   255.255.255.0 UG    0      0      0 eth0
157.122.57.0   *               255.255.255.0 U     0      0      0 eth0
157.122.90.0   *               255.255.255.0 U     0      0      0 eth3
root@R2:/tmp/pycore.58782/R2.conf#
```



Checking the routes that were added

### Updating R3:



LXTerminal

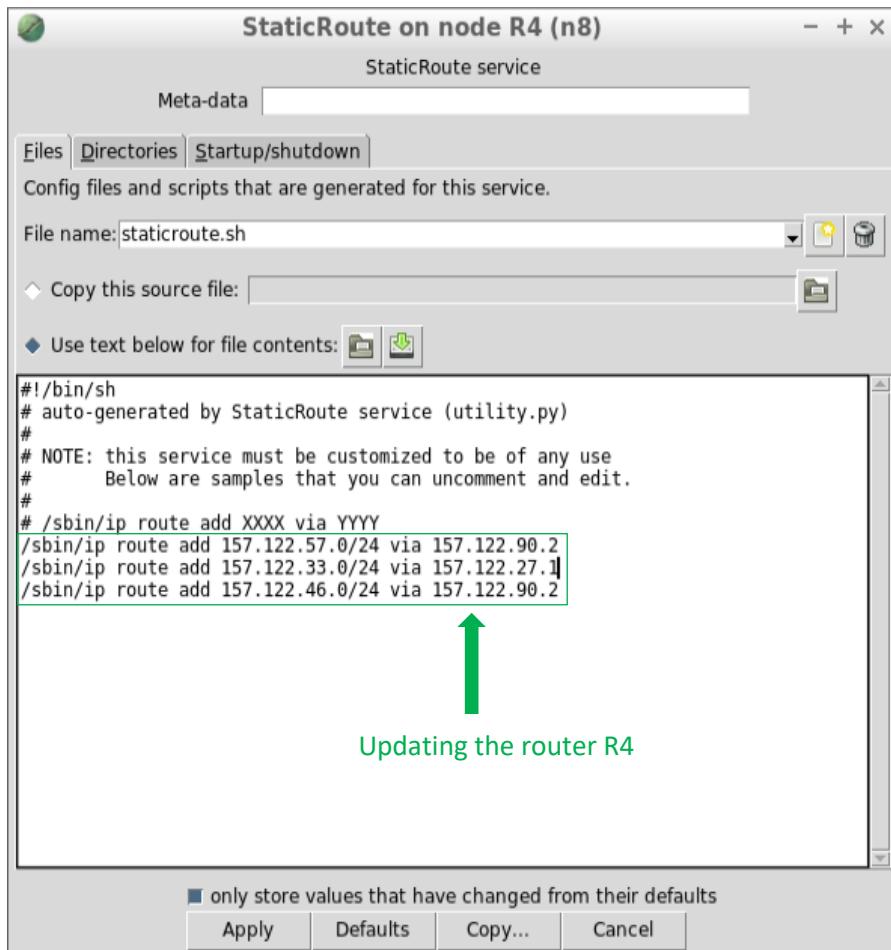
File Edit Tabs Help

```
root@R3:/tmp/pycore.58782/R3.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.27.0   157.122.57.2  255.255.255.0 UG      0      0        0 eth2
157.122.33.0   157.122.57.2  255.255.255.0 UG      0      0        0 eth2
157.122.46.0   *               255.255.255.0 U        0      0        0 eth3
157.122.57.0   *               255.255.255.0 U        0      0        0 eth2
157.122.90.0   157.122.57.2  255.255.255.0 UG      0      0        0 eth2
157.122.95.0   *               255.255.255.0 U        0      0        0 eth1
root@R3:/tmp/pycore.58782/R3.conf#
```



Checking the routes that were added

Updating R4:



LXTerminal

File Edit Tabs Help

```
root@R4:/tmp/pycore.58782/R4.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.27.0   *               255.255.255.0 U     0      0        0 eth0
157.122.33.0   157.122.27.1  255.255.255.0 UG    0      0        0 eth0
157.122.44.0   *               255.255.255.0 U     0      0        0 eth2
157.122.46.0   157.122.90.2  255.255.255.0 UG    0      0        0 eth1
157.122.57.0   157.122.90.2  255.255.255.0 UG    0      0        0 eth1
157.122.90.0   *               255.255.255.0 U     0      0        0 eth1
root@R4:/tmp/pycore.58782/R4.conf#
```

↑

Checking the routes that were added

Result:

LXTerminal

File Edit Tabs Help

```
root@client1:/tmp/pycore.58784/client1.conf# ping -c 3 157.122.46.12 ←
PING 157.122.46.12 (157.122.46.12) 56(84) bytes of data.
64 bytes from 157.122.46.12: icmp_seq=1 ttl=60 time=33.8 ms
64 bytes from 157.122.46.12: icmp_seq=2 ttl=60 time=75.7 ms
64 bytes from 157.122.46.12: icmp_seq=3 ttl=60 time=1.93 ms

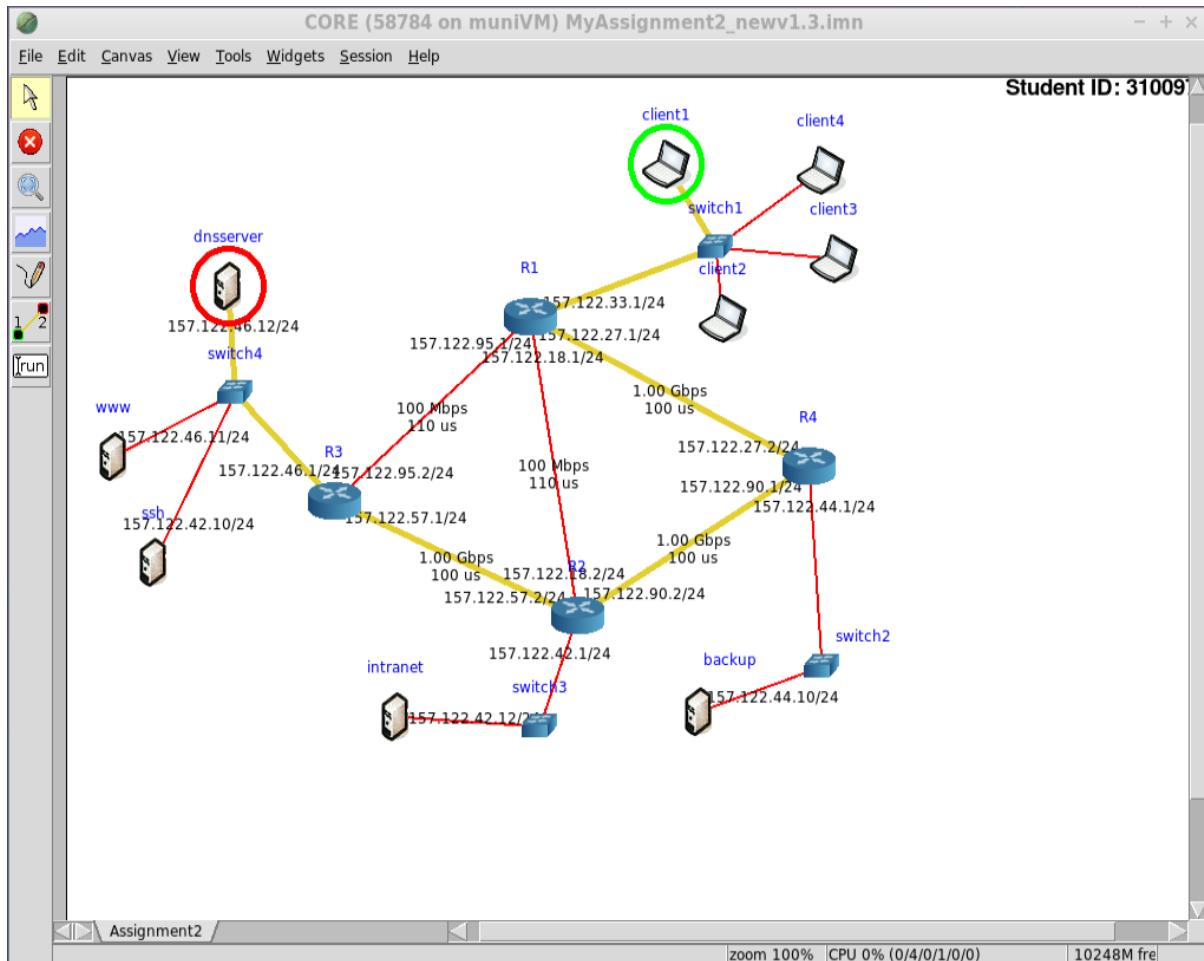
--- 157.122.46.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2014ms
rtt min/avg/max/mdev = 1.936/37.196/75.762/30.229 ms
root@client1:/tmp/pycore.58784/client1.conf#
```

↑

Packets are transmitted and acknowledgement is received

Client1 pinging server

The path chosen here is as shown below since the link speeds between each router is 1Gbps and the packets are transmitted and received quickly. i.e., R1 -> R4 -> R2 -> R3 and R3 -> R2 -> R4 -> R1 (all 1Gbps link speeds) instead of R1 -> R3 (100Mbps link speeds).



### Client to Intranet:

#### Before:

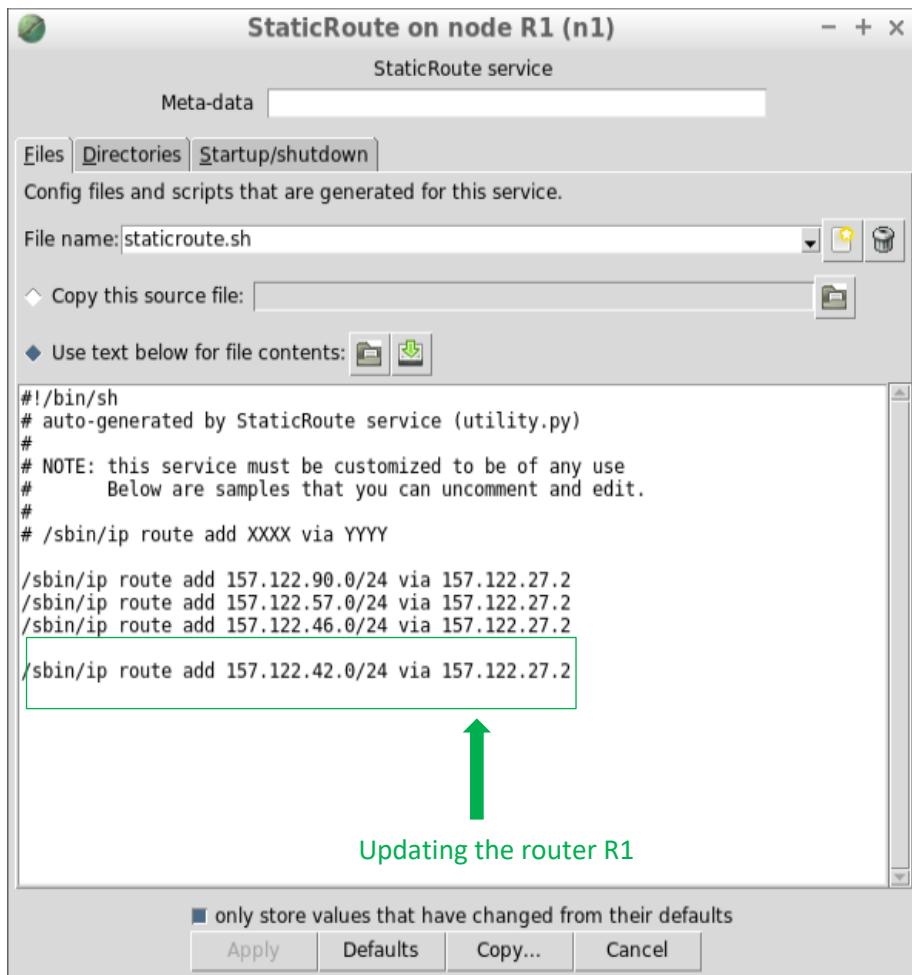
The screenshot shows an LXTerminal window with the following command and output:

```
root@client1:/tmp/pycore.38380/client1.conf# ping -c 3 157.122.42.12
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data,
From 157.122.33.1 icmp_seq=1 Destination Net Unreachable
From 157.122.33.1 icmp_seq=2 Destination Net Unreachable
From 157.122.33.1 icmp_seq=3 Destination Net Unreachable
--- 157.122.42.12 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2045ms
root@client1:/tmp/pycore.38380/client1.conf#
```

A red arrow points to the error message "Destination Net Unreachable". A red box highlights the entire output area with the label "Client1 pinging server". Another red arrow points to the "Packets are transmitted but acknowledgement isn't received" text at the bottom left.

Packets are transmitted but acknowledgement isn't received

### Updating R1:

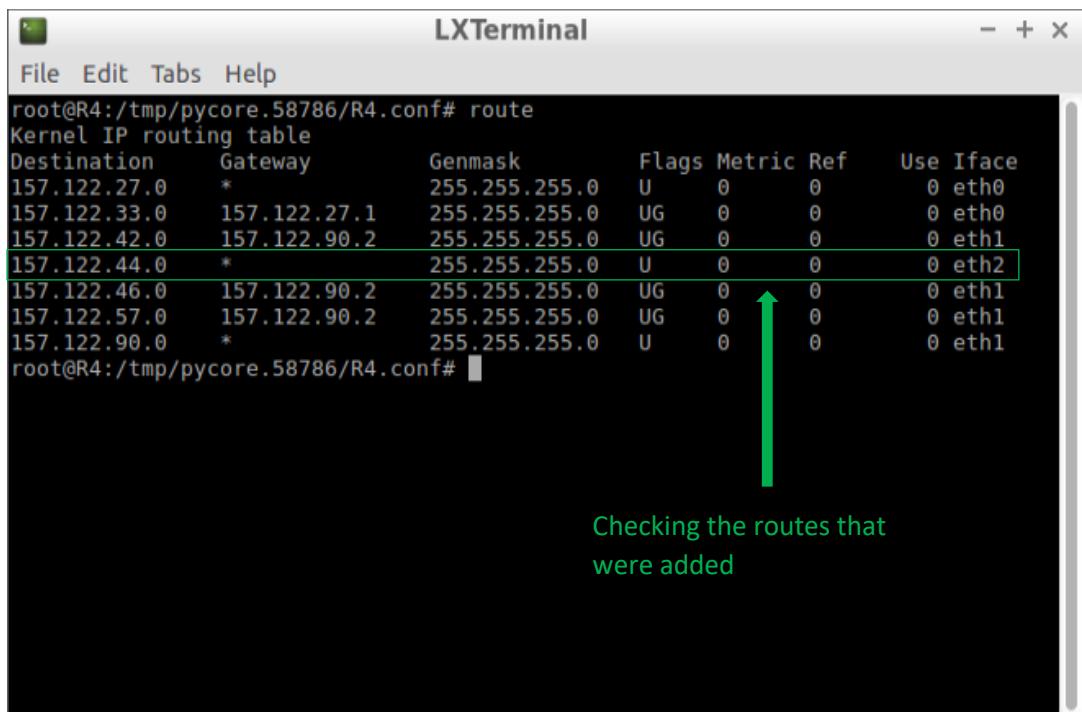
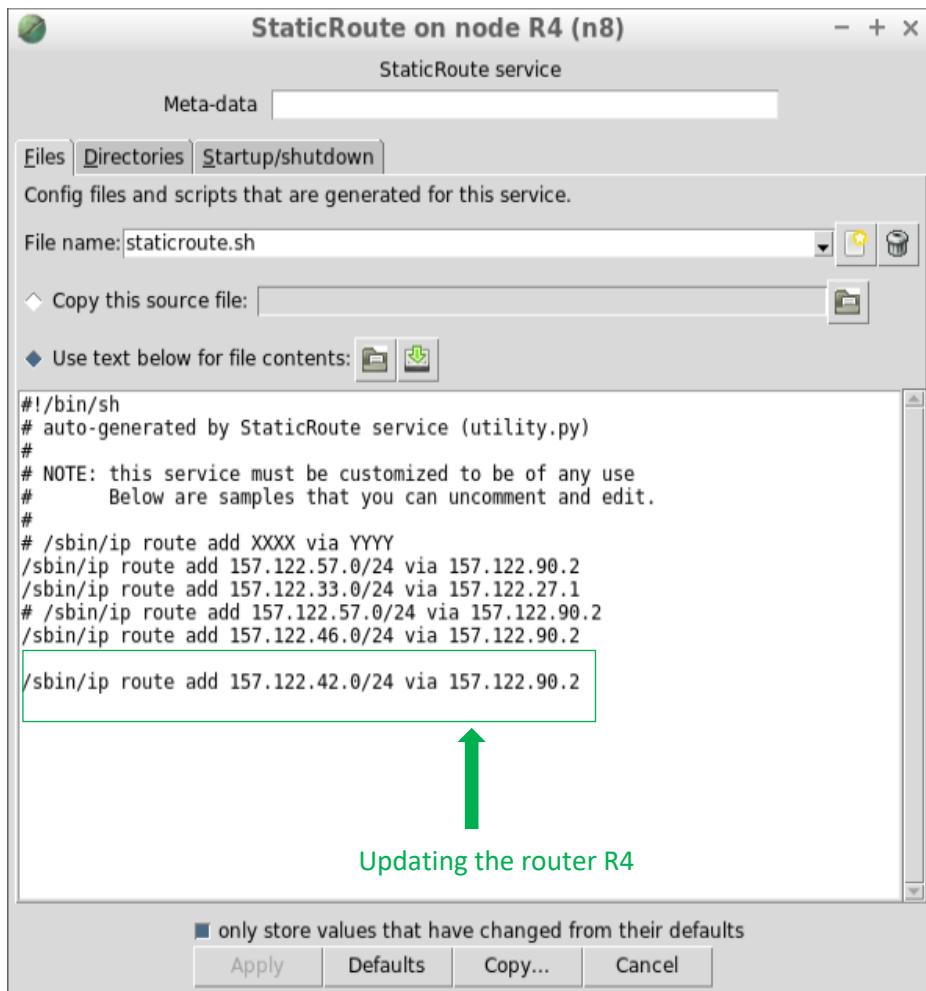


The screenshot shows the LXTerminal window with the command 'root@R1:/tmp/pycore.58786/R1.conf# route' entered. The output displays the kernel IP routing table with several routes added, including the one highlighted in the previous screenshot. A green arrow points upwards from the terminal window to the highlighted route in the table.

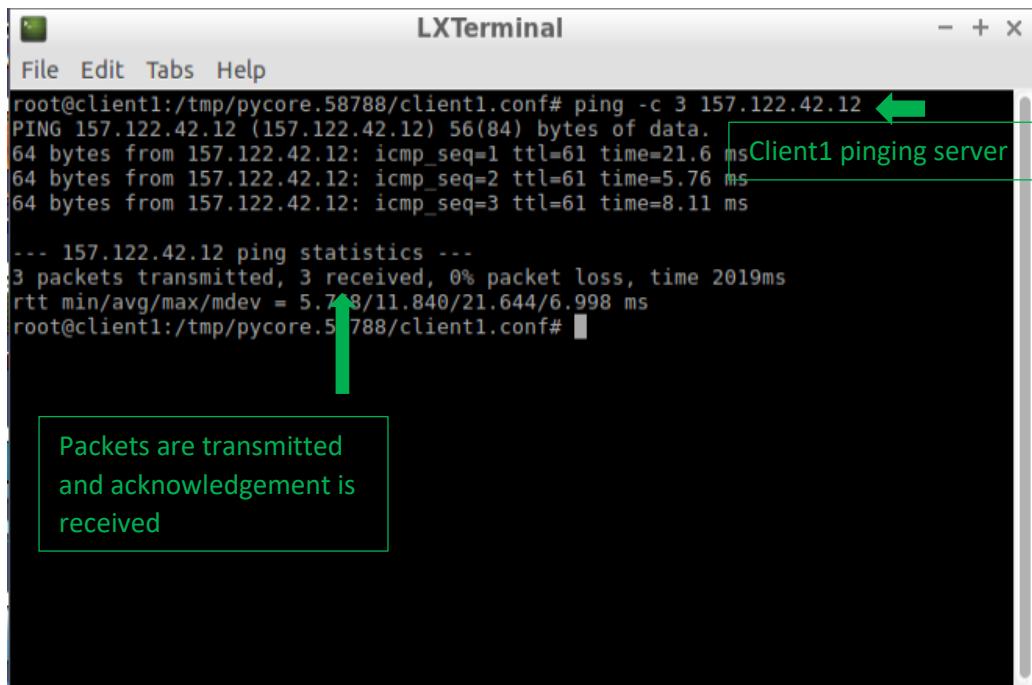
Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
157.122.18.0	*	255.255.255.0	U	0	0	0	eth3
157.122.27.0	*	255.255.255.0	U	0	0	0	eth2
157.122.33.0	*	255.255.255.0	U	0	0	0	eth1
157.122.42.0	157.122.27.2	255.255.255.0	UG	0	0	0	eth2
157.122.46.0	157.122.27.2	255.255.255.0	UG	0	0	0	eth2
157.122.57.0	157.122.27.2	255.255.255.0	UG	0	0	0	eth2
157.122.90.0	157.122.27.2	255.255.255.0	UG	0	0	0	eth2
157.122.95.0	*	255.255.255.0	U	0	0	0	eth0

Checking the routes that were added

## Updating R4:



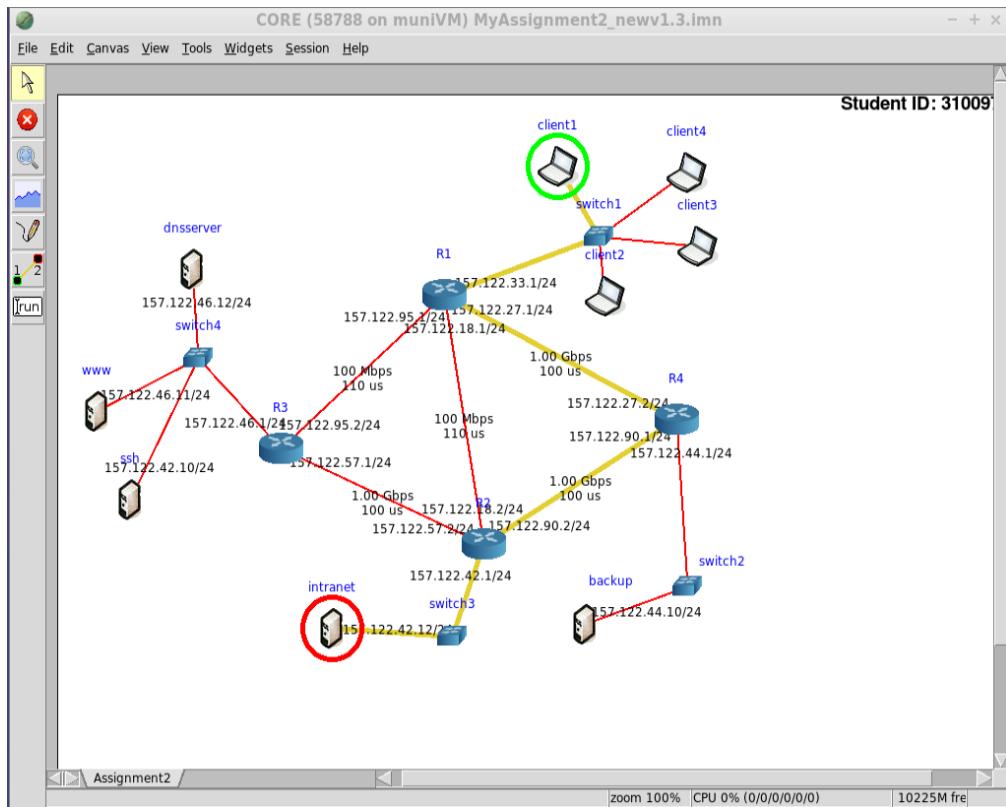
## Result:



```
LXTerminal
File Edit Tabs Help
root@client1:/tmp/pycore.58788/client1.conf# ping -c 3 157.122.42.12
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data.
64 bytes from 157.122.42.12: icmp_seq=1 ttl=61 time=21.6 ms
64 bytes from 157.122.42.12: icmp_seq=2 ttl=61 time=5.76 ms
64 bytes from 157.122.42.12: icmp_seq=3 ttl=61 time=8.11 ms
--- 157.122.42.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2019ms
rtt min/avg/max/mdev = 5.76/11.840/21.644/6.998 ms
root@client1:/tmp/pycore.58788/client1.conf#
```

Packets are transmitted and acknowledgement is received

The path chosen here is as shown below since the link speeds between each router is 1Gbps and the packets are transmitted and received quickly. i.e., R1 -> R4 -> R2 and R2 -> R4 -> R1 (all 1Gbps link speeds) instead of R1 -> R2 (100Mbps link speeds).



## Client to Backup:

Before:

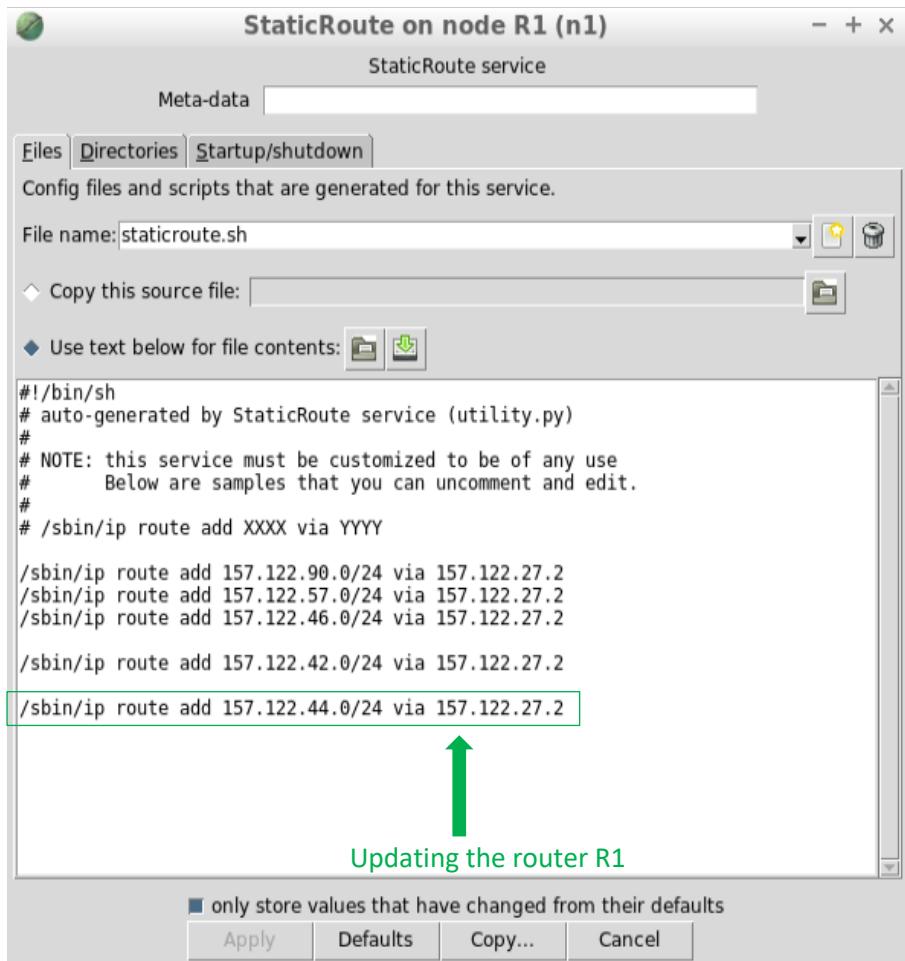
```
LXTerminal
File Edit Tabs Help
root@client1:/tmp/pycore.38478/client1.conf# ping -c 3 157.122.44.10
PING 157.122.44.10 (157.122.44.10) 56(84) bytes of data.
From 157.122.33.1 icmp_seq=1 Destination Net Unreachable
From 157.122.33.1 icmp_seq=2 Destination Net Unreachable
From 157.122.33.1 icmp_seq=3 Destination Net Unreachable

--- 157.122.44.10 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2040ms
root@client1:/tmp/pycore.38478/client1.conf#
```

Packets are transmitted but acknowledgement isn't received

Client1 pinging server

## Updating R1:



LXTerminal

File Edit Tabs Help

```
root@R1:/tmp/pycore.58790/R1.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.18.0   *              255.255.255.0 U     0      0        0 eth3
157.122.27.0   *              255.255.255.0 U     0      0        0 eth2
157.122.33.0   *              255.255.255.0 U     0      0        0 eth1
157.122.42.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.44.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.46.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.57.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.90.0   157.122.27.2  255.255.255.0 UG    0      0        0 eth2
157.122.95.0   *              255.255.255.0 U     0      0        0 eth0
root@R1:/tmp/pycore.58790/R1.conf#
```

Checking the routes that  
were added

Result:

LXTerminal

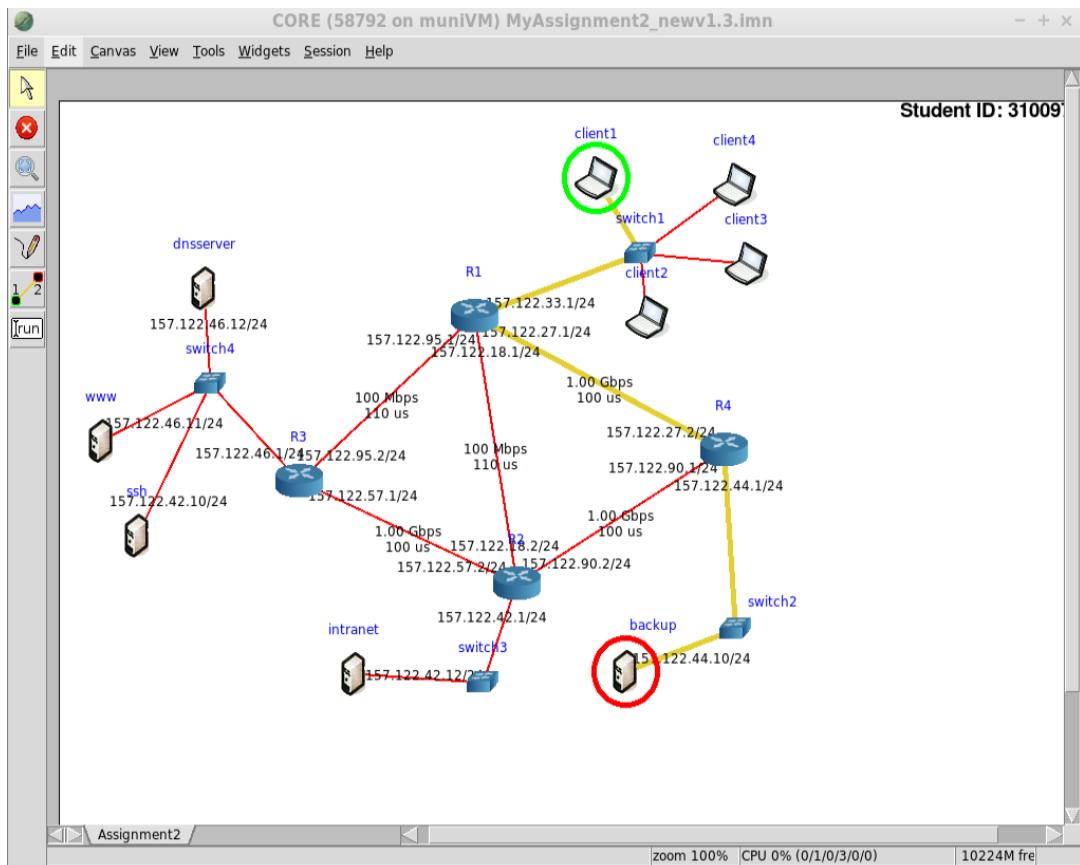
File Edit Tabs Help

```
root@client1:/tmp/pycore.58792/client1.conf# ping -c 3 157.122.44.10
PING 157.122.44.10 (157.122.44.10) 56(84) bytes of data.
64 bytes from 157.122.44.10: icmp_seq=1 ttl=62 time=1.75 ms
64 bytes from 157.122.44.10: icmp_seq=2 ttl=62 time=0.867 ms
64 bytes from 157.122.44.10: icmp_seq=3 ttl=62 time=0.342 ms

--- 157.122.44.10 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2013ms
rtt min/avg/max/mdev = 0.342/0.989/1.759/0.585 ms
root@client1:/tmp/pycore.58792/client1.conf#
```

Packets are transmitted  
and acknowledgement is  
received

The path chosen here is as shown below since the link speed between each router is 1Gbps and the packets are transmitted and received quickly. i.e., R1 -> R4 and R4 -> R1 (1Gbps link speeds)



### DNS to Intranet:

Before:

```

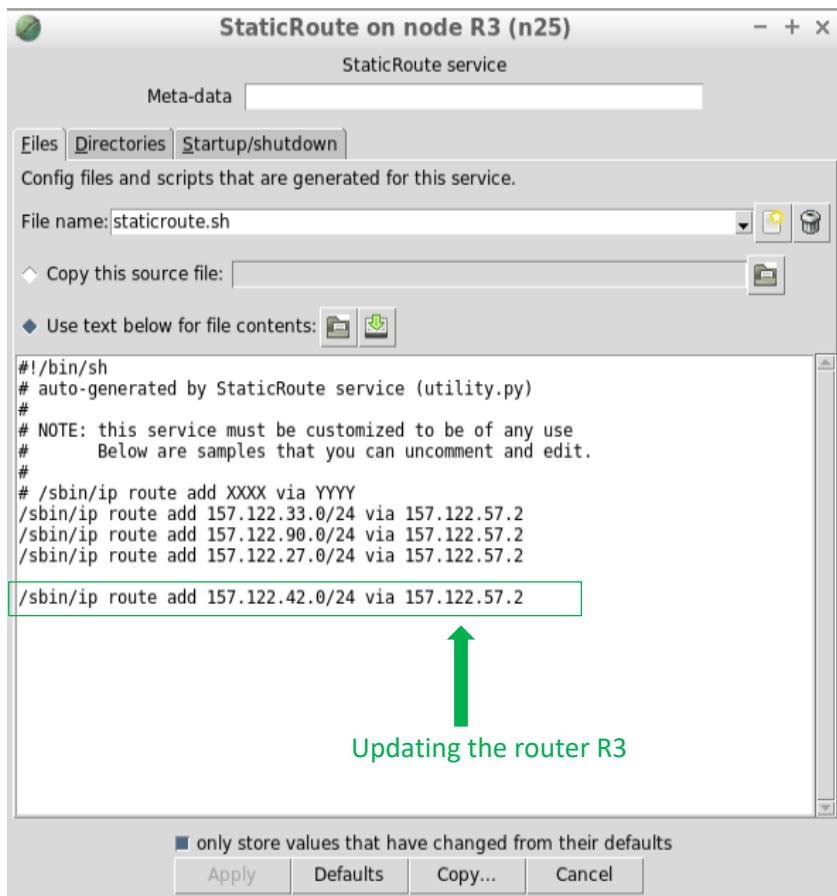
LXTerminal
File Edit Tabs Help
root@dnsserver:/tmp/pycore.38522/dnsserver.conf# ping -c 3 157.122.42.12
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data.
From 157.122.46.1 icmp_seq=1 Destination Net Unreachable
From 157.122.46.1 icmp_seq=2 Destination Net Unreachable
From 157.122.46.1 icmp_seq=3 Destination Net Unreachable

--- 157.122.42.12 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2031ms
root@dnsserver:/tmp/pycore.38522/dnsserver.conf#
  
```

Packets are transmitted but acknowledgement isn't received

dnsserver pinging server

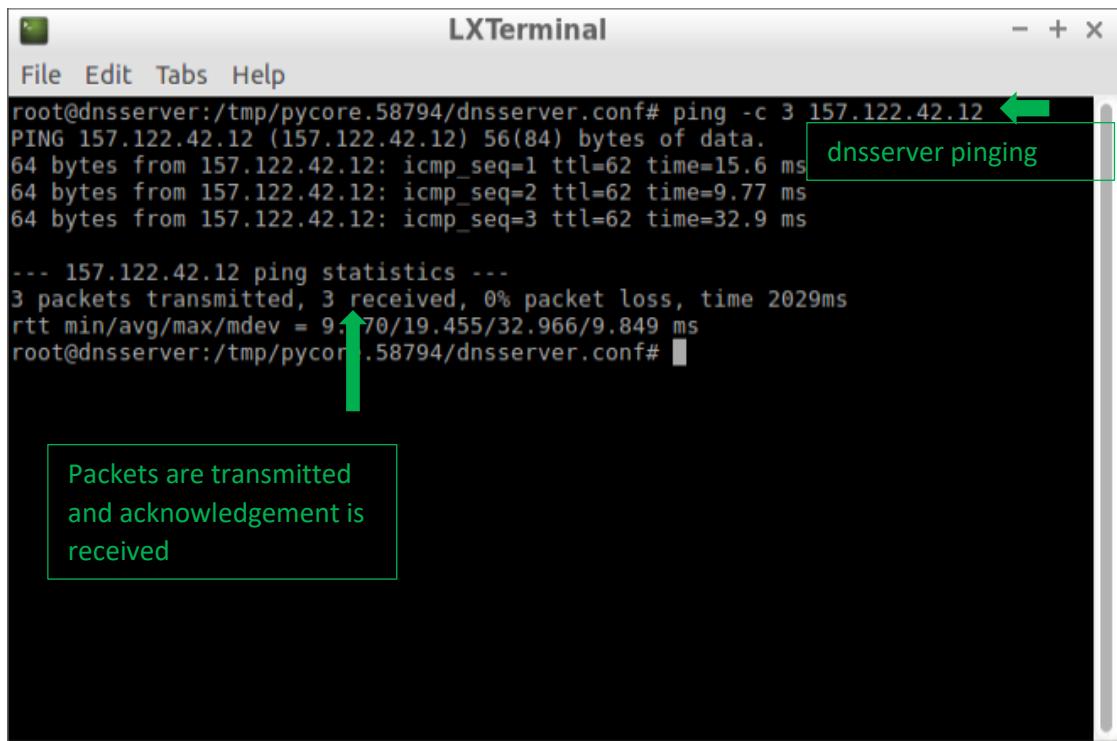
### Updating R3:



The screenshot shows an LXTerminal window titled 'LXTerminal'. The terminal output displays the kernel routing table with several routes added. A green arrow points from the terminal output back up to the 'File name:' field in the configuration window, with the label 'Checking the routes that were added' positioned below the arrow.

```
root@R3:/tmp/pycore.58794/R3.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.27.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.33.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.42.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.46.0   *               255.255.255.0  U        0      0        0 eth3
157.122.57.0   *               255.255.255.0  U        0      0        0 eth2
157.122.90.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.95.0   *               255.255.255.0  U        0      0        0 eth1
```

### Result:

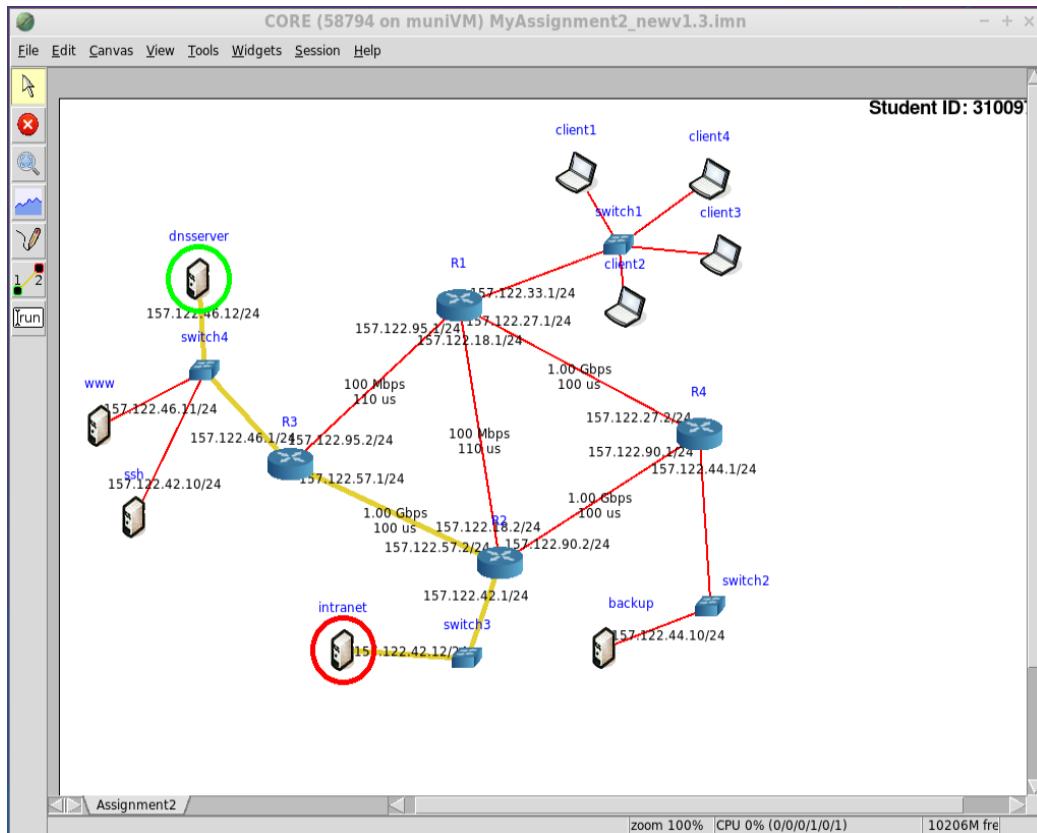


```
LXTerminal
File Edit Tabs Help
root@dnsserver:/tmp/pycore.58794/dnsserver.conf# ping -c 3 157.122.42.12
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data.
64 bytes from 157.122.42.12: icmp_seq=1 ttl=62 time=15.6 ms
64 bytes from 157.122.42.12: icmp_seq=2 ttl=62 time=9.77 ms
64 bytes from 157.122.42.12: icmp_seq=3 ttl=62 time=32.9 ms

--- 157.122.42.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2029ms
rtt min/avg/max/mdev = 9.70/19.455/32.966/9.849 ms
root@dnsserver:/tmp/pycore.58794/dnsserver.conf#
```

Packets are transmitted and acknowledgement is received

The path chosen here is as shown below since the link speed between each router is 1Gbps and the packets are transmitted and received quickly. i.e., R3 → R2 and R2 → R3 (1Gbps link speeds)



## Intranet to Backup:

Before:

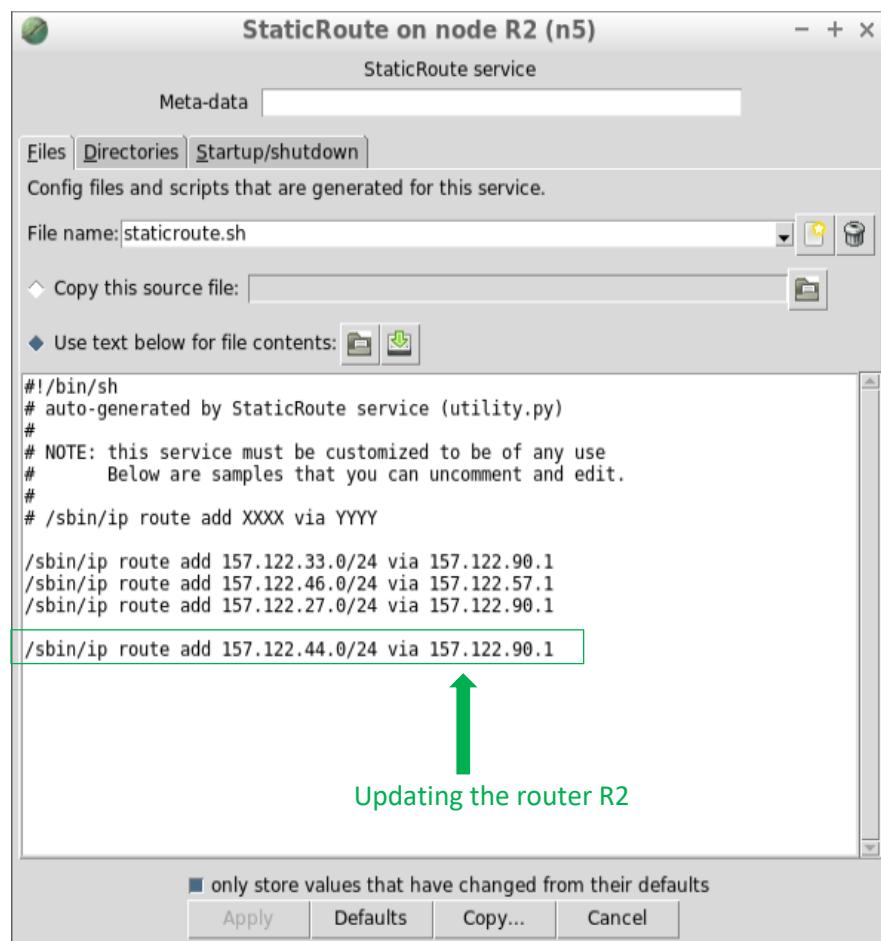
The screenshot shows a terminal window titled "LXTerminal". The command "ping -c 3 157.122.44.10" is run, resulting in the following output:

```
root@intranet:/tmp/pycore.39026/intranet.conf# ping -c 3 157.122.44.10
PING 157.122.44.10 (157.122.44.10) 56(84) bytes of data.
From 157.122.42.1 icmp_seq=1 Destination Net Unreachable
From 157.122.42.1 icmp_seq=2 Destination Net Unreachable
From 157.122.42.1 icmp_seq=3 Destination Net Unreachable

--- 157.122.44.10 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2056ms
```

A red arrow points from the text "Packets are transmitted but acknowledgement isn't received" to the line "3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2056ms". A red box highlights the line "Intranet pinging server".

## Updating R2:



**LXTerminal**

File Edit Tabs Help

```
root@R2:/tmp/pycore.58798/R2.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.18.0   *               255.255.255.0 U     0      0        0 eth2
157.122.27.0   157.122.90.1   255.255.255.0 UG    0      0        0 eth3
157.122.33.0   157.122.90.1   255.255.255.0 UG    0      0        0 eth3
157.122.42.0   *               255.255.255.0 U     0      0        0 eth1
157.122.44.0   157.122.90.1   255.255.255.0 UG    0      0        0 eth3
157.122.46.0   157.122.57.1   255.255.255.0 UG    0      0        0 eth0
157.122.57.0   *               255.255.255.0 U     0      0        0 eth0
157.122.90.0   *               255.255.255.0 U     0      0        0 eth3
root@R2:/tmp/pycore.58798/R2.conf#
```

Checking the routes that were added



### Result:

**LXTerminal**

File Edit Tabs Help

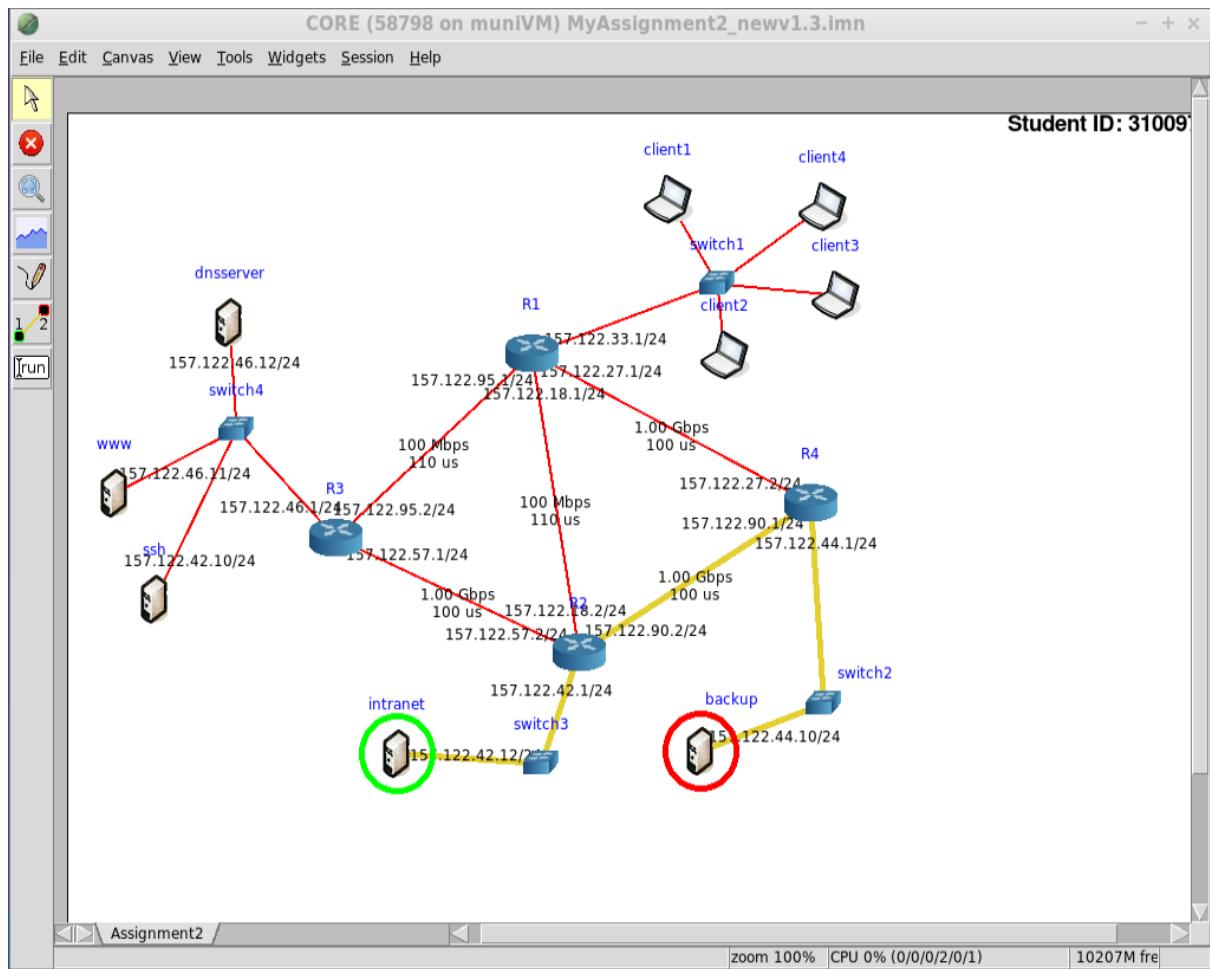
```
root@intranet:/tmp/pycore.58798/intranet.conf# ping -c 3 157.122.44.10 ←
PING 157.122.44.10 (157.122.44.10) 56(84) bytes of data.
64 bytes from 157.122.44.10: icmp_seq=1 ttl=62 time=0.985 ms
Intranet pinging
64 bytes from 157.122.44.10: icmp_seq=2 ttl=62 time=0.266 ms
server
64 bytes from 157.122.44.10: icmp_seq=3 ttl=62 time=0.267 ms

--- 157.122.44.10 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2035ms
rtt min/avg/max/mdev = 0.266/0.506/0.985/0.338 ms
root@intranet:/tmp/pycore.58798/intranet.conf#
```

Packets are transmitted and acknowledgement is received



The path chosen here is as shown below since the link speed between each router is 1Gbps and the packets are transmitted and received quickly. i.e., R2 -> R4 and R4 -> R2 (1Gbps link speeds)



### DNS to Backup:

Before:

LXTerminal

File Edit Tabs Help

```
root@dnsserver:/tmp/pycore.38522/dnsserver.conf# ping -c 3 157.122.42.12
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data.
From 157.122.46.1 icmp_seq=1 Destination Net Unreachable
From 157.122.46.1 icmp_seq=2 Destination Net Unreachable
From 157.122.46.1 icmp_seq=3 Destination Net Unreachable

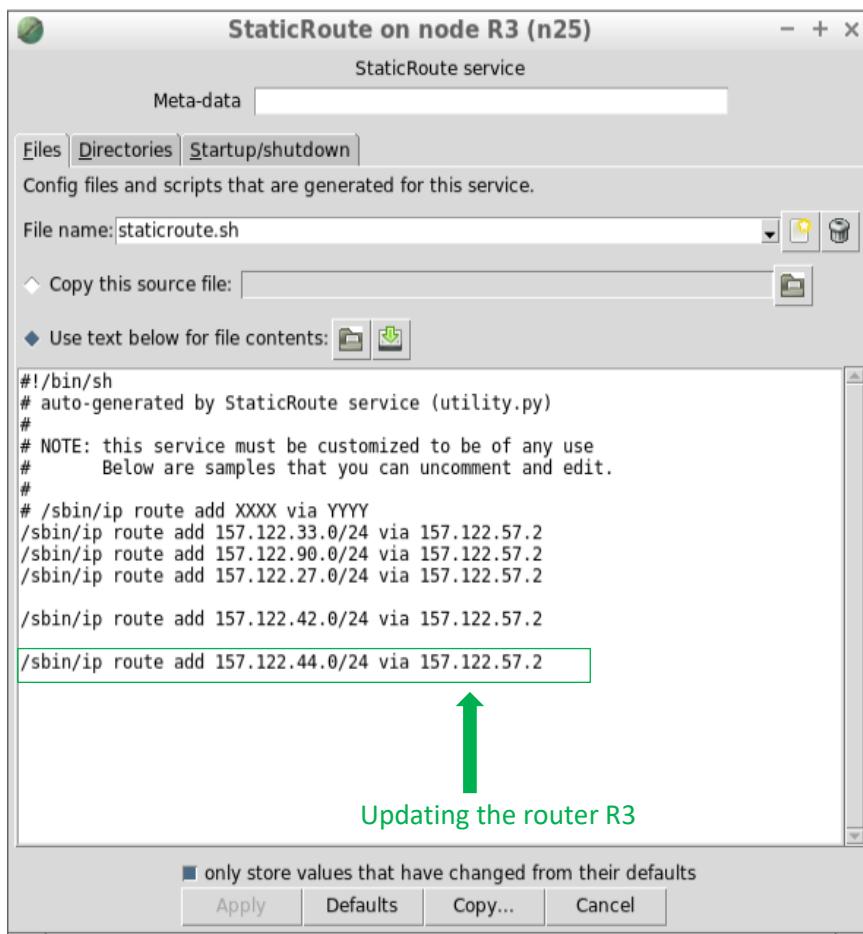
--- 157.122.42.12 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2031ms
```

root@dnsserver:/tmp/pycore.38522/dnsserver.conf#

Packets are transmitted but acknowledgement isn't received

dnsserver pinging server

Updating R3:



LXTerminal

File Edit Tabs Help

```
root@R3:/tmp/pycore.58804/R3.conf# route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref    Use Iface
157.122.27.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.33.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.42.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.44.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.46.0   *               255.255.255.0  U       0      0        0 eth3
157.122.57.0   *               255.255.255.0  U       0      0        0 eth2
157.122.90.0   157.122.57.2   255.255.255.0  UG      0      0        0 eth2
157.122.95.0   *               255.255.255.0  U       0      0        0 eth1
root@R3:/tmp/pycore.58804/R3.conf#
```

Checking the routes that  
were added

Result:

LXTerminal

File Edit Tabs Help

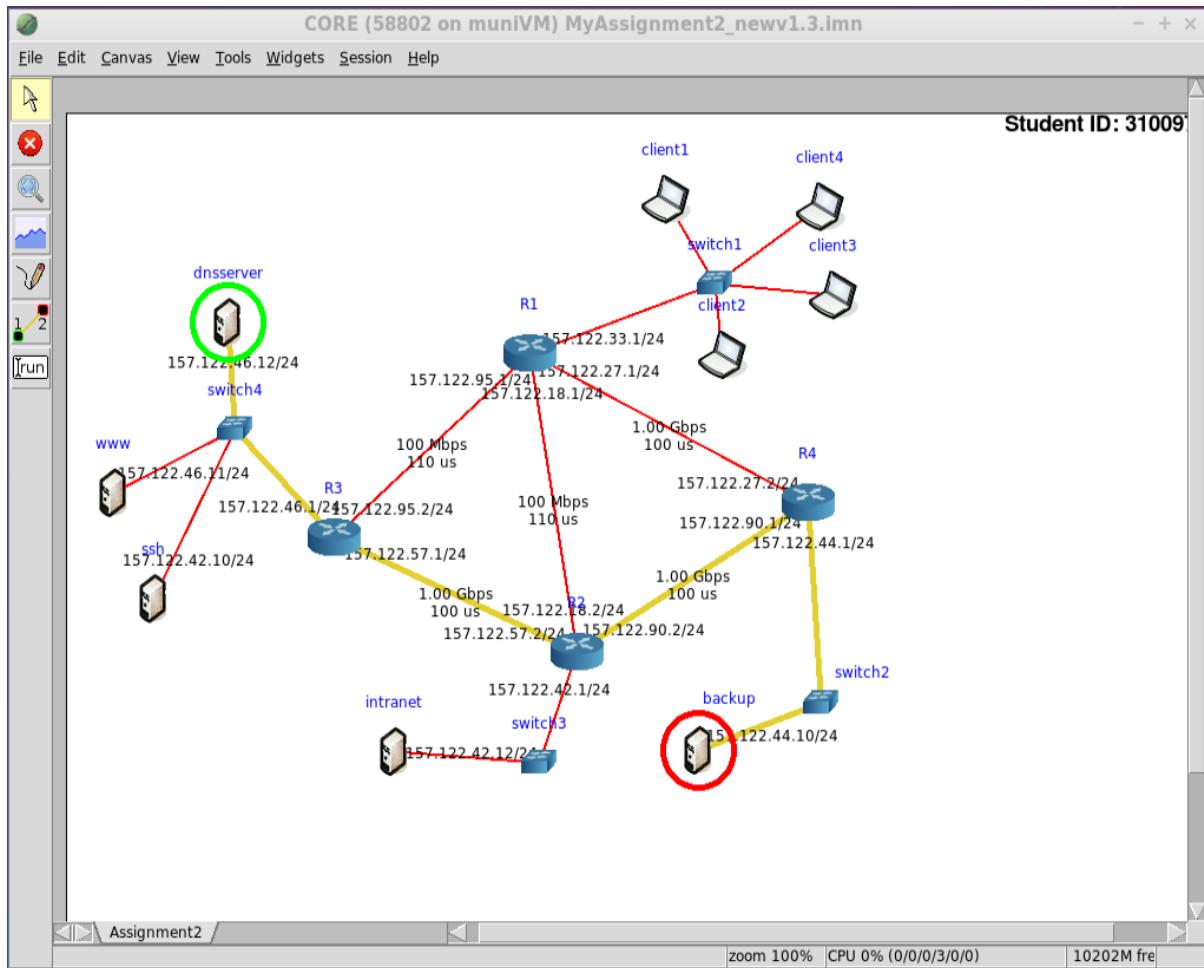
```
root@dnsserver:/tmp/pycore.58802/dnsserver.conf# ping -c 3 157.122.44.10 ←
PING 157.122.44.10 (157.122.44.10) 56(84) bytes of data.
64 bytes from 157.122.44.10: icmp_seq=1 ttl=61 time=14.9 ms
64 bytes from 157.122.44.10: icmp_seq=2 ttl=61 time=18.1 ms
64 bytes from 157.122.44.10: icmp_seq=3 ttl=61 time=2.91 ms

--- 157.122.44.10 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2006ms
rtt min/avg/max/mdev = 2.917/11.987/18.139/6.547 ms
root@dnsserver:/tmp/pycore.58802/dnsserver.conf#
```

Packets are transmitted  
and acknowledgement is  
received

dnsserver pinging  
server

The path chosen here is as shown below since the link speed between each router is 1Gbps and the packets are transmitted and received quickly. i.e., R3 -> R2 -> R4 and R4 -> R2 -> R3 (1Gbps link speeds)



### b) Error:

#### Error 1:

What the error was: In the network 157.122.46.0/24, there is a server which has a subnet of that of R2 (157.122.42.0/24). This raises a problem.

How was the error discovered: If any other device outside this network must communicate with 157.122.42.10, it does not allow to establish a connection because 157.122.42.10 does not belong to the network 157.122.46.0/24.

Fix: Change 157.122.42.10 to 157.122.46.10

Testing if fix works: Pinging the SSH server (157.122.46.10) from any of the clients or other servers on different networks, will establish a connection.

#### Error 2:

What the error was: R2 has one of its interfaces as 157.122.90.2/28 which had to be /24 since the all the masking of all the other subnets are /24.

How was the error discovered: Using the command ifconfig, we got to know that the mask is 255.255.255.240 which means it is /28 and not /24

```
LXTerminal
File Edit Tabs Help
RX packets:27 errors:0 dropped:0 overruns:0 frame:0
TX packets:9 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:2494 (2.4 KB) TX bytes:1062 (1.0 KB)

eth3      Link encap:Ethernet HWaddr 00:00:00:aa:00:10
          inet addr:157.122.90.2 Bcast:0.0.0.0 Mask:255.255.255.240
         inet6 addr: fe80::200:ff:feaa:10/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:25 errors:0 dropped:0 overruns:0 frame:0
          TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2242 (2.2 KB) TX bytes:896 (896.0 B)

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:65536 Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)

root@R2:/tmp/pycore.39106/R2.conf#
```

Fix: Changed the masking of interface of R3 from 157.122.90.2/28 to 157.122.90.2/24

Testing if fix works: Run ifconfig again on R3

#### Error 3:

What was the error: The IP address of R3 eth2 was the same as eth0 of R2.

How was the error discovered: This cannot be true because every device has a unique IP address.

Fix: Changed the R3 eth2 to 157.122.57.1/24 from 157.122.57.2/24

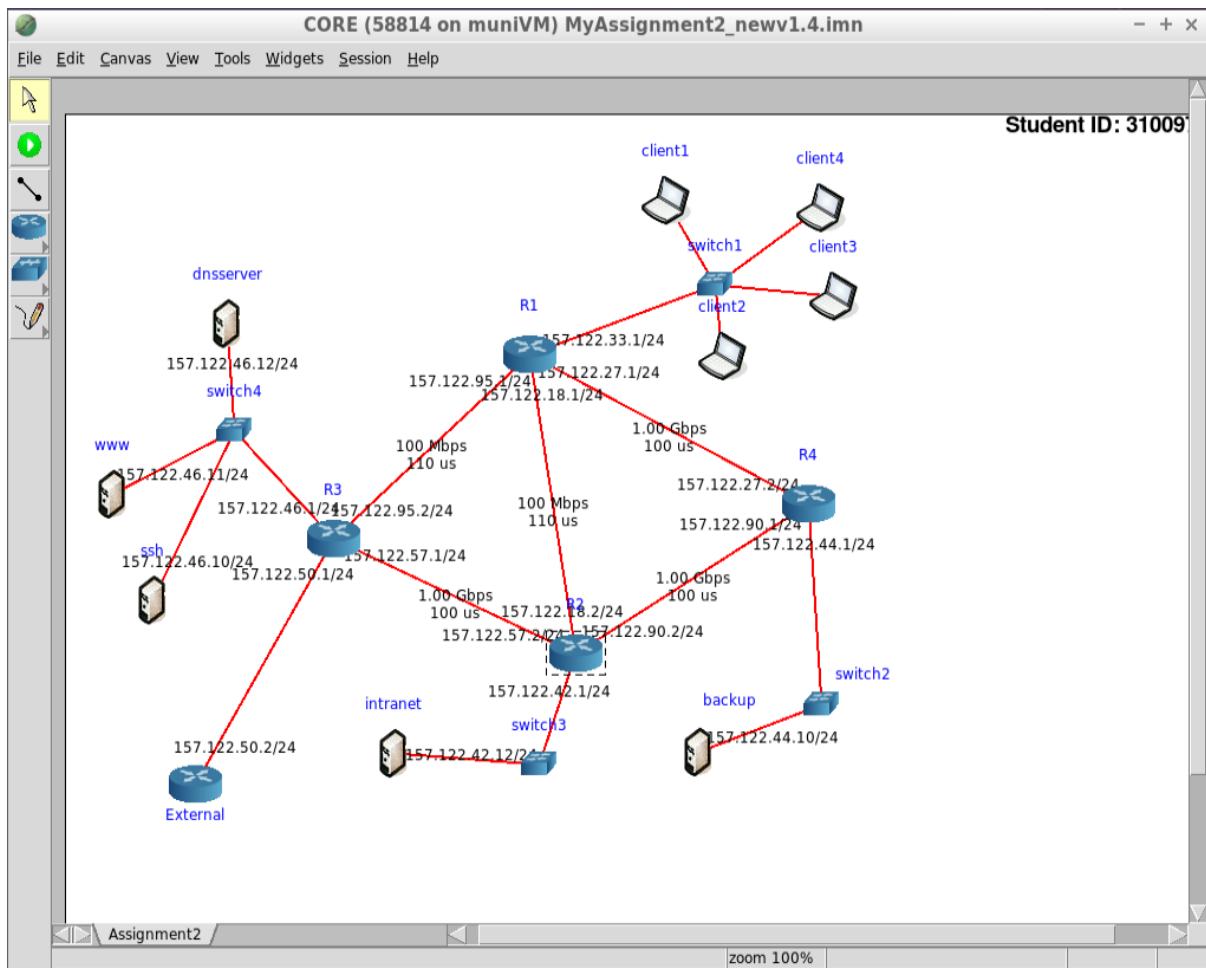
Testing if fix works: A connection can be established via R3 eth2 (157.122.57.1/24) from any of the internal devices.

#### Error 4:

R1 and R3 already had their static routing table updated such that if any client on the network 157.122.33.0/24 had to communicate with any of the servers in the network 157.122.46.0/24

the path is directly from R1 to R3 (without taking into consideration the link speed between them).  
But the actual path should be R1 -> R4 -> R2 -> R3

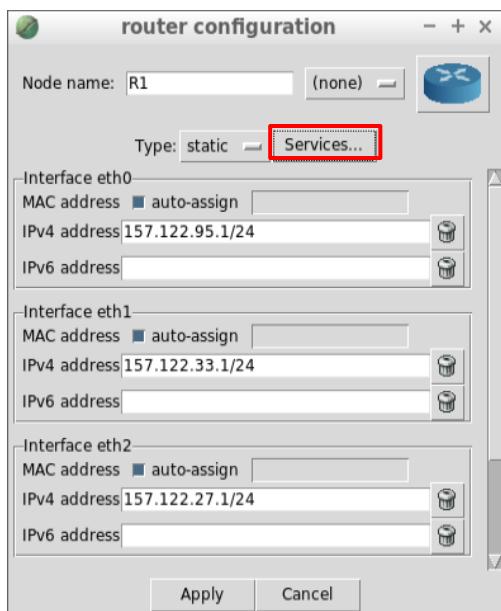
### C) Default route:

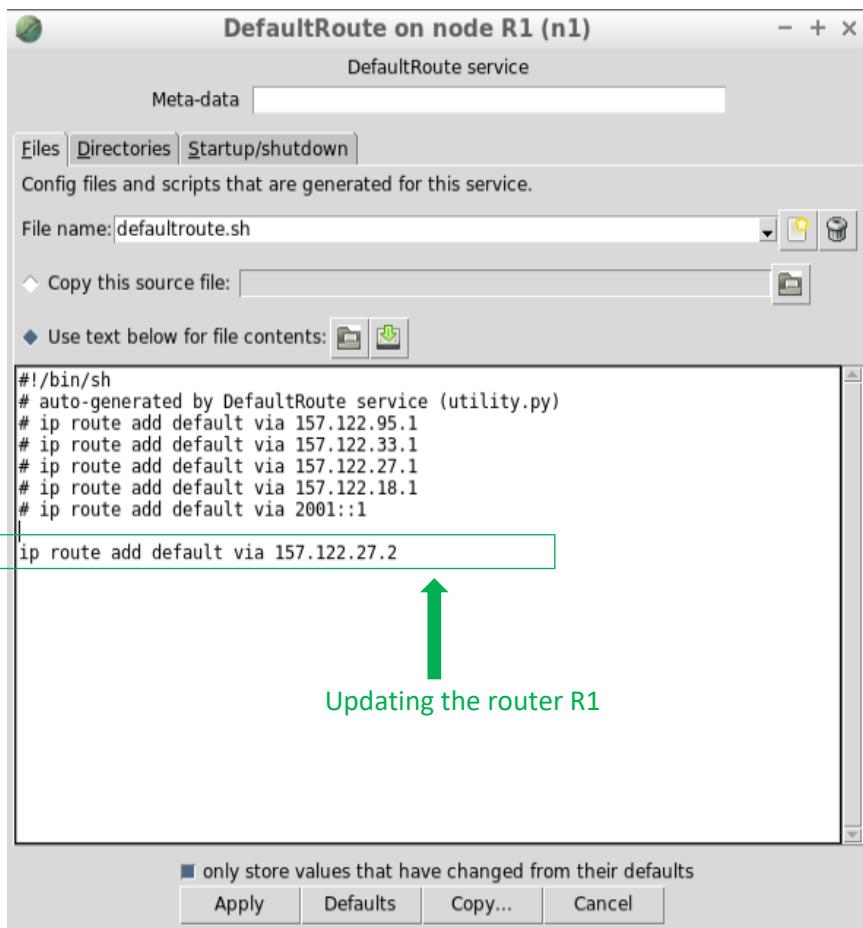
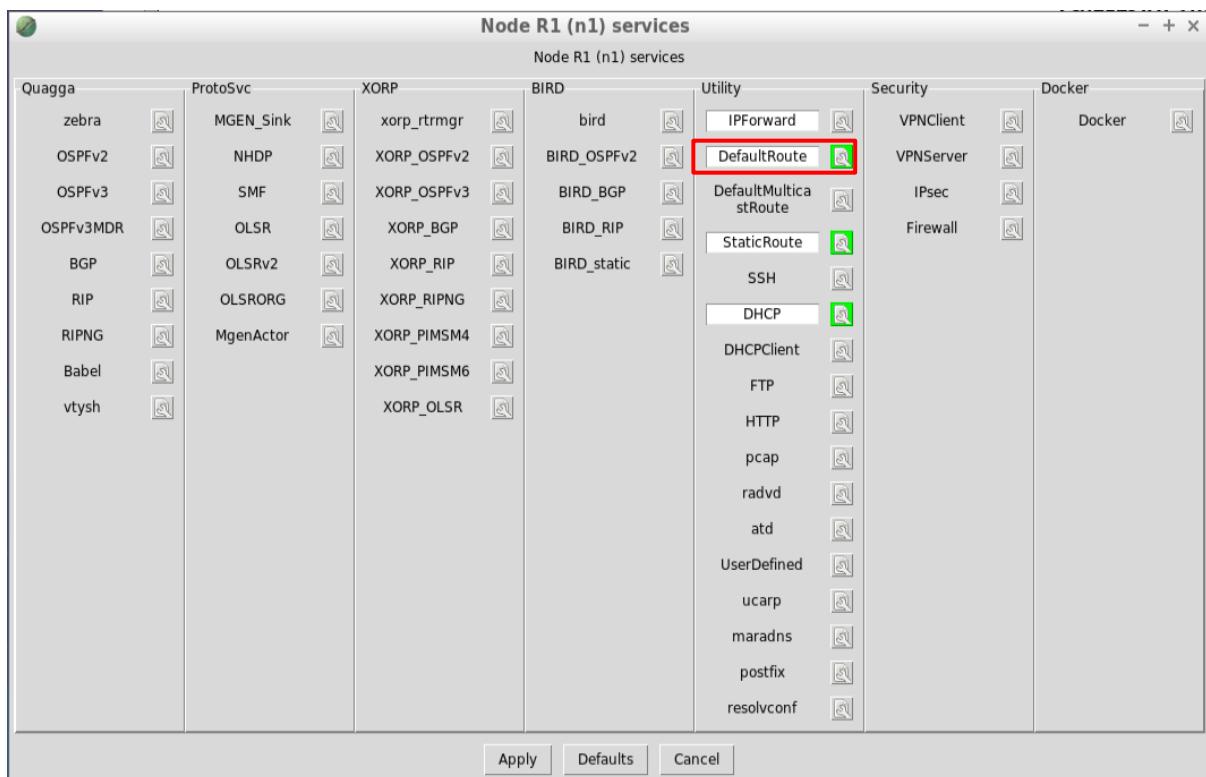


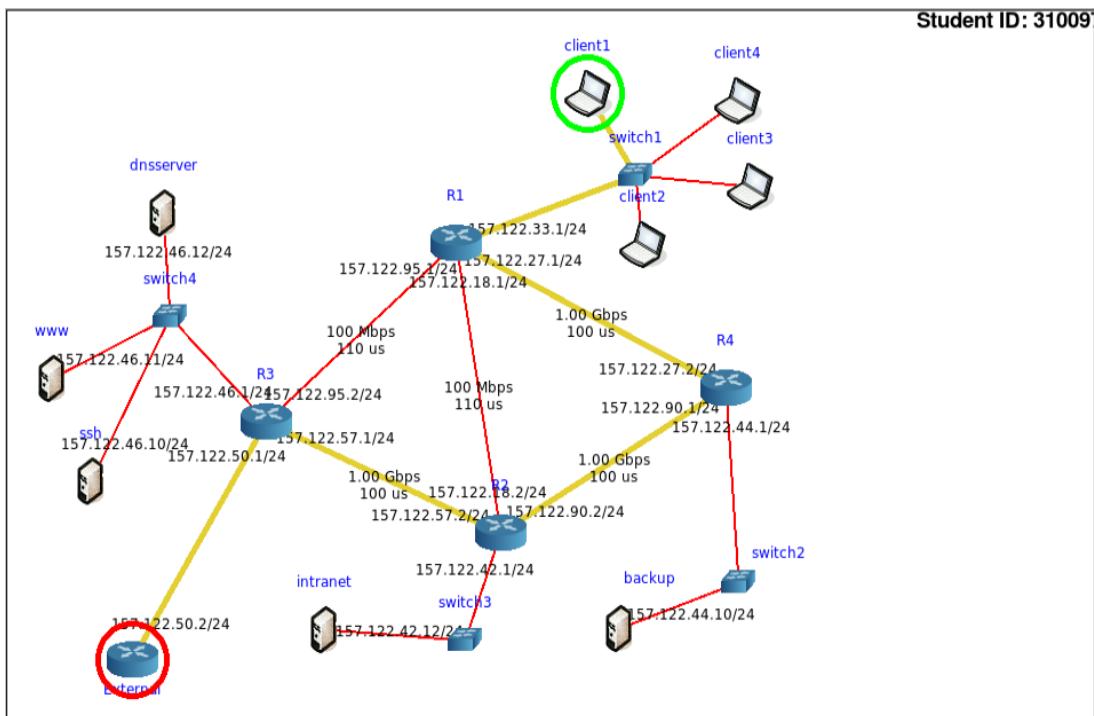
Note: A dummy external router is added here

#### For R1:

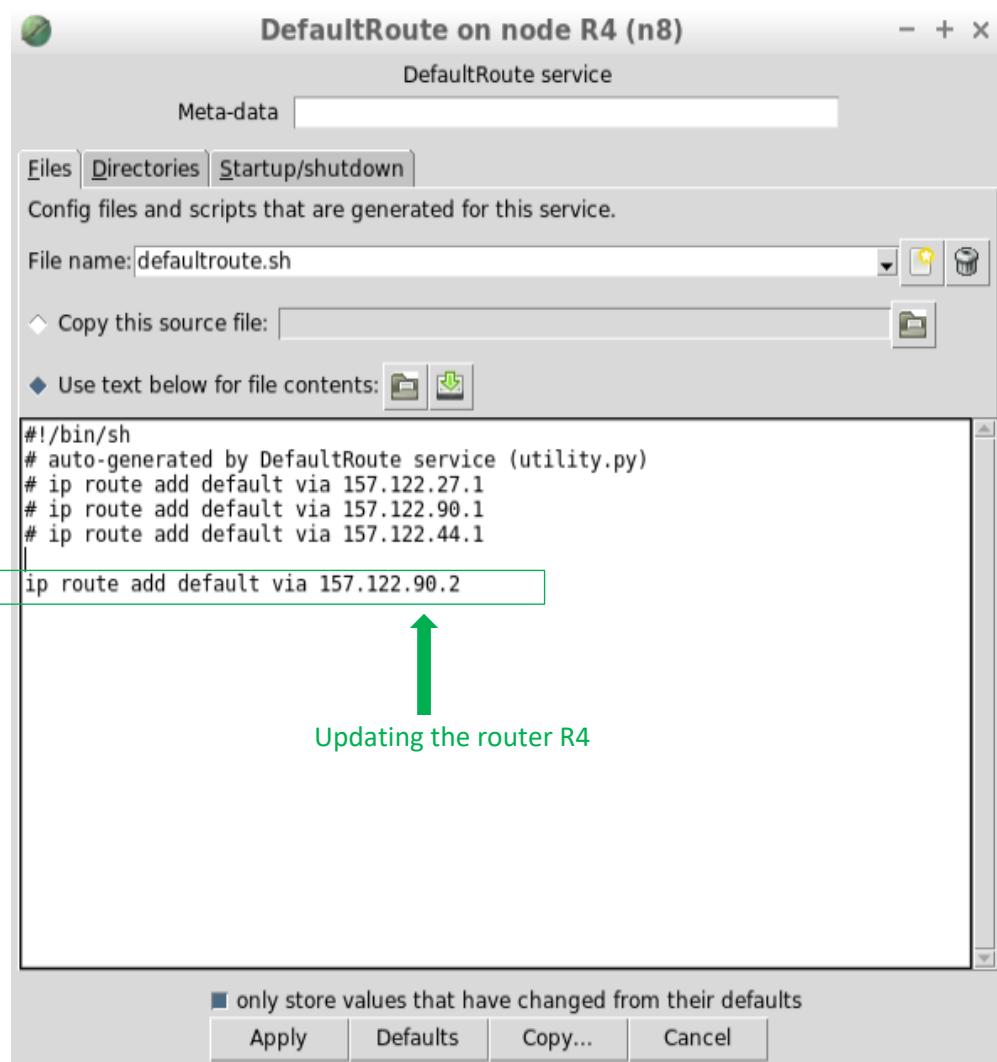
Follow the following steps as shown in the screenshots:

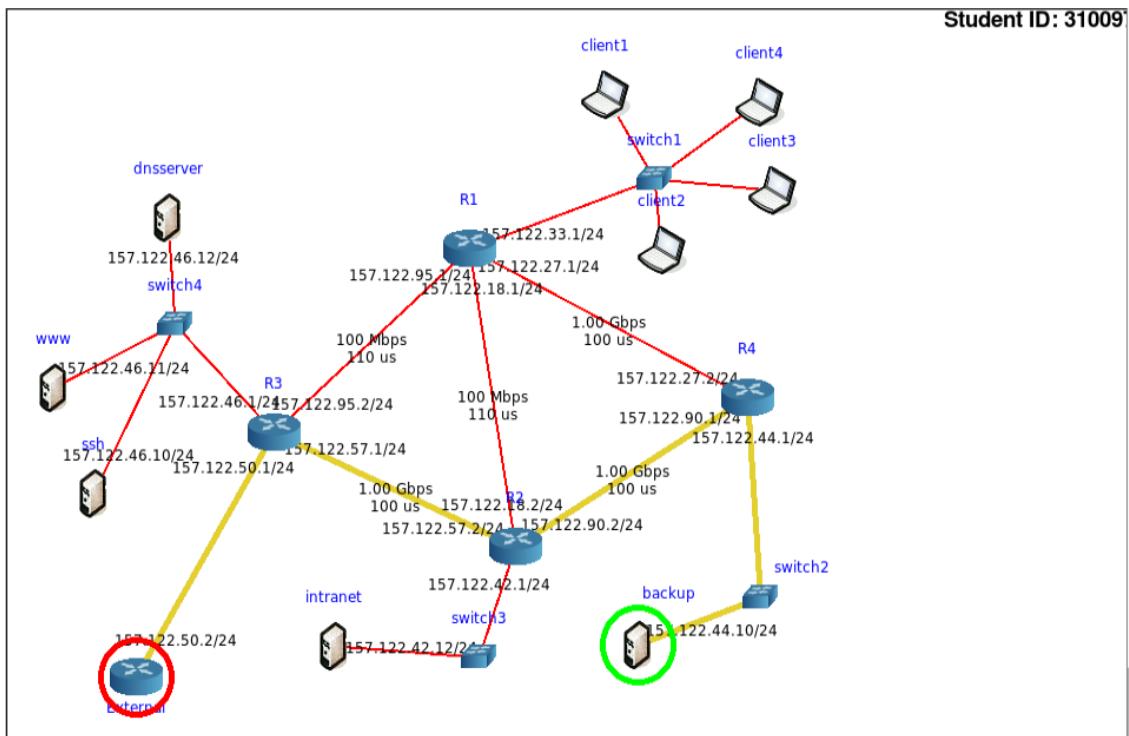




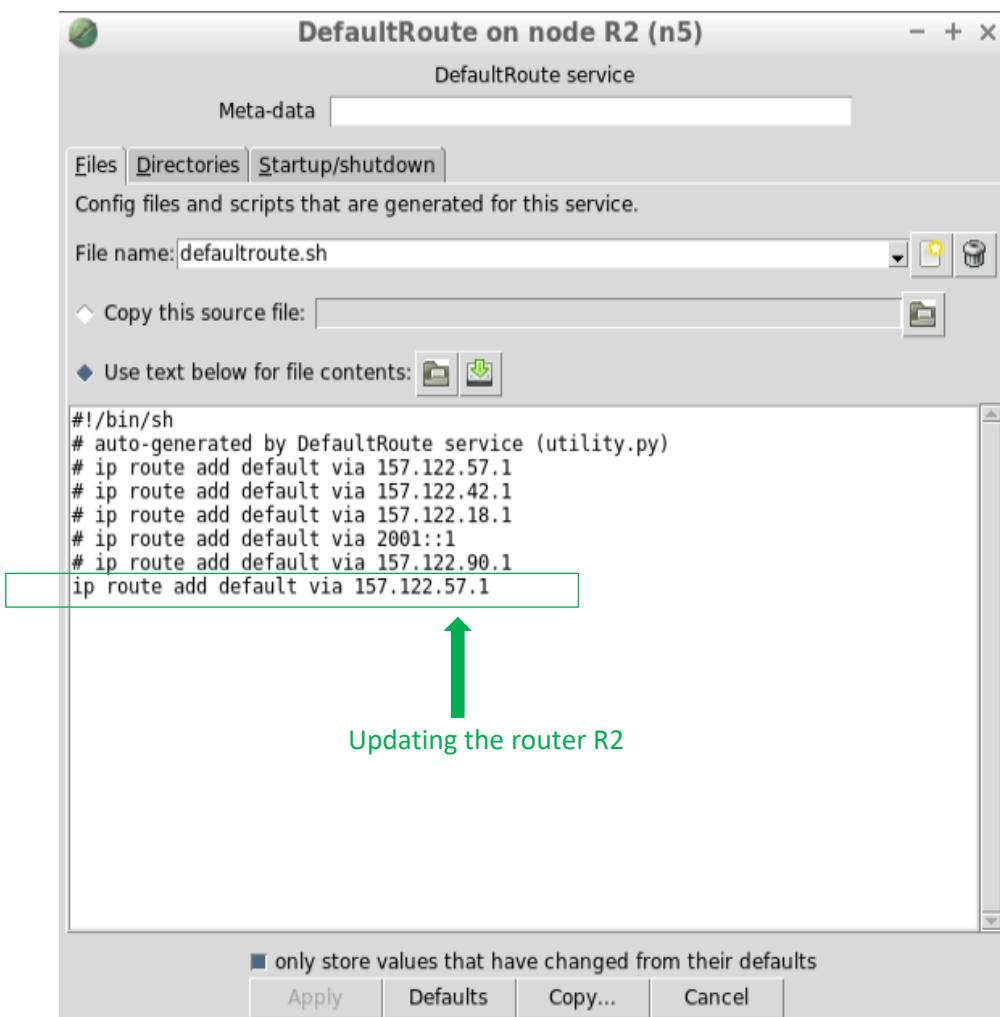


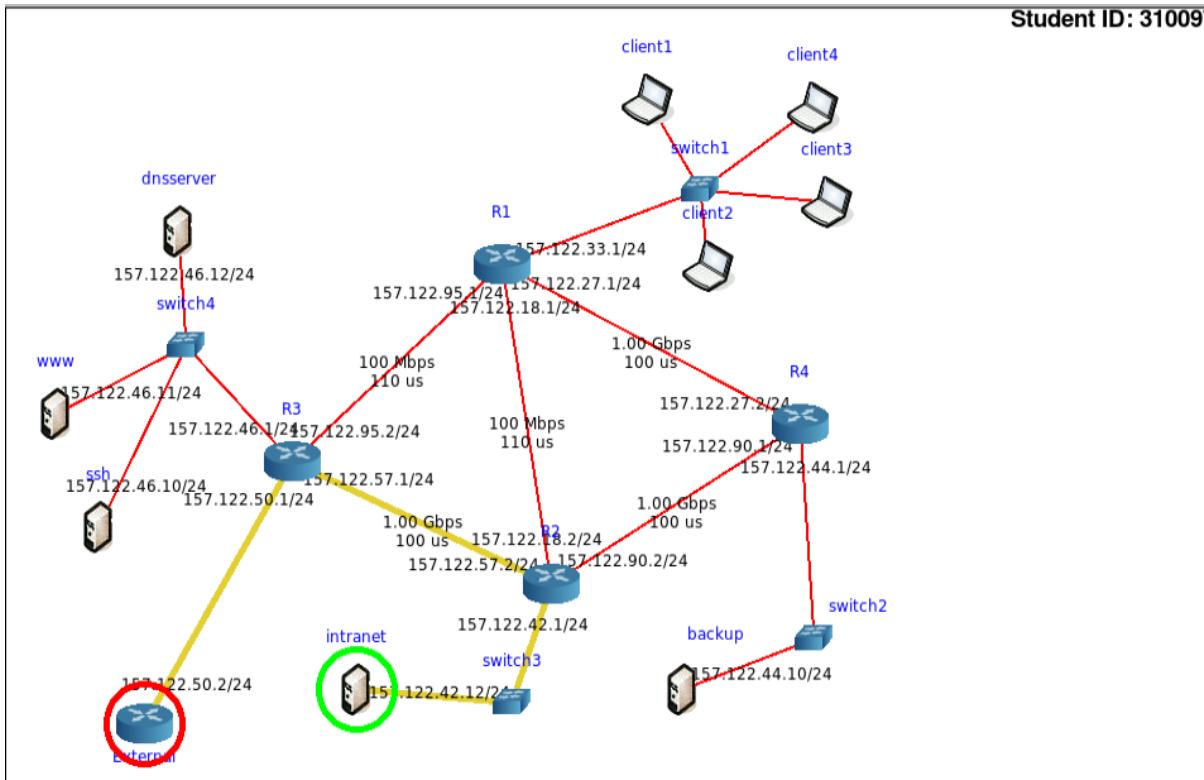
For R4:



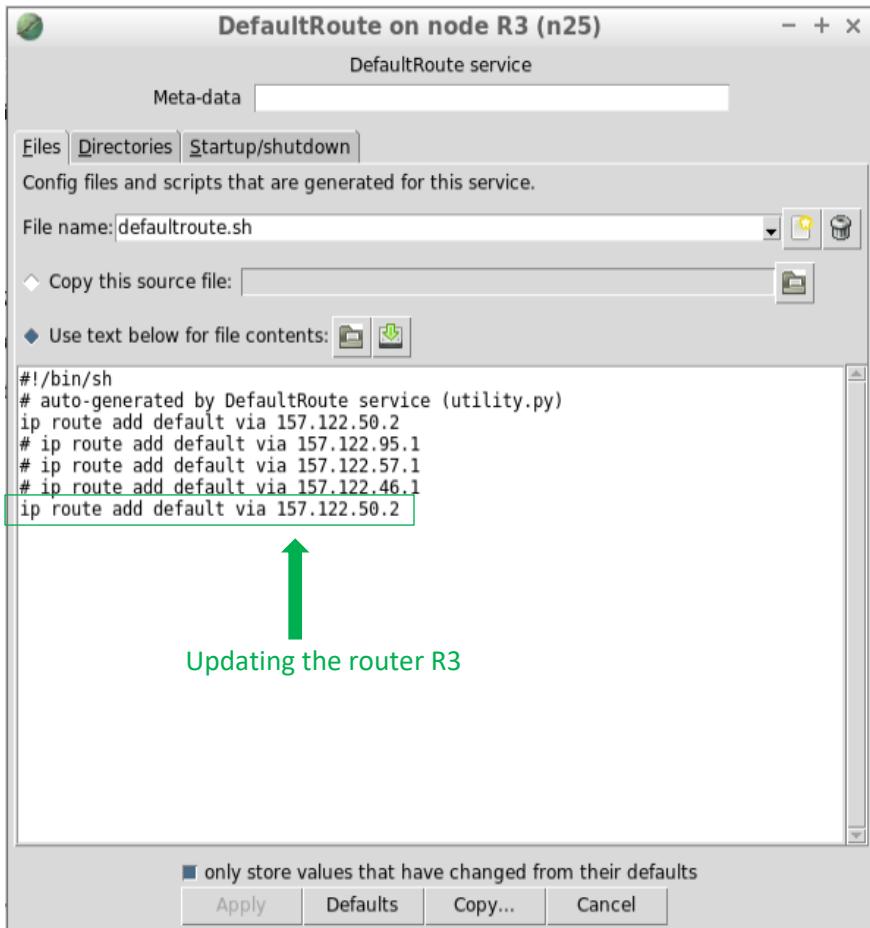


For R2:



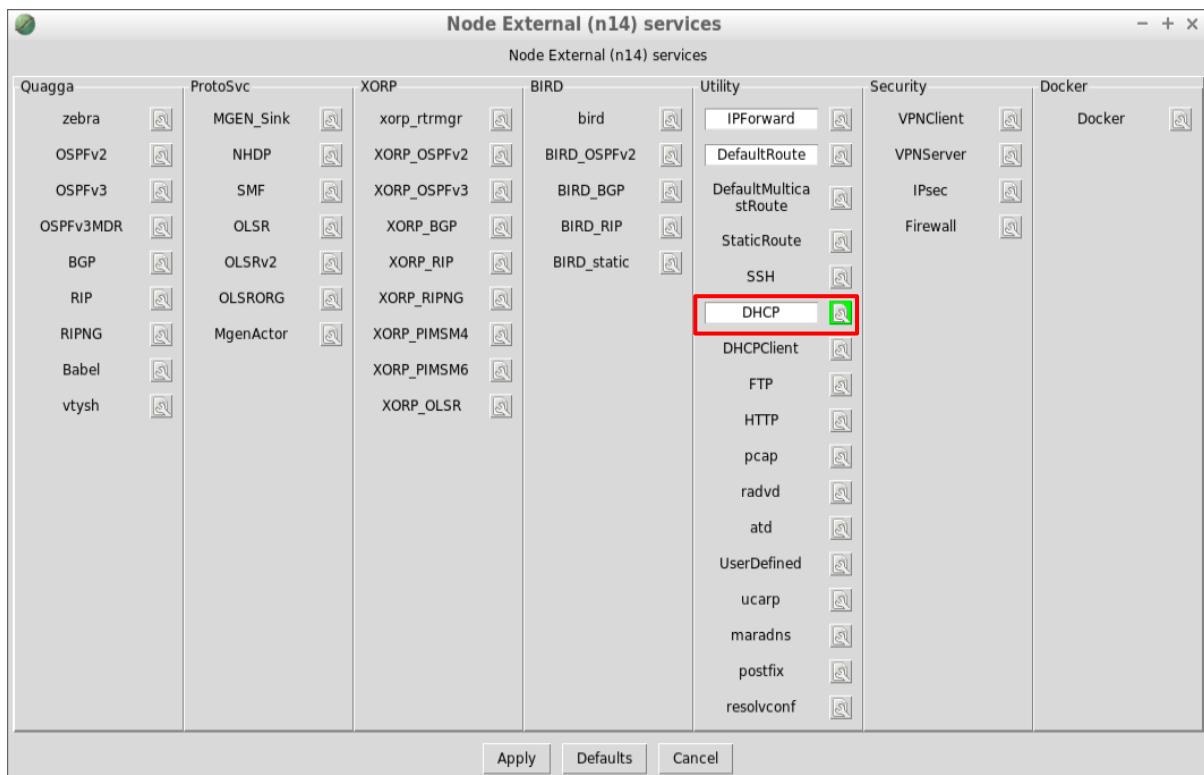
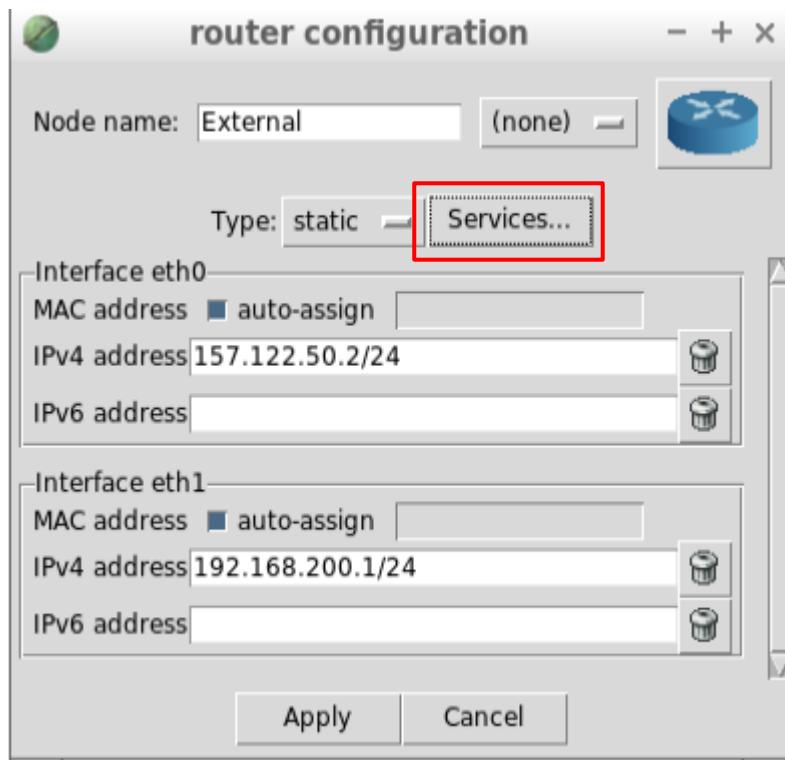


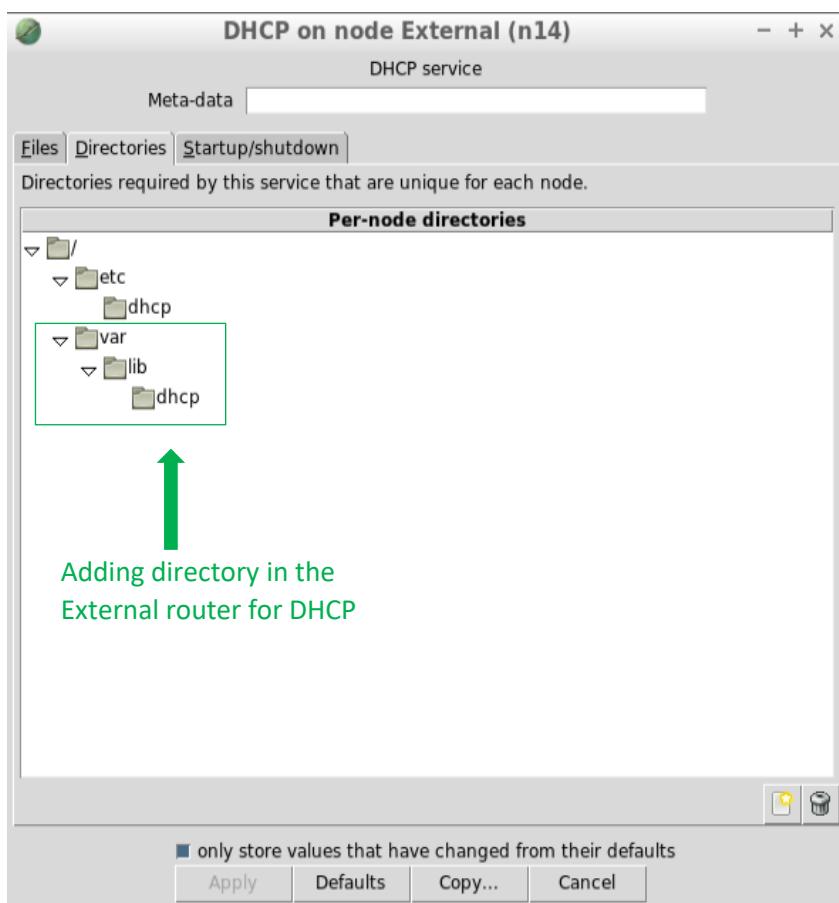
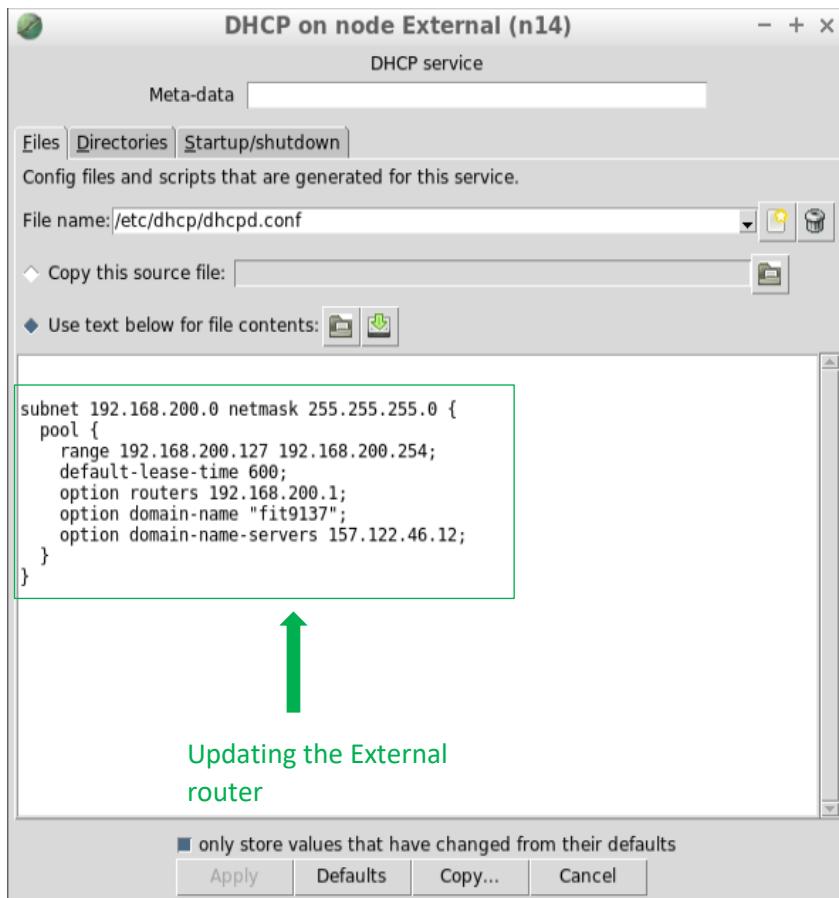
### Updating R3:

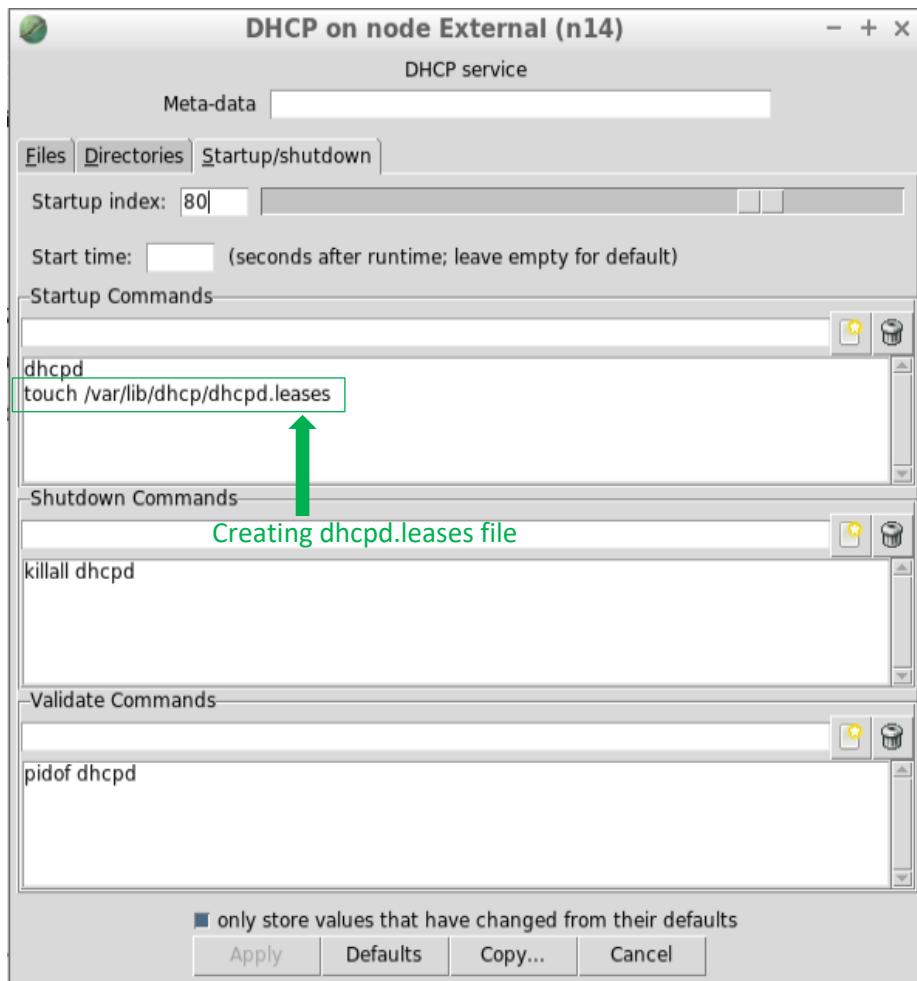


**DHCP:****Creating DHCP on External Router:**

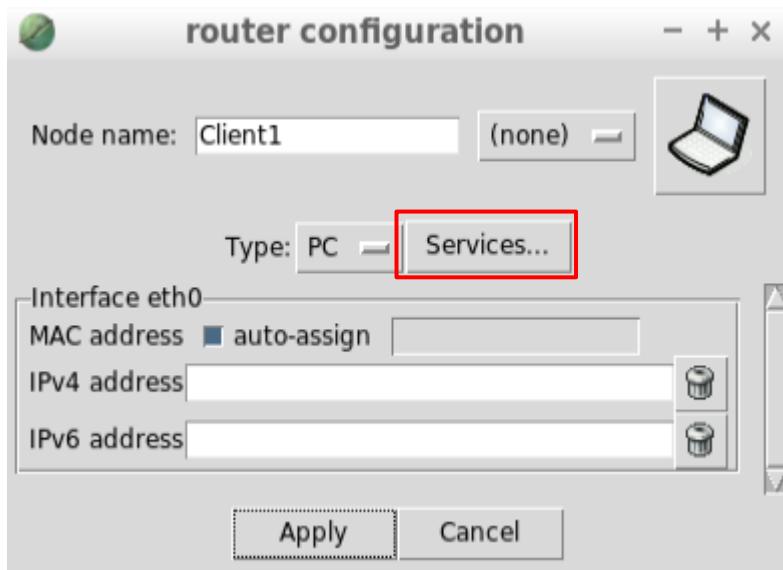
Follow the steps as shown below in the screenshots

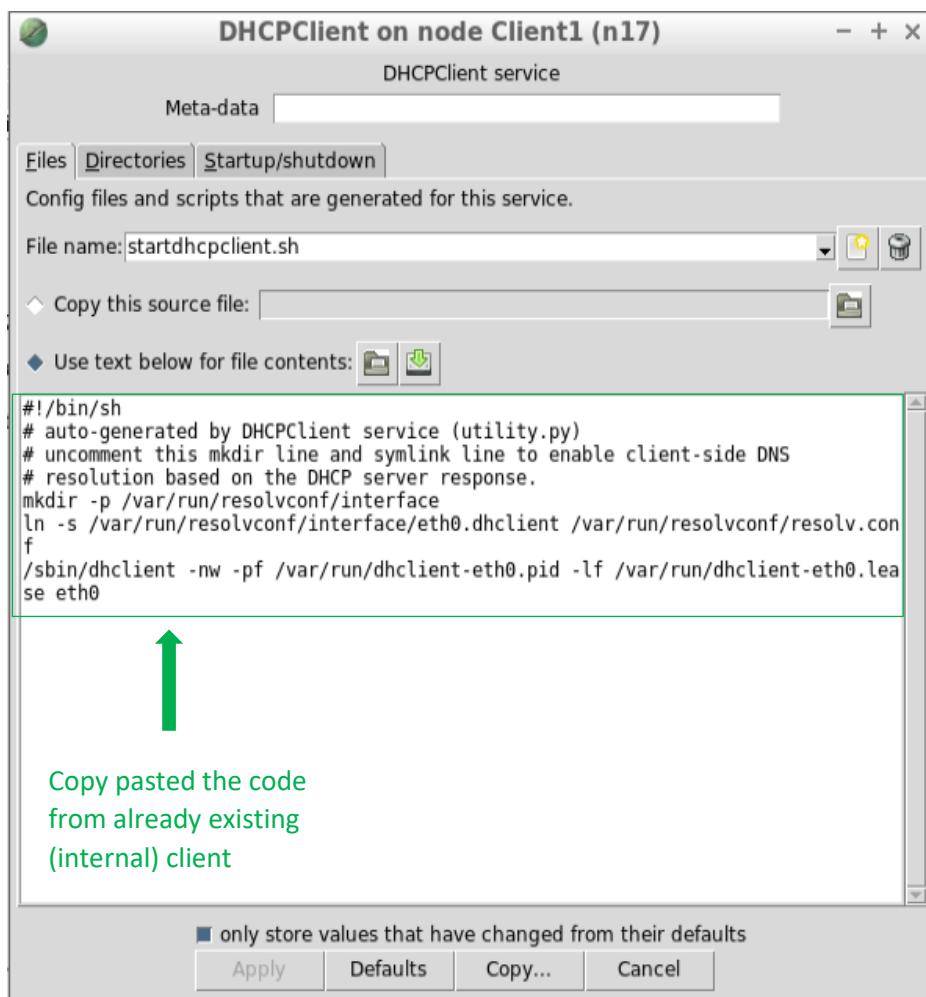
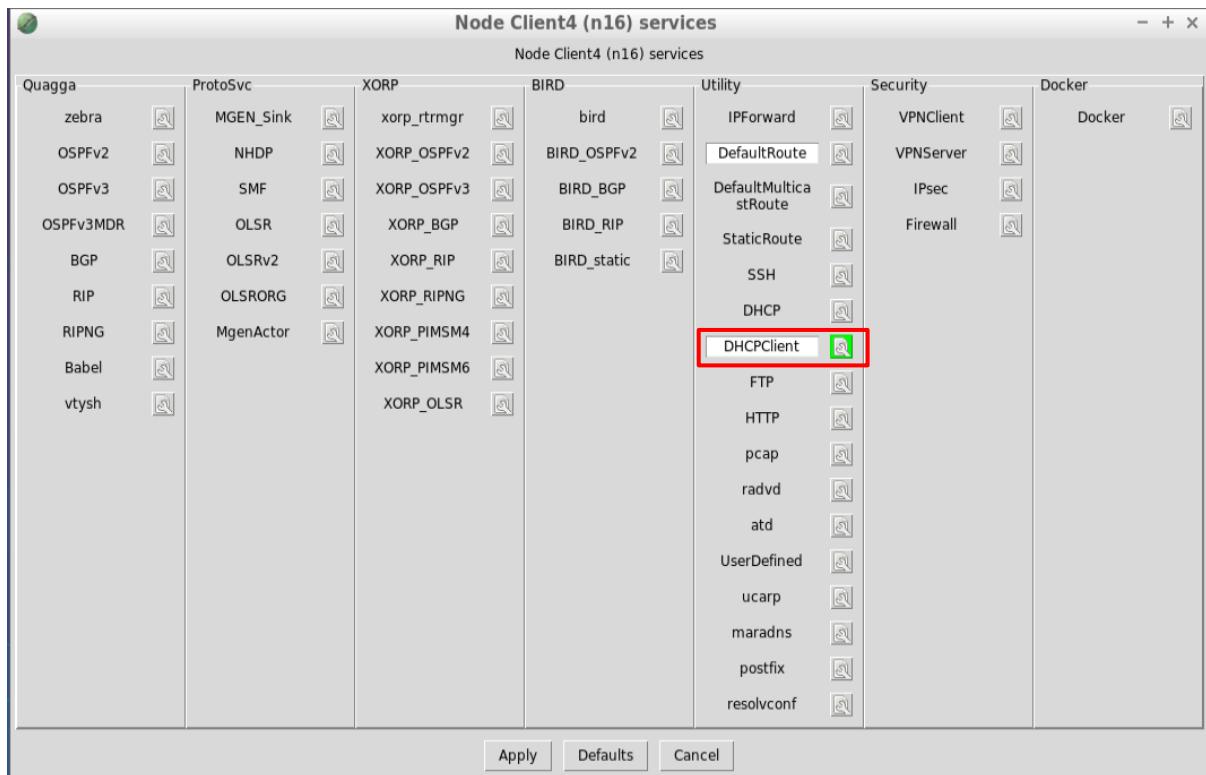


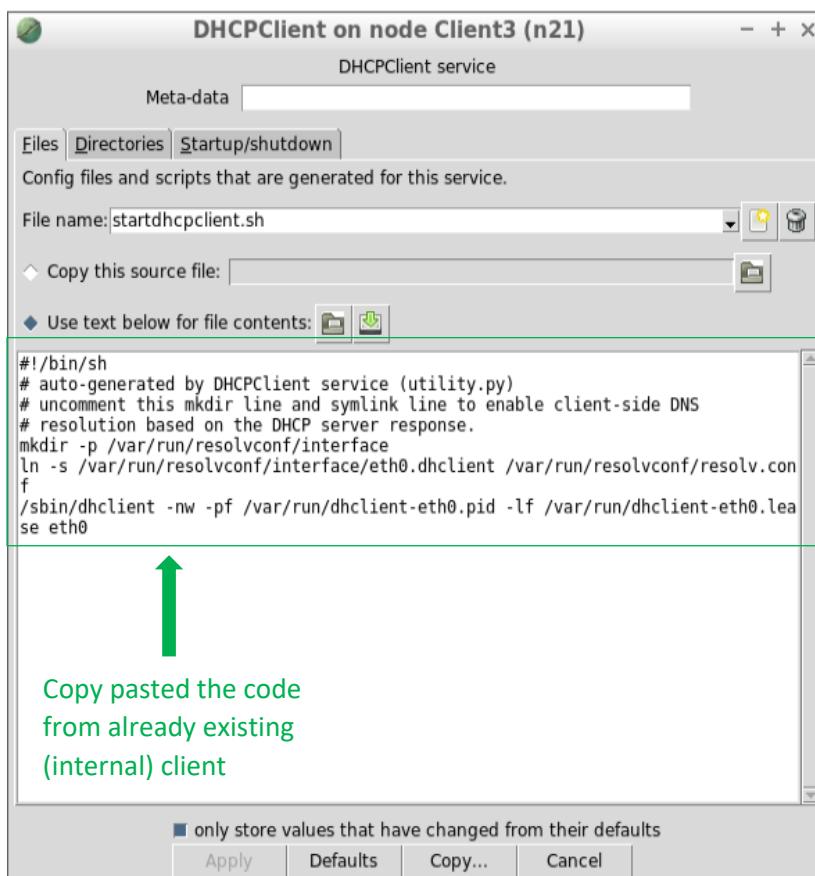
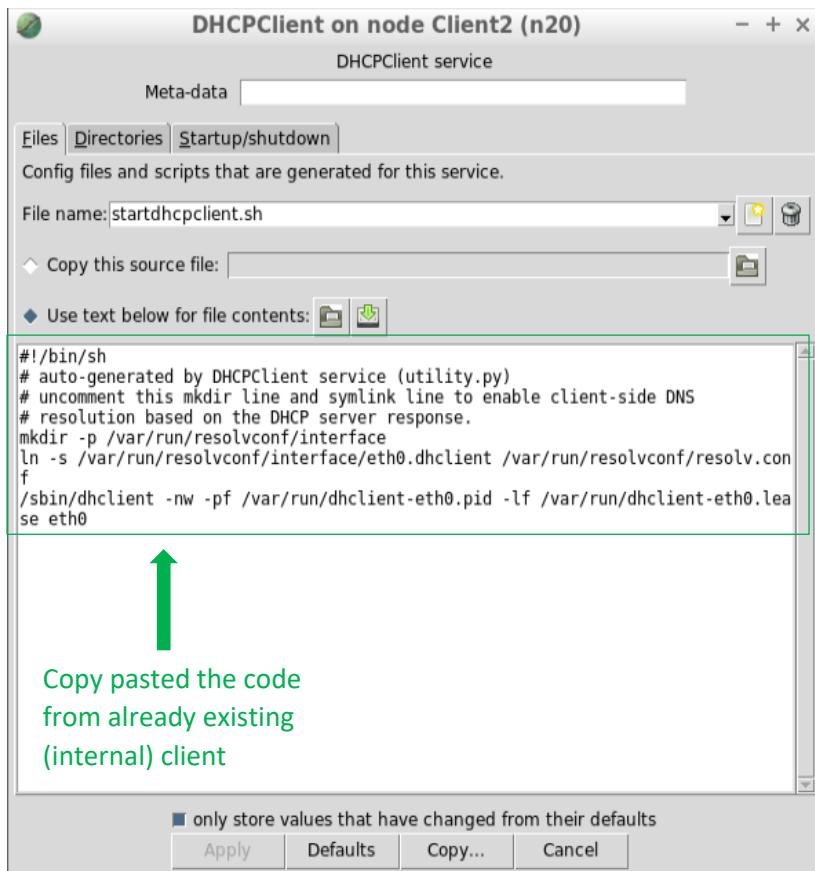




#### Setting up client's dhcp features:







**DHCPClient on node Client4 (n16)**

DHCPClient service

Meta-data [ ]

Files Directories Startup/shutdown [ ]

Config files and scripts that are generated for this service.

File name: startdhcpclient.sh

Copy this source file: [ ]

Use text below for file contents: [ ]

```
#!/bin/sh
# auto-generated by DHCPClient service (utility.py)
# uncomment this mkdir line and symlink line to enable client-side DNS
# resolution based on the DHCP server response.
mkdir -p /var/run/resolvconf/interface
ln -s /var/run/resolvconf/interface/eth0.dhclient /var/run/resolvconf/resolv.conf
/sbin/dhclient -nw -pf /var/run/dhclient-eth0.pid -lf /var/run/dhclient-eth0.lease eth0
```

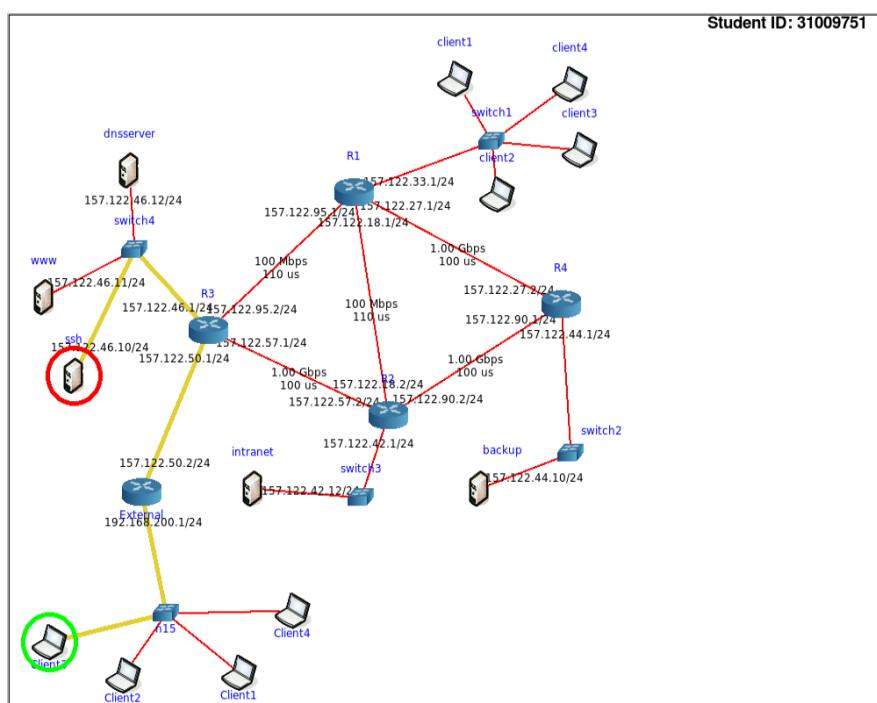
only store values that have changed from their defaults

Apply Defaults Copy... Cancel

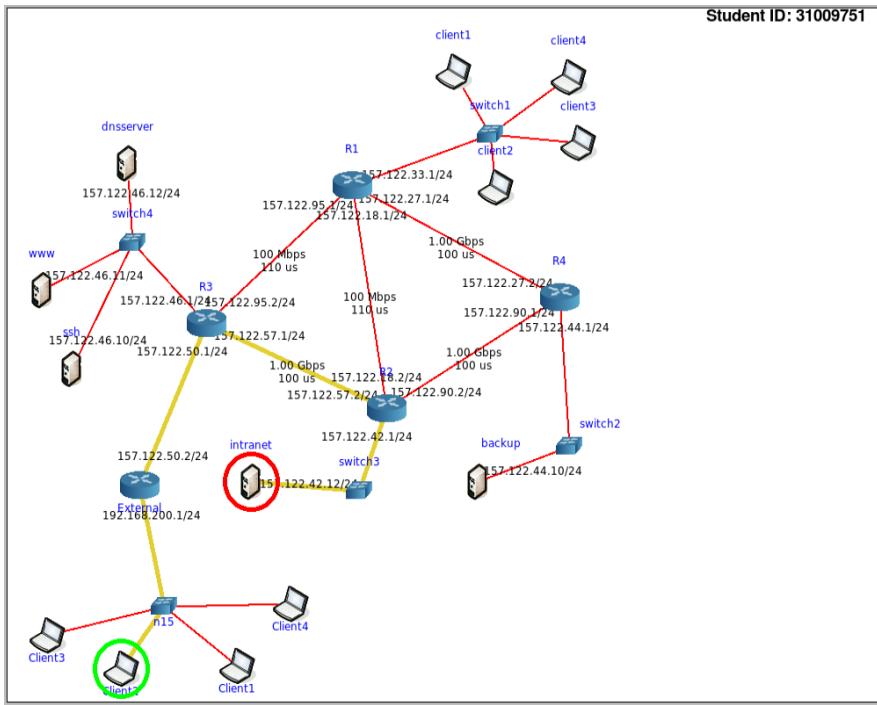
**Copy pasted the code from already existing (internal) client**

Following are the connections between Clients on the External Network and Servers within the network 157.122.xx.xx:

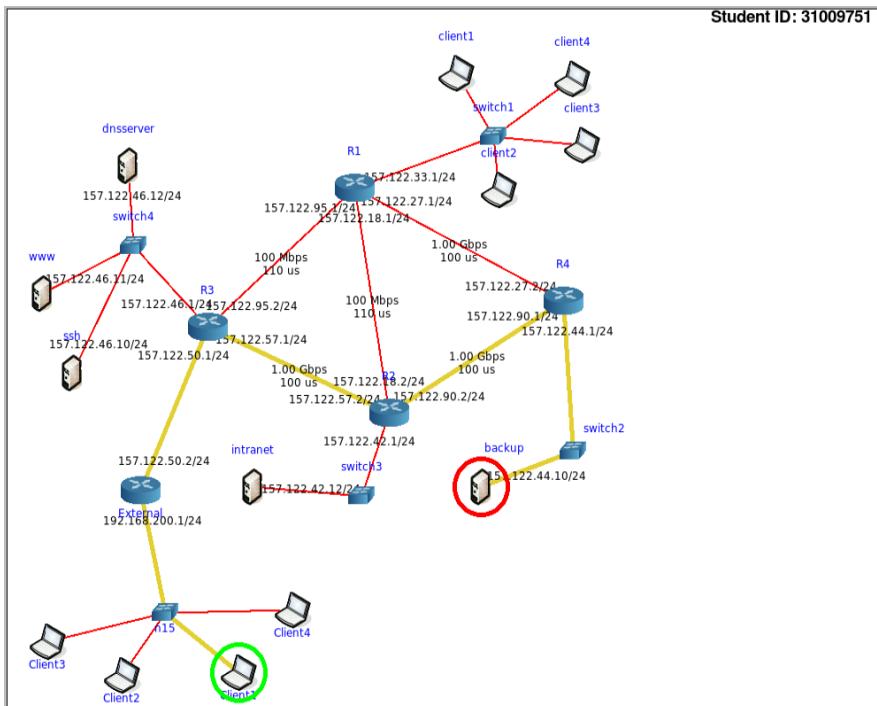
External client to ssh:



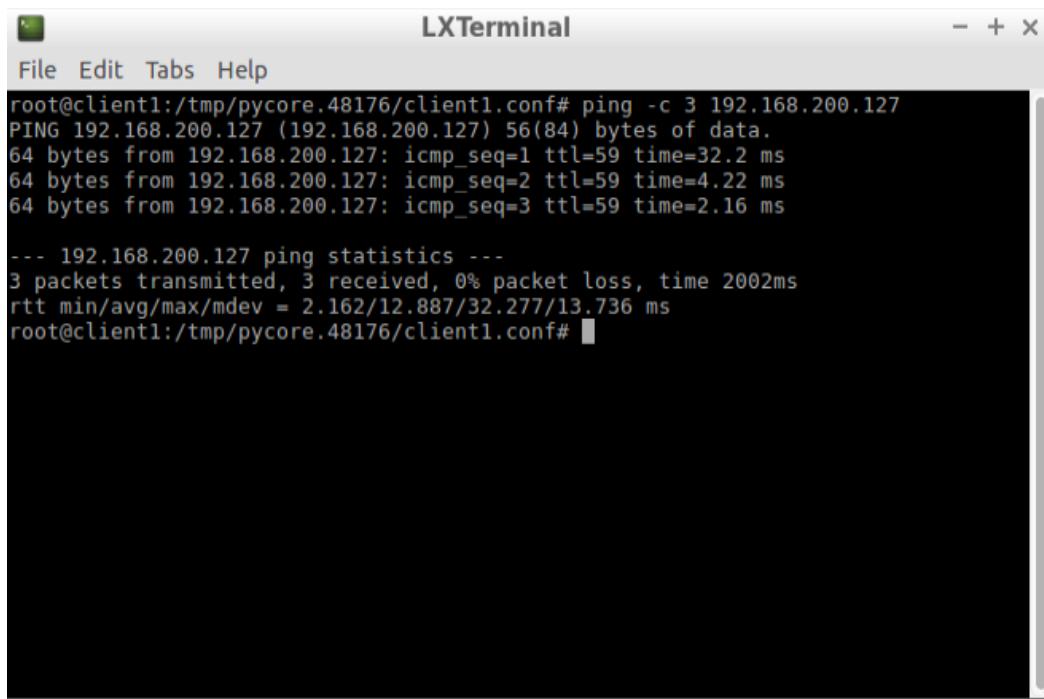
External client to intranet:



External client to Backup:



External client to internal client:



LXTerminal window showing terminal output. The terminal title is "LXTerminal". The menu bar includes "File", "Edit", "Tabs", and "Help". The command entered is "root@client1:/tmp/pycore.48176/client1.conf# ping -c 3 192.168.200.127". The output shows three successful ping packets to 192.168.200.127 with times 32.2 ms, 4.22 ms, and 2.16 ms. Statistics show 3 packets transmitted, 3 received, 0% packet loss, and an average round-trip time of 2002ms.

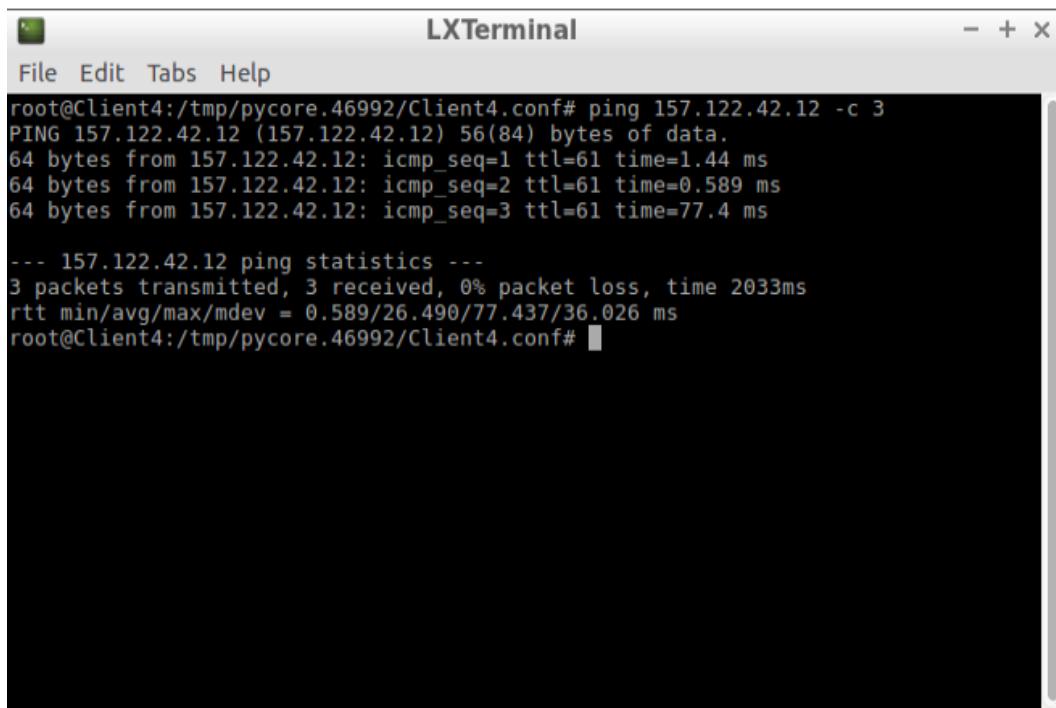
```
root@client1:/tmp/pycore.48176/client1.conf# ping -c 3 192.168.200.127
PING 192.168.200.127 (192.168.200.127) 56(84) bytes of data.
64 bytes from 192.168.200.127: icmp_seq=1 ttl=59 time=32.2 ms
64 bytes from 192.168.200.127: icmp_seq=2 ttl=59 time=4.22 ms
64 bytes from 192.168.200.127: icmp_seq=3 ttl=59 time=2.16 ms

--- 192.168.200.127 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 2.162/12.887/32.277/13.736 ms
root@client1:/tmp/pycore.48176/client1.conf#
```

#### D) Firewall

a)

Before setting up firewall:

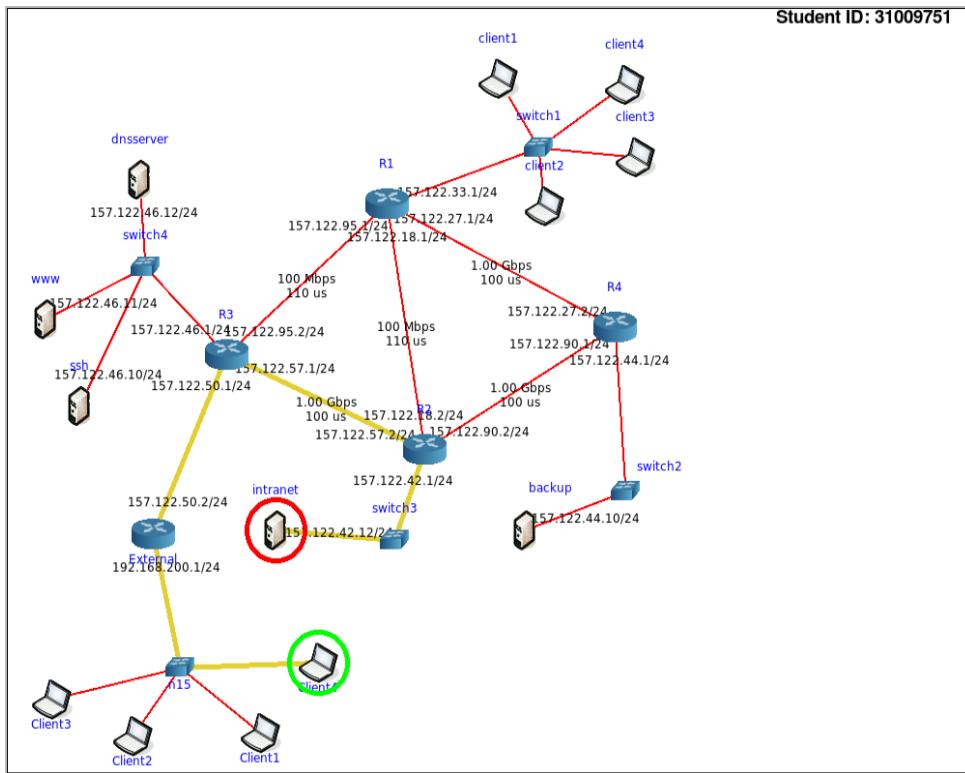


LXTerminal window showing terminal output. The terminal title is "LXTerminal". The menu bar includes "File", "Edit", "Tabs", and "Help". The command entered is "root@Client4:/tmp/pycore.46992/Client4.conf# ping 157.122.42.12 -c 3". The output shows three successful ping packets to 157.122.42.12 with times 1.44 ms, 0.589 ms, and 77.4 ms. Statistics show 3 packets transmitted, 3 received, 0% packet loss, and an average round-trip time of 2033ms.

```
root@Client4:/tmp/pycore.46992/Client4.conf# ping 157.122.42.12 -c 3
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data.
64 bytes from 157.122.42.12: icmp_seq=1 ttl=61 time=1.44 ms
64 bytes from 157.122.42.12: icmp_seq=2 ttl=61 time=0.589 ms
64 bytes from 157.122.42.12: icmp_seq=3 ttl=61 time=77.4 ms

--- 157.122.42.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2033ms
rtt min/avg/max/mdev = 0.589/26.490/77.437/36.026 ms
root@Client4:/tmp/pycore.46992/Client4.conf#
```

Pinging external client to intranet is possible (i.e., intranet is accessible to external world)



After setting up firewall:

**Firewall on node R3 (n25)**

Firewall service

Meta-data: [ ]

Files | Directories | Startup/shutdown |

Config files and scripts that are generated for this service.

File name:  [ ]

Copy this source file: [ ]

Use text below for file contents: [ ]

```

iptables -P INPUT DROP
iptables -P OUTPUT DROP
iptables -P FORWARD DROP

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.11 -p tcp --dport 80 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.11 -p tcp --sport 80 -j ACCEPT

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.10 -p tcp --dport 22 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.10 -p tcp --sport 22 -j ACCEPT

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.12 -p udp --dport 53 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.12 -p udp --sport 53 -j ACCEPT

iptables -A FORWARD -p icmp -j ACCEPT -i eth0 -o eth3
iptables -A FORWARD -p icmp -j ACCEPT -i eth3 -o eth0

# b)
iptables -A FORWARD -i eth2 -o eth3 -j ACCEPT
# iptables -A FORWARD -i eth3 -o eth2 -j ACCEPT

# C)

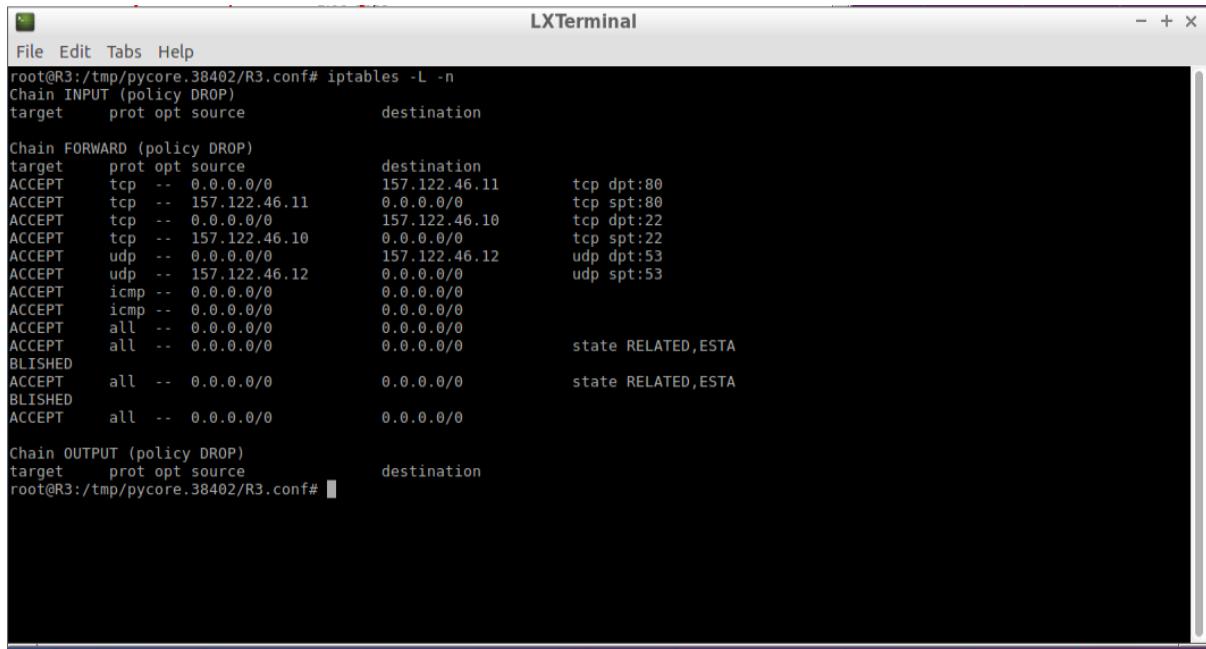
```

only store values that have changed from their defaults

Apply | Defaults | Copy... | Cancel

Accepting http packets  
Accepting ssh packets  
Accepting dns packets  
Accepting icmp packets

Firewall rules after updating:



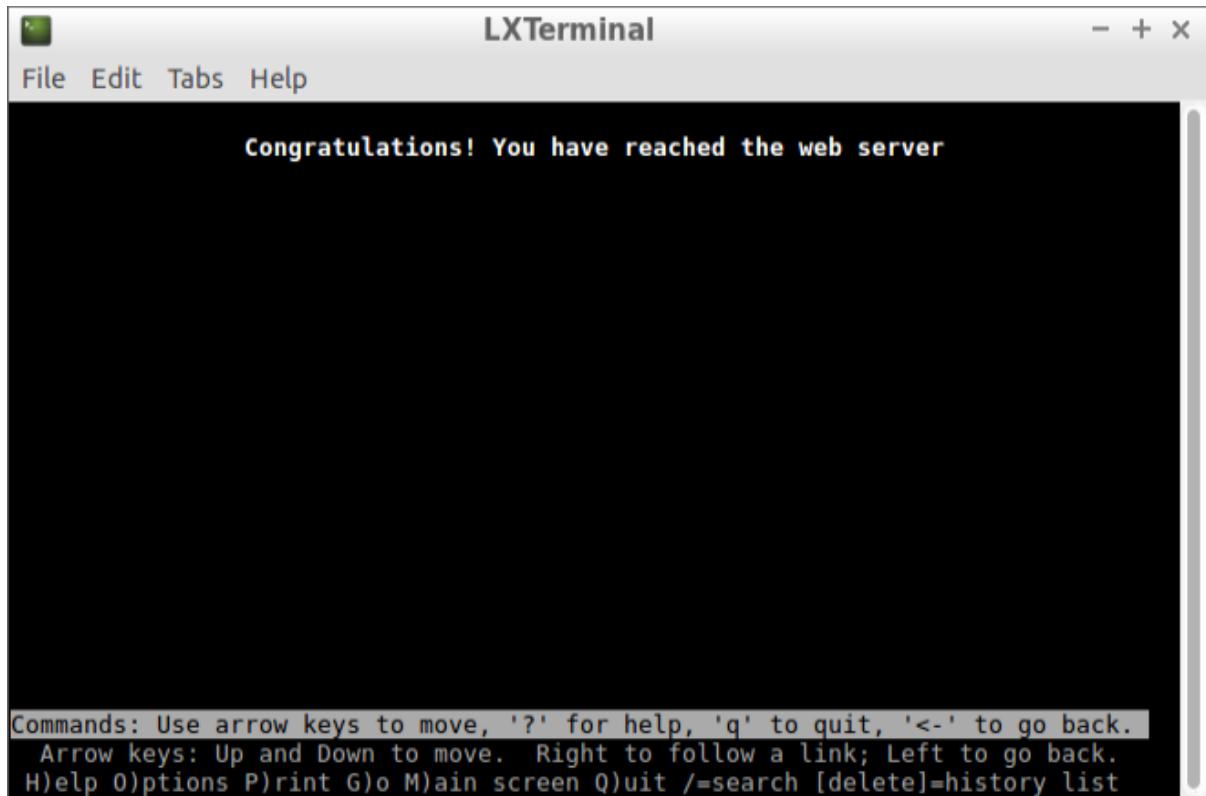
```
LXTerminal
File Edit Tabs Help
root@R3:/tmp/pycore.38402/R3.conf# iptables -L -n
Chain INPUT (policy DROP)
target     prot opt source          destination
ACCEPT    tcp  --  0.0.0.0/0      157.122.46.11    tcp dpt:80
ACCEPT    tcp  --  157.122.46.11  0.0.0.0/0      tcp spt:80
ACCEPT    tcp  --  0.0.0.0/0      157.122.46.10    tcp dpt:22
ACCEPT    tcp  --  157.122.46.10  0.0.0.0/0      tcp spt:22
ACCEPT    udp  --  0.0.0.0/0      157.122.46.12    udp dpt:53
ACCEPT    udp  --  157.122.46.12  0.0.0.0/0      udp spt:53
ACCEPT    icmp --  0.0.0.0/0      0.0.0.0/0
ACCEPT    icmp --  0.0.0.0/0      0.0.0.0/0
ACCEPT    all  --  0.0.0.0/0      0.0.0.0/0      state RELATED,ESTA
BLISHED   all  --  0.0.0.0/0      0.0.0.0/0      state RELATED,ESTA
BLISHED   all  --  0.0.0.0/0      0.0.0.0/0
ACCEPT    all  --  0.0.0.0/0      0.0.0.0/0      state RELATED,ESTA
BLISHED   all  --  0.0.0.0/0      0.0.0.0/0
ACCEPT    all  --  0.0.0.0/0      0.0.0.0/0      state RELATED,ESTA

Chain FORWARD (policy DROP)
target     prot opt source          destination
root@R3:/tmp/pycore.38402/R3.conf#
```

**Result:**

**From external client to DMZ:**

Lynx www.fit9137



```
LXTerminal
File Edit Tabs Help
Congratulations! You have reached the web server

Commands: Use arrow keys to move, '?' for help, 'q' to quit, '<->' to go back.
Arrow keys: Up and Down to move. Right to follow a link; Left to go back.
H)elp O)ptions P)rint G)o M)ain screen Q)uit /=search [delete]=history list
```

**SSH:**

LXTerminal

File Edit Tabs Help

```
Are you sure you want to quit? (y)
Arrow keys: Up and Down to move. Right to follow a link; Left to go back.
root@Client4:/tmp/pycore.46984/Client4.conf# y
y: command not found
root@Client4:/tmp/pycore.46984/Client4.conf# ssh 157.122.46.10
@@@@@@@@@@@cccccccccccccccccccccccccccccccccccccccccccccccccccccccc
@ WARNING: REMOTE HOST IDENTIFICATION HAS CHANGED! @
@@@@@@@cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
IT IS POSSIBLE THAT SOMEONE IS DOING SOMETHING NASTY!
Someone could be eavesdropping on you right now (man-in-the-middle attack)!
It is also possible that a host key has just been changed.
The fingerprint for the RSA key sent by the remote host is
SHA256:NcIcjiFK2fAfob6e895oBDEmwFlpt0+JsP/68e+uWCc.
Please contact your system administrator.
Add correct host key in /root/.ssh/known_hosts to get rid of this message.
Offending RSA key in /root/.ssh/known_hosts:1
remove with:
ssh-keygen -f "/root/.ssh/known_hosts" -R 157.122.46.10
RSA host key for 157.122.46.10 has changed and you have requested strict checking.
g.
Host key verification failed.
root@Client4:/tmp/pycore.46984/Client4.conf#
```

DNS:

LXTerminal

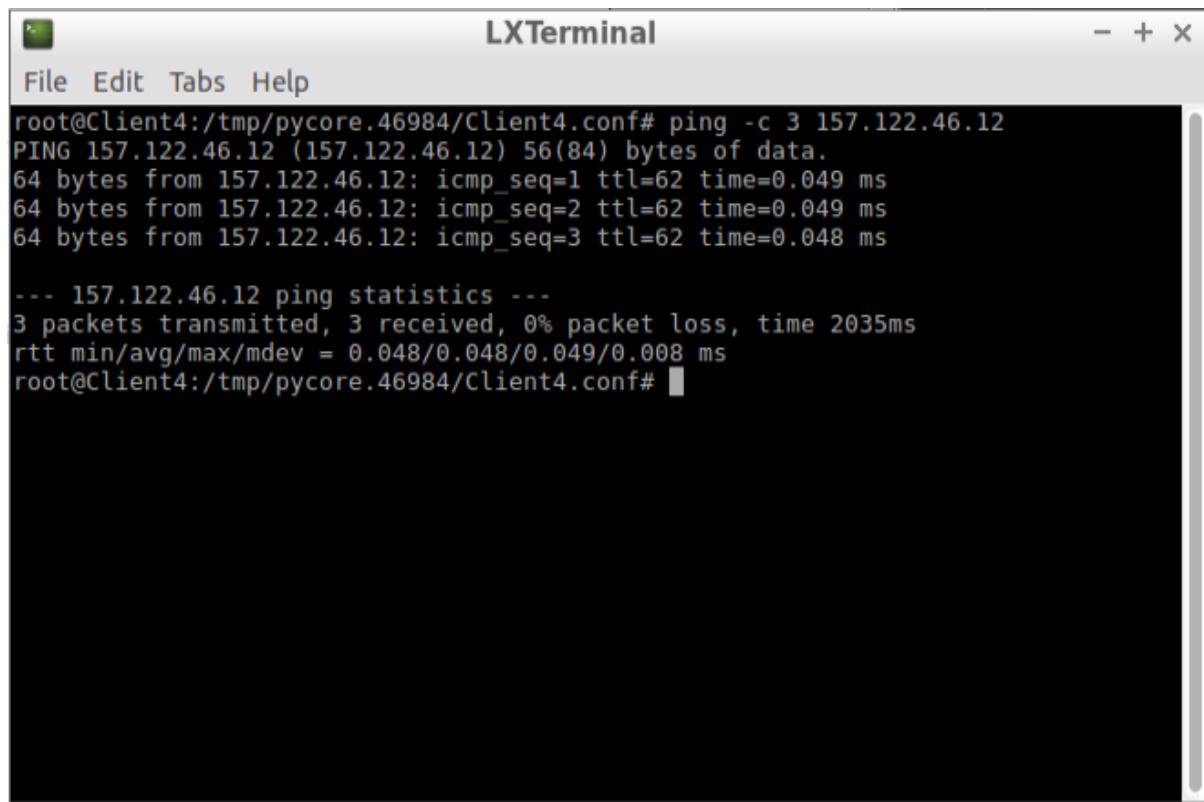
File Edit Tabs Help

```
<984/Client4.conf# nslookup www.fit9137 157.122.46.12
Server:      157.122.46.12
Address:     157.122.46.12#53

Name:   www.fit9137
Address: 157.122.46.11

root@Client4:/tmp/pycore.46984/Client4.conf#
```

**PING:**

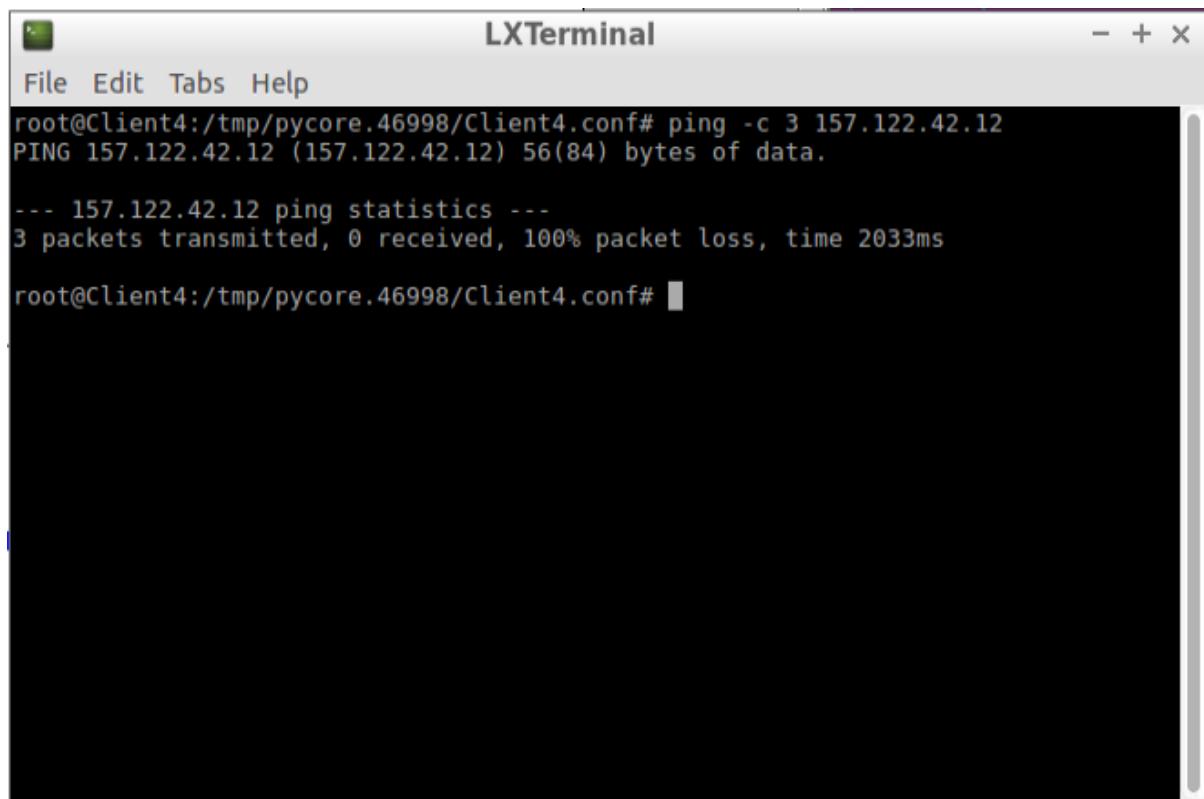


The screenshot shows an LXTerminal window with a black background and white text. The title bar reads "LXTerminal". The menu bar includes "File", "Edit", "Tabs", and "Help". The command entered was "ping -c 3 157.122.46.12". The output shows three packets being sent to 157.122.46.12, each with 56(84) bytes of data. The first two packets have an ICMP sequence number of 1, TTL of 62, and time values of 0.049 ms. The third packet has an ICMP sequence number of 3, TTL of 62, and a time value of 0.048 ms. Below this, the "ping statistics" are displayed, showing 3 packets transmitted, 3 received, 0% packet loss, and a total time of 2035ms. The rtt min/avg/max/mdev values are 0.048/0.048/0.049/0.008 ms. The prompt "root@Client4:/tmp/pycore.46984/Client4.conf#" is visible at the bottom.

```
root@Client4:/tmp/pycore.46984/Client4.conf# ping -c 3 157.122.46.12
PING 157.122.46.12 (157.122.46.12) 56(84) bytes of data.
64 bytes from 157.122.46.12: icmp_seq=1 ttl=62 time=0.049 ms
64 bytes from 157.122.46.12: icmp_seq=2 ttl=62 time=0.049 ms
64 bytes from 157.122.46.12: icmp_seq=3 ttl=62 time=0.048 ms

--- 157.122.46.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2035ms
rtt min/avg/max/mdev = 0.048/0.048/0.049/0.008 ms
root@Client4:/tmp/pycore.46984/Client4.conf#
```

External client to other devices in the network (Example of pinging the intranet server):



The screenshot shows an LXTerminal window with a black background and white text. The title bar reads "LXTerminal". The menu bar includes "File", "Edit", "Tabs", and "Help". The command entered was "ping -c 3 157.122.42.12". The output shows three packets being sent to 157.122.42.12, each with 56(84) bytes of data. All three packets are lost, indicated by "0 received". The total time is 2033ms. The prompt "root@Client4:/tmp/pycore.46998/Client4.conf#" is visible at the bottom.

```
root@Client4:/tmp/pycore.46998/Client4.conf# ping -c 3 157.122.42.12
PING 157.122.42.12 (157.122.42.12) 56(84) bytes of data.

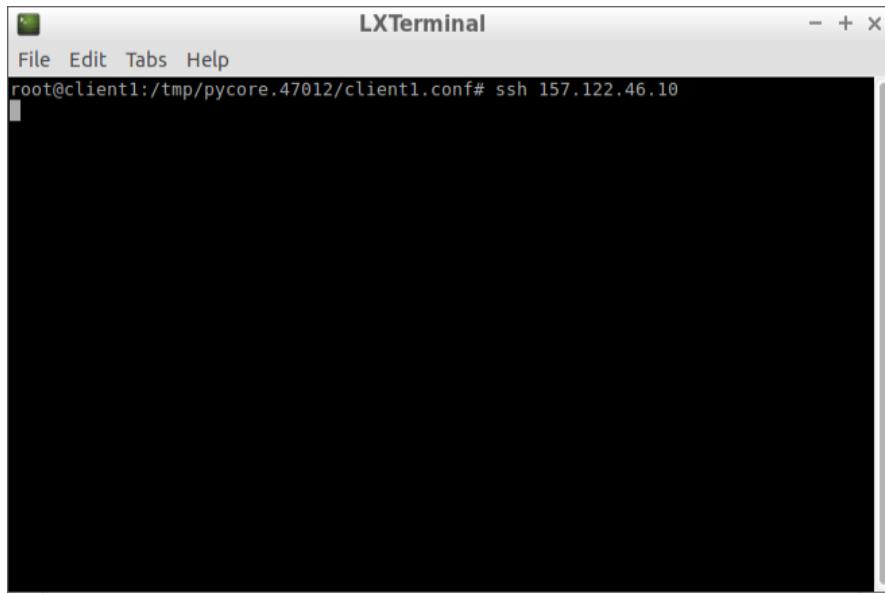
--- 157.122.42.12 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2033ms

root@Client4:/tmp/pycore.46998/Client4.conf#
```

**b) "Any packets from inside the company network are accepted."**

**Before:**

Internal client1 trying to ssh the ssh-server:



**After:**

The screenshot shows the "Firewall on node R3 (n25)" configuration dialog. It has tabs for "Files", "Directories", and "Startup/shutdown". The "Files" tab is selected, showing a file named "firewall.sh" with the following iptables rules:

```
iptables -P INPUT DROP
iptables -P OUTPUT DROP
iptables -P FORWARD DROP

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.11 -p tcp --dport 80 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.11 -p tcp --sport 80 -j ACCEPT

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.10 -p tcp --dport 22 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.10 -p tcp --sport 22 -j ACCEPT

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.12 -p udp --dport 53 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.12 -p udp --sport 53 -j ACCEPT

iptables -A FORWARD -p icmp -j ACCEPT -i eth0 -o eth3
iptables -A FORWARD -p icmp -j ACCEPT -i eth3 -o eth0

# b)
iptables -A FORWARD -i eth2 -o eth3 -j ACCEPT
# iptables -A FORWARD -i eth3 -o eth2 -j ACCEPT

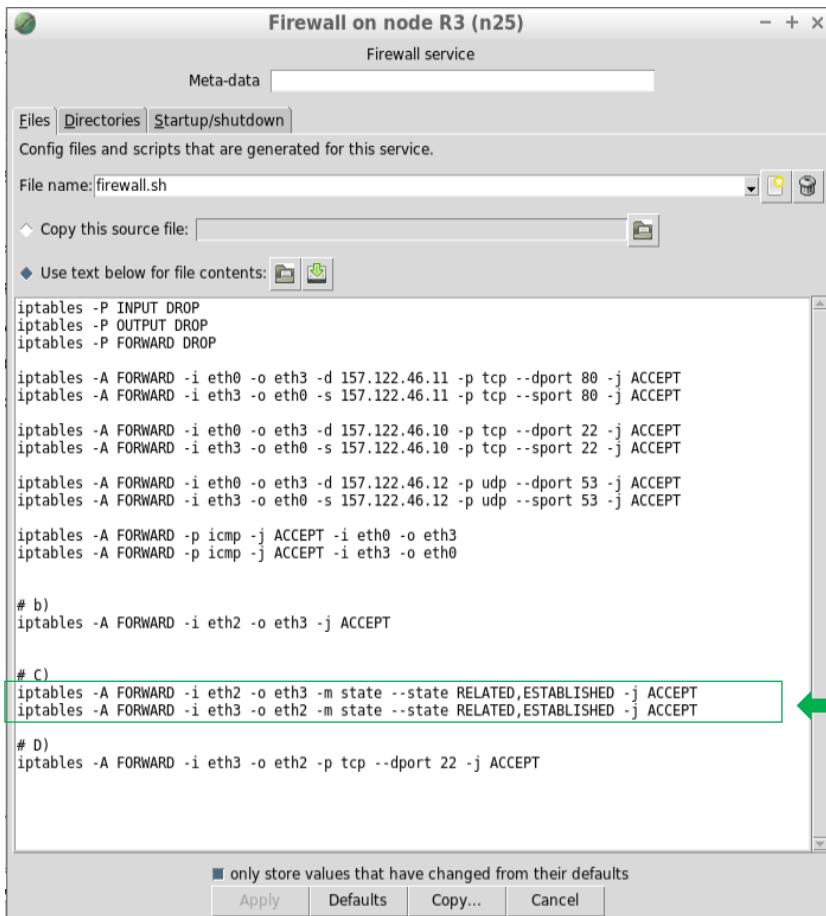
# C)
```

A green arrow points to the last two lines of the rule list: "# b)" and "# C)". To the right of the arrow, the text "Accepting any internal packets into DMZ" is displayed in green. At the bottom of the dialog, there is a checkbox "only store values that have changed from their defaults" and buttons for "Apply", "Defaults", "Copy...", and "Cancel".

Internal client1 trying to ssh the ssh-server:

```
File Edit Tabs Help
root@client1:/tmp/pycore.46998/client1.conf# ssh 157.122.46.10
@@@@@@@WARNING: REMOTE HOST IDENTIFICATION HAS CHANGED! @
@@@@@@@ IT IS POSSIBLE THAT SOMEONE IS DOING SOMETHING NASTY!
Someone could be eavesdropping on you right now (man-in-the-middle attack)!
It is also possible that a host key has just been changed.
The fingerprint for the RSA key sent by the remote host is
SHA256:IyhngYQguPRIQlrPcpcdFvL5UVqaxu0QXIIP/6AcyJ8.
Please contact your system administrator.
Add correct host key in /root/.ssh/known_hosts to get rid of this message.
Offending RSA key in /root/.ssh/known_hosts:1
    remove with:
        ssh-keygen -f "/root/.ssh/known_hosts" -R 157.122.46.10
RSA host key for 157.122.46.10 has changed and you have requested strict checking.
Host key verification failed.
root@client1:/tmp/pycore.46998/client1.conf#
```

c)



Accepting any internal packets into DMZ that are related or established

d)

The screenshot shows the 'Firewall on node R3 (n25)' configuration window. The 'File name' is set to 'firewall.sh'. The 'File contents' pane displays the following iptables rules:

```
iptables -P INPUT DROP
iptables -P OUTPUT DROP
iptables -P FORWARD DROP

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.11 -p tcp --dport 80 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.11 -p tcp --sport 80 -j ACCEPT

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.10 -p tcp --dport 22 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.10 -p tcp --sport 22 -j ACCEPT

iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.12 -p udp --dport 53 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.12 -p udp --sport 53 -j ACCEPT

iptables -A FORWARD -p icmp -j ACCEPT -i eth0 -o eth3
iptables -A FORWARD -p icmp -j ACCEPT -i eth3 -o eth0

# b)
iptables -A FORWARD -i eth2 -o eth3 -j ACCEPT

# C)
iptables -A FORWARD -i eth2 -o eth3 -m state --state RELATED,ESTABLISHED -j ACCEPT
iptables -A FORWARD -i eth3 -o eth2 -m state --state RELATED,ESTABLISHED -j ACCEPT

# D)
iptables -A FORWARD -i eth3 -o eth2 -p tcp --dport 22 -j ACCEPT
```

A green arrow points from the text '# D) iptables -A FORWARD -i eth3 -o eth2 -p tcp --dport 22 -j ACCEPT' to the right, with the text 'Accepting any ssh packets into internal network' to its right.

Accepting any ssh  
packets into internal  
network

e)

The screenshot shows the 'Firewall on node R3 (n25)' configuration window. The 'File name' is set to 'firewall.sh'. The 'File contents' pane displays the following iptables rules:

```
iptables -A FORWARD -i eth0 -o eth3 -d 157.122.46.12 -p udp --dport 53 -j ACCEPT
iptables -A FORWARD -i eth3 -o eth0 -s 157.122.46.12 -p udp --sport 53 -j ACCEPT

iptables -A FORWARD -p icmp -j ACCEPT -i eth0 -o eth3
iptables -A FORWARD -p icmp -j ACCEPT -i eth3 -o eth0

# b)
iptables -A FORWARD -i eth2 -o eth3 -j ACCEPT

# C)
iptables -A FORWARD -i eth2 -o eth3 -m state --state RELATED,ESTABLISHED -j ACCEPT
iptables -A FORWARD -i eth3 -o eth2 -m state --state RELATED,ESTABLISHED -j ACCEPT

# D)
iptables -A FORWARD -i eth3 -o eth2 -p tcp --dport 22 -j ACCEPT

# e)
iptables -I INPUT ! -s 157.122.0.0/16 -j DROP
```

A green arrow points from the text '# e) iptables -I INPUT ! -s 157.122.0.0/16 -j DROP' to the right, with the text 'Dropping any other packets from other sources.' to its right.

Dropping any other  
packets from other  
sources.