Experiment No:1-Simulate a three node point to point network with duplex links between them. Set queue size and vary the bandwidth and find number of packets dropped.

Program:

```
set ns [new Simulator] /* Letter S is capital */
set nf [open lab1.nam w] /* open a nam trace file in write mode */
$ns namtrace-all $nf /* nf – nam file */
set tf [open lab1.tr w] /* tf- trace file */
$ns trace-all $tf
proc finish { } { /* provide space b/w proc and finish and all are in small case */
global ns nf tf
$ns flush-trace /* clears trace file contents */
close $nf
close $tf
exec nam lab1.nam &
exit 0
}
set n0 [$ns node] /* creates 4 nodes */
 set n1 [$ns node]
set n2 [$ns node]
 set n3 [$ns node]
$ns duplex-link $n0 $n2 200Mb 10ms DropTail /*Letter M is capital Mb*/
$ns duplex-link $n1 $n2 100Mb 5ms DropTail /*D and T are capital*/
$ns duplex-link $n2 $n3 1Mb 1000ms DropTail
$ns queue-limit $n0 $n2 10
$ns queue-limit $n1 $n2 10
set udp0 [new Agent/UDP] /* Letters A,U,D and P are capital */
$ns attach-agent $n0 $udp0
set cbr0 [new Application/Traffic/CBR] /* A,T,C,B and R are capital*/
$cbr0 set packetSize_ 500 /*S is capital, space after underscore*/
$cbr0 set interval_ 0.005
$cbr0 attach-agent $udp0
 set udp1 [new Agent/UDP]
$ns attach-agent $n1 $udp1
set cbr1 [new Application/Traffic/CBR]
$cbr1 attach-agent $udp1
```

```
set udp2 [new Agent/UDP]
$ns attach-agent $n2 $udp2
set cbr2 [new Application/Traffic/CBR]
$cbr2 attach-agent $udp2
set null0 [new Agent/Null] /* A and N are capital */
$ns attach-agent $n3 $null0
$ns connect $udp0 $null0
$ns connect $udp1 $null0
$ns at 0.1 "$cbr0 start"
$ns at 0.2 "$cbr1 start"
$ns at 1.0 "finish"
$ns run
```

AWK file: ***(Open a new editor using "vi command" and write awk file and save with ".awk" extension) #immediately after BEGIN should open braces '{'***

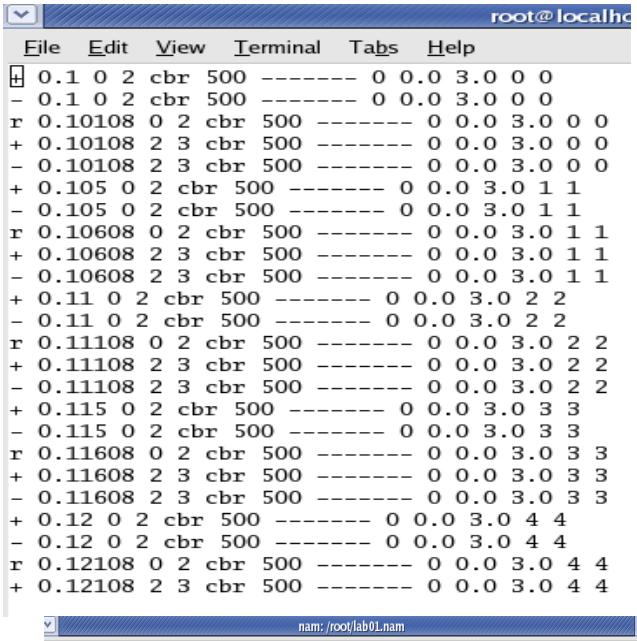
```
BEGIN{ c=0; }
{
  if ($1 = = "d")
  {       c++;
          printf("%s\t%s\n",$5,$11);
  }
}
END{ printf("The number of packets dropped =%d\n",c); }
```

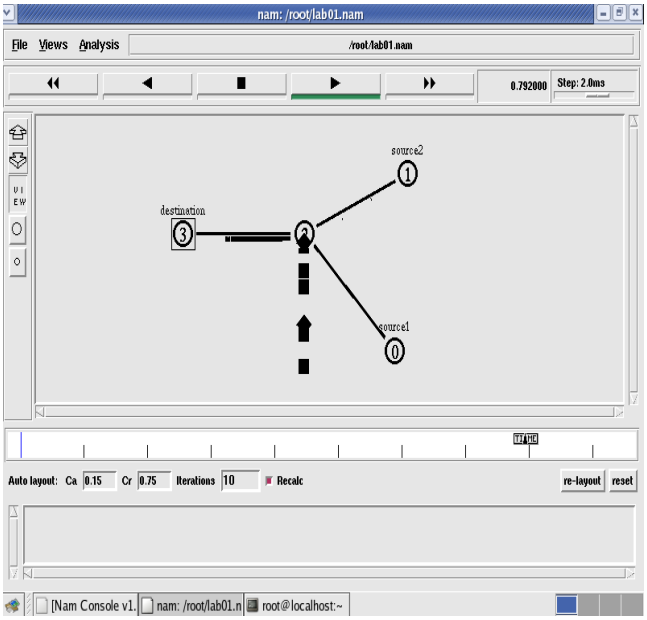
Steps for execution:

- *Open gedit editor and type program. Program name should have the extension " **.tcl** "*
  [root@localhost ~]# gedit lab1.tcl
- *Save the program*
- *Open editor and type **awk** program. Program name should have the extension "**.awk** "*
  [root@localhost ~]# gedit lab1.awk
- *Save the program*
- *Run the simulation program*
  [root@localhost~]# ns lab1.tcl
- *Here **"ns"** indicates network simulator. We get the topology shown in the snapshot.*
- *Now press the play button in the simulation window and the simulation will begins.*
- *After simulation is completed run **awk file** to see the output ,*
  [root@localhost~]# awk –f lab1.awk lab1.tr
- *To see the trace file contents open the file as ,*
  [root@localhost~]# gedit lab1.tr

Trace file contains 12 columns:

Event type, Event time, From Node, To Node, Packet Type, Packet Size, Flags (indicated by --------), Flow ID, Source address, Destination address, Sequence ID, Packet ID





```
File  Edit  View  Terminal  Tabs  Help
[root@localhost ~]
[root@localhost ~]# awk -f prog1.awk prog1.tr
cbr      139
cbr      143
cbr      130
cbr      149
cbr      151
cbr      154
cbr      139
cbr      159
cbr      163
cbr      145
cbr      169
cbr      171
cbr      174
cbr      177
cbr      179
cbr      182
The number of packets dropped =16
[root@localhost ~]#
```

Experiment No: 2-Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.

program:

```
set ns [ new Simulator ]
set nf [ open lab2.nam w ]
$ns namtrace-all $nf
set tf [ open lab2.tr w ]
$ns trace-all $tf
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]

$ns duplex-link $n0 $n4 1005Mb 1ms DropTail
$ns duplex-link $n1 $n4 50Mb 1ms DropTail
$ns duplex-link $n2 $n4 2000Mb 1ms DropTail
$ns duplex-link $n3 $n4 200Mb 1ms DropTail
$ns duplex-link $n4 $n5 1Mb 1ms DropTail

set p1 [new Agent/Ping] # letters A and P should be capital
$ns attach-agent $n0 $p1
```

```
$p1 set packetSize_ 50000
$p1 set interval_ 0.0001

set p2 [new Agent/Ping] # letters A and P should be capital
$ns attach-agent $n1 $p2

set p3 [new Agent/Ping] # letters A and P should be capital
$ns attach-agent $n2 $p3
$p3 set packetSize_ 30000
$p3 set interval_ 0.00001


set p4 [new Agent/Ping] # letters A and P should be capital
$ns attach-agent $n3 $p4

set p5 [new Agent/Ping] # letters A and P should be capital
$ns attach-agent $n5 $p5

$ns queue-limit $n0 $n4 5
$ns queue-limit $n2 $n4 3
$ns queue-limit $n4 $n5 2

Agent/Ping instproc recv {from rtt} {

$self instvar node_
puts "node [$node_ id]received answer from $from with round trip time $rtt msec"
}
# please provide space between $node_ and id. No space between $ and from. No space
between and $ and rtt */

$ns connect $p1 $p5
$ns connect $p3 $p4

proc finish { } {
global ns nf tf
$ns flush-trace
close $nf
close $tf
exec nam lab2.nam &
exit 0
}
$ns at 0.1 "$p1 send"
$ns at 0.2 "$p1 send"
$ns at 0.3 "$p1 send"
$ns at 0.4 "$p1 send"
$ns at 0.5 "$p1 send"
$ns at 0.6 "$p1 send"
$ns at 0.7 "$p1 send"
$ns at 0.8 "$p1 send"
$ns at 0.9 "$p1 send"
```

```
$ns at 1.0 "$p1 send"
$ns at 1.1 "$p1 send"
$ns at 1.2 "$p1 send"
$ns at 1.3 "$p1 send"
$ns at 1.4 "$p1 send"
$ns at 1.5 "$p1 send"
$ns at 1.6 "$p1 send"
$ns at 1.7 "$p1 send"
$ns at 1.8 "$p1 send"
$ns at 1.9 "$p1 send"
$ns at 2.0 "$p1 send"
$ns at 2.1 "$p1 send"
$ns at 2.2 "$p1 send"
$ns at 2.3 "$p1 send"
$ns at 2.4 "$p1 send"
$ns at 2.5 "$p1 send"
$ns at 2.6 "$p1 send"
$ns at 2.7 "$p1 send"
$ns at 2.8 "$p1 send"
$ns at 2.9 "$p1 send"

$ns at 0.1 "$p3 send"
$ns at 0.2 "$p3 send"
$ns at 0.3 "$p3 send"
$ns at 0.4 "$p3 send"
$ns at 0.5 "$p3 send"
$ns at 0.6 "$p3 send"
$ns at 0.7 "$p3 send"
$ns at 0.8 "$p3 send"
$ns at 0.9 "$p3 send"
$ns at 1.0 "$p3 send"
$ns at 1.1 "$p3 send"
$ns at 1.2 "$p3 send"
$ns at 1.3 "$p3 send"
$ns at 1.4 "$p3 send"
$ns at 1.5 "$p3 send"
$ns at 1.6 "$p3 send"
$ns at 1.7 "$p3 send"
$ns at 1.8 "$p3 send"
$ns at 1.9 "$p3 send"
$ns at 2.0 "$p3 send"
$ns at 2.1 "$p3 send"
$ns at 2.2 "$p3 send"
$ns at 2.3 "$p3 send"
$ns at 2.4 "$p3 send"
$ns at 2.5 "$p3 send"
$ns at 2.6 "$p3 send"
$ns at 2.7 "$p3 send"
$ns at 2.8 "$p3 send"
$ns at 2.9 "$p3 send"
```

```
$ns at 3.0 "finish"
$ns run
```

AWK file: *(Open a new editor using "vi command" and write awk file and save with ".awk" extension)*

```
BEGIN{
drop=0;
}
{
 if($1= ="d" )
  {
   drop++;
   }
}
END{

printf("Total number of %s packets dropped due to congestion =%d\n",$5, drop);
}
```

Steps for execution

1) *Open vi editor and type program. Program name should have the extension "* ***.tcl*** *"*

   [root@localhost ~]# vi lab2.tcl

2) *Save the program by pressing* ***"ESC key"*** *first, followed by* ***"Shift and :"*** *keys simultaneously and type* ***"wq"*** *and press* ***Enter key****.*

3) *Open vi editor and type* ***awk*** *program. Program name should have the extension "****.awk*** *"*

   [root@localhost ~]# vi lab2.awk

4) *Save the program by pressing* ***"ESC key"*** *first, followed by* ***"Shift and :"*** *keys simultaneously and type* ***"wq"*** *and press* ***Enter key****.*

5) *Run the simulation program*

   [root@localhost~]# ns lab2.tcl

   i) *Here* ***"ns"*** *indicates network simulator. We get the topology shown in the snapshot.*

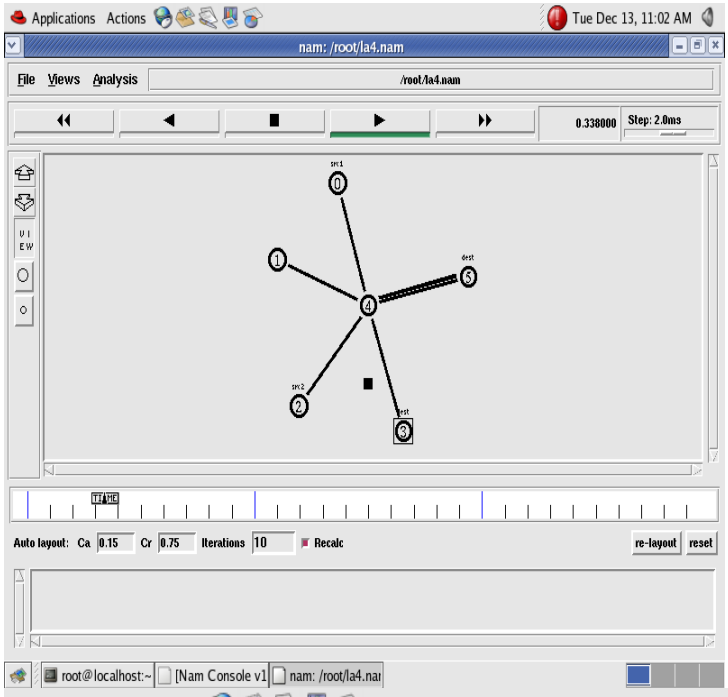
   ii) *Now press the play button in the simulation window and the simulation will begins.*

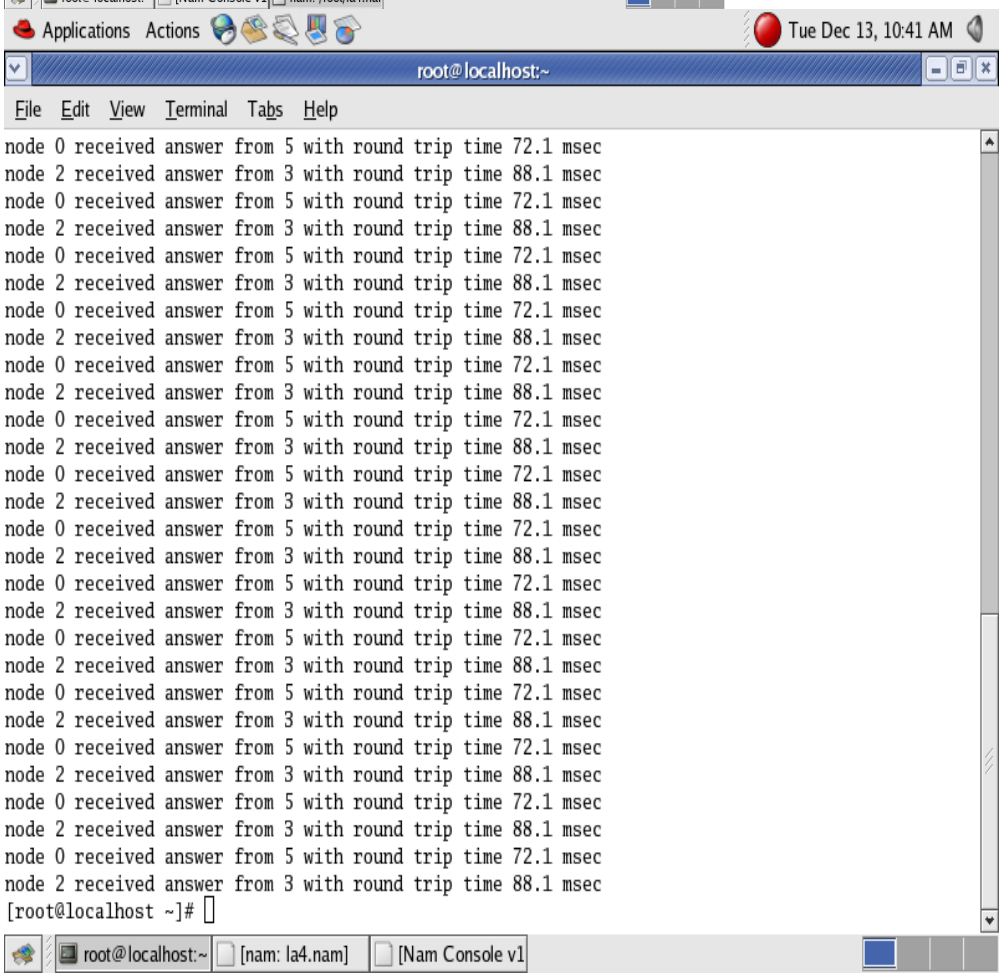
6) *After simulation is completed run* ***awk file*** *to see the output ,*

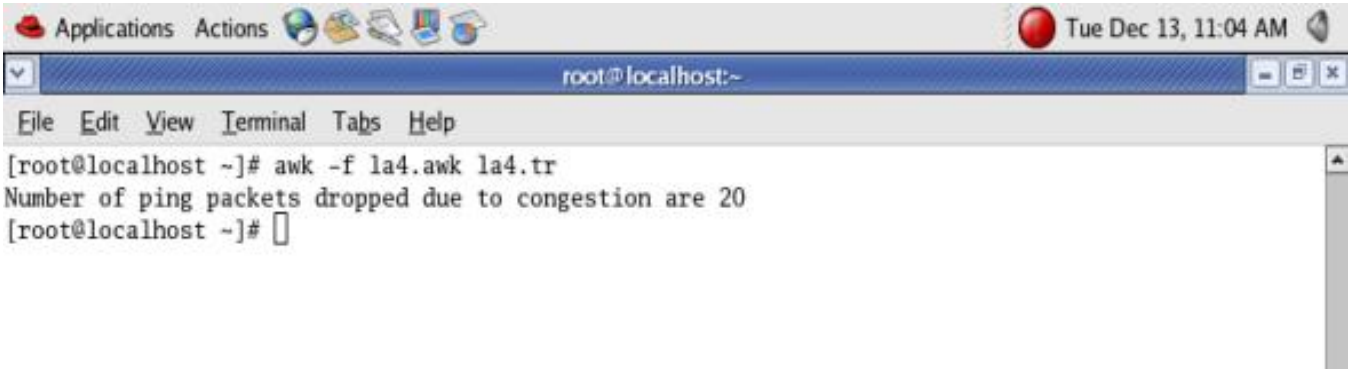
   [root@localhost~]# awk –f lab2.awk lab2.tr

7) *To see the trace file contents open the file as ,*

[root@localhost~]# vi lab2.tr







Experiment No: 3 Simulate an Ethernet LAN using ‘n’ nodes and set multiple traffic nodes and plot congestion window for different source / destination.

Program:

```
set ns [new Simulator]
set tf [open lab3.tr w]
$ns trace-all $tf
set nf [open lab3.nam w]
$ns namtrace-all $nf

set n0 [$ns node]
$n0 color "magenta"
$n0 label "src1"
set n1 [$ns node]
set n2 [$ns node]
$n2 color "magenta"
$n2 label "src2"
set n3 [$ns node]
$n3 color "blue"
$n3 label "dest2"
set n4 [$ns node]
set n5 [$ns node]
$n5 color "blue"
$n5 label "dest1"
```

```
$ns make-lan "$n0 $n1 $n2 $n3 $n4" 100Mb 100ms LL Queue/DropTail Mac/802_3
# should come in single line
$ns duplex-link $n4 $n5 1Mb 1ms DropTail

set tcp0 [new Agent/TCP]
$ns attach-agent $n0 $tcp0
set ftp0 [new Application/FTP]
$ftp0 attach-agent $tcp0
$ftp0 set packetSize_ 500
$ftp0 set interval_ 0.0001
set sink5 [new Agent/TCPSink]
$ns attach-agent $n5 $sink5

$ns connect $tcp0 $sink5

set tcp2 [new Agent/TCP]
$ns attach-agent $n2 $tcp2
set ftp2 [new Application/FTP]
$ftp2 attach-agent $tcp2

$ftp2 set packetSize_600

$ftp2 set interval_ 0.001

set sink3 [new Agent/TCPSink]
$ns attach-agent $n3 $sink3
$ns connect $tcp2 $sink3

set file1 [open file1.tr w]
$tcp0 attach $file1
set file2 [open file2.tr w]
$tcp2 attach $file2

$tcp0 trace cwnd_  # must put underscore ( _ ) after cwnd and no space between them
$tcp2 trace cwnd_

proc finish { } {
global ns nf tf
$ns flush-trace
close $tf
close $nf
exec nam lab3.nam &
exit 0
}

$ns at 0.1 "$ftp0 start"
$ns at 5 "$ftp0 stop"
$ns at 7 "$ftp0 start"
$ns at 0.2 "$ftp2 start"
```

```
$ns at 8 "$ftp2 stop"
$ns at 14 "$ftp0 stop"
$ns at 10 "$ftp2 start"
$ns at 15 "$ftp2 stop"
$ns at 16 "finish"
$ns run
```

AWK file: *(Open a new editor using "vi command" and write awk file and save with ".awk" extension)*

```
cwnd:- means congestion window
BEGIN {
}
{
if($6= ="cwnd_")  # don't leave space after writing cwnd_
printf("%f\t%f\t\n",$1,$7); # you must put \n in printf
}
END{
}
```

Steps for execution:

1) *Open vi editor and type program. Program name should have the extension "* ***.tcl*** *"*

   [root@localhost ~]# vi lab3.tcl

2) *Save the program by pressing* ***"ESC key"*** *first, followed by* ***"Shift and :"*** *keys simultaneously and type* ***"wq"*** *and press* ***Enter key****.*

3) *Open vi editor and type* ***awk*** *program. Program name should have the extension "****.awk*** *"*

   [root@localhost ~]# vi lab3.awk

4) *Save the program by pressing* ***"ESC key"*** *first, followed by* ***"Shift and :"*** *keys simultaneously and type* ***"wq"*** *and press* ***Enter key****.*

5) *Run the simulation program*

   [root@localhost~]# ns lab3.tcl

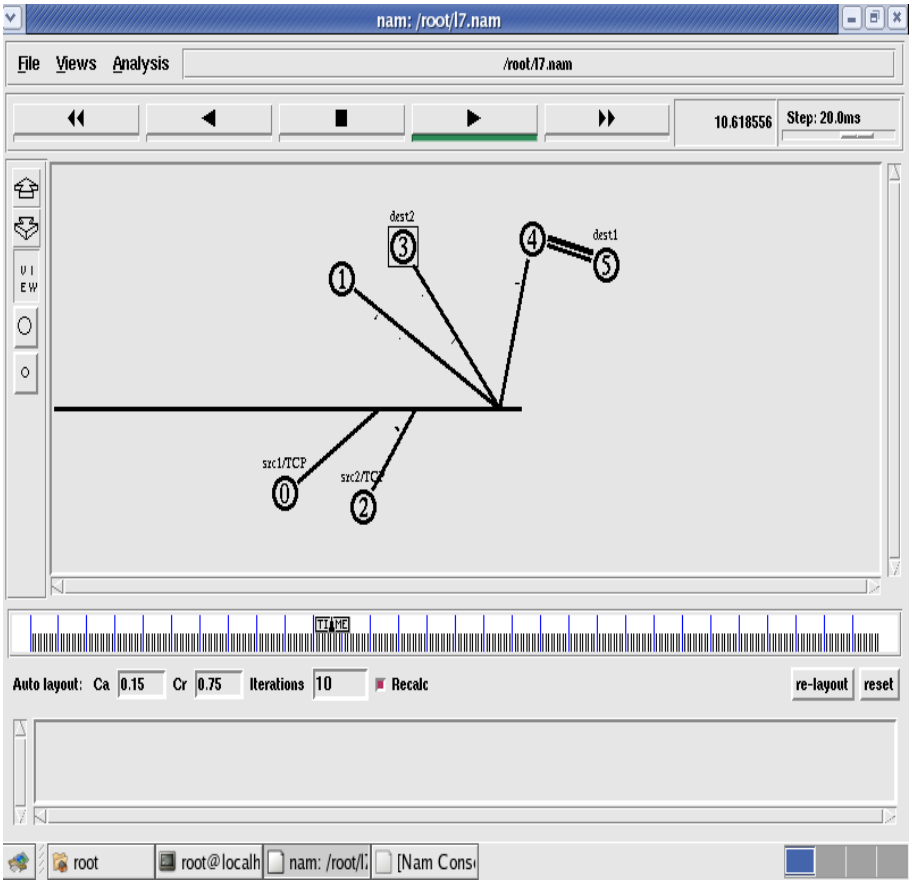
6) *After simulation is completed run* ***awk file*** *to see the output ,*

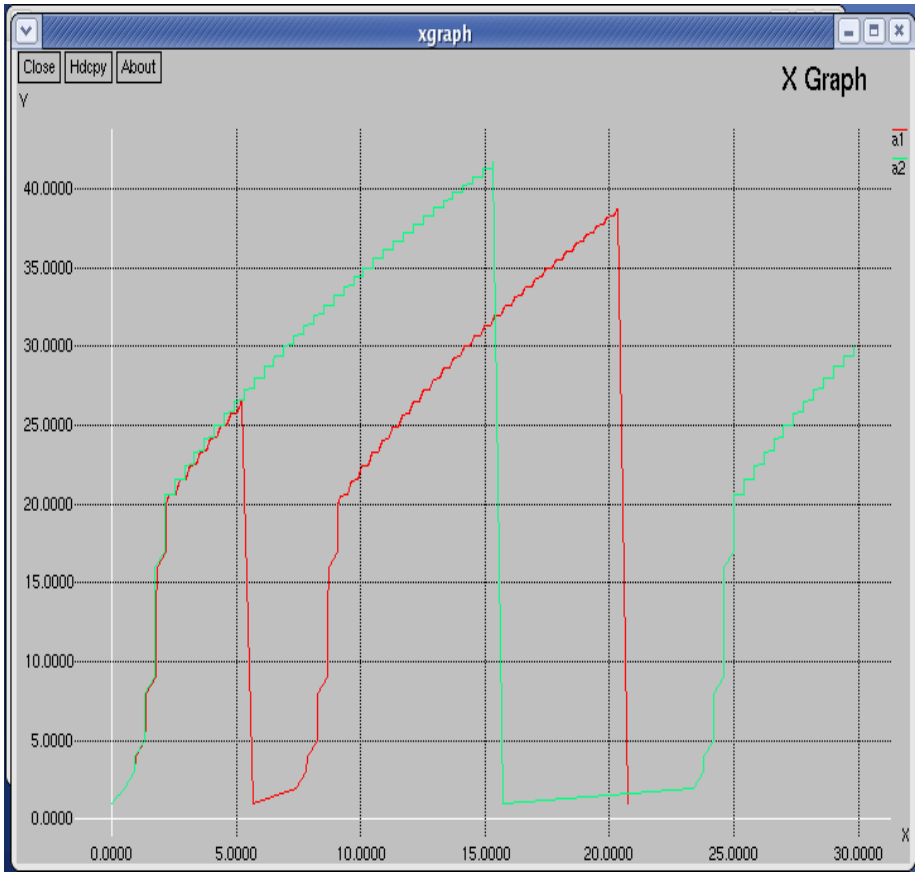
   i. ***[root@localhost~]# awk –f lab3.awk file1.tr > a1***
   ii. ***[root@localhost~]# awk –f lab3.awk file2.tr > a2***
   iii. ***[root@localhost~]# xgraph a1 a2***

7) *Here we are using the congestion window trace files i.e.* ***file1.tr*** *and* ***file2.tr*** *and we are redirecting the contents of those files to new files say* ***a1*** *and* ***a2*** *using* ***output redirection operator (>)***.

8) *To see the trace file contents open the file as ,*

[root@localhost~]# vi lab3.tr





Experiment No: 4 Simulate simple ESS and with transmitting nodes in wireless LAN by simulation and determine the performance with respect to transmission of packets.

Program:

```
set ns [new Simulator]
set tf [open lab4.tr w]
$ns trace-all $tf
set topo [new Topography]
$topo load_flatgrid 1000 1000
set nf [open lab4.nam w]
$ns namtrace-all-wireless $nf 1000 1000

$ns node-config -adhocRouting DSDV \
                -llType LL \
                -macType Mac/802_11 \
                -ifqType Queue/DropTail \
                -ifqLen 50 \
                -phyType Phy/WirelessPhy \
                -channelType Channel/WirelessChannel \
                -prrootype Propagation/TwoRayGround \
                -antType Antenna/OmniAntenna \
                -topoInstance $topo \
                -agentTrace ON \
```

```
                -routerTrace ON

create-god 3
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]

$n0 label "tcp0"
$n1 label "sink1/tcp1"
$n2 label "sink2"

$n0 set X_ 50
$n0 set Y_ 50
$n0 set Z_ 0
$n1 set X_ 100
$n1 set Y_ 100
$n1 set Z_ 0
$n2 set X_ 600
$n2 set Y_ 600
$n2 set Z_ 0

$ns at 0.1 "$n0 setdest 50 50 15"

$ns at 0.1 "$n1 setdest 100 100 25"

$ns at 0.1 "$n2 setdest 600 600 25"

set tcp0 [new Agent/TCP]
$ns attach-agent $n0 $tcp0
set ftp0 [new Application/FTP]
$ftp0 attach-agent $tcp0
set sink1 [new Agent/TCPSink]
$ns attach-agent $n1 $sink1
$ns connect $tcp0 $sink1
set tcp1 [new Agent/TCP]
$ns attach-agent $n1 $tcp1
set ftp1 [new Application/FTP]
$ftp1 attach-agent $tcp1
set sink2 [new Agent/TCPSink]
$ns attach-agent $n2 $sink2
$ns connect $tcp1 $sink2
$ns at 5 "$ftp0 start"
$ns at 5 "$ftp1 start"
$ns at 100 "$n1 setdest 550 550 15"
$ns at 190 "$n1 setdest 70 70 15"
proc finish { } {
        global ns nf tf
        $ns flush-trace
        exec nam lab4.nam  &
        close $tf
```

```
        exit 0
}
$ns at 250 "finish"
$ns run
```

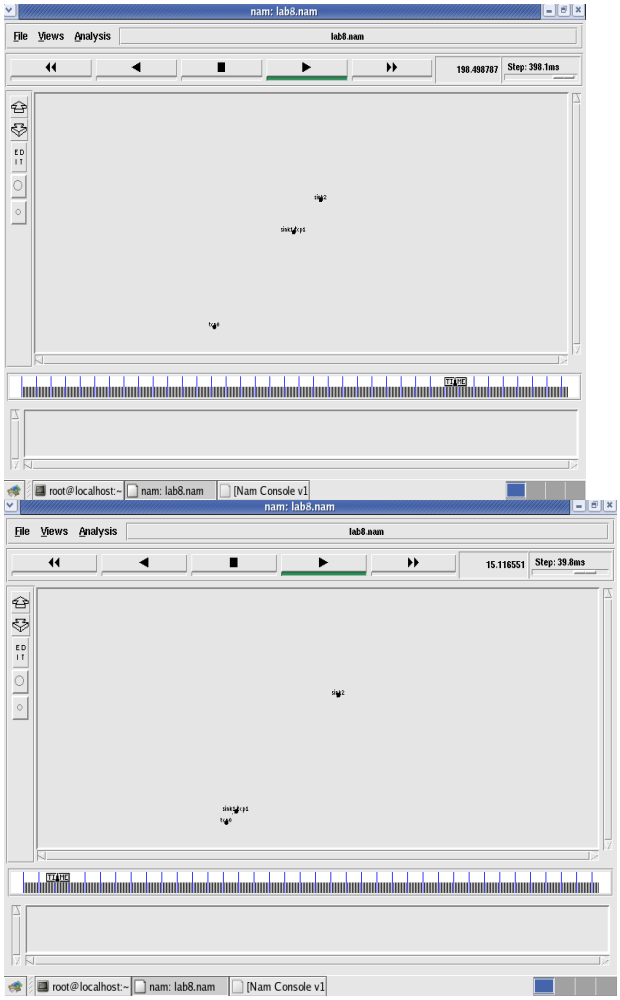
AWK file: *(Open a new editor using "vi command" and write awk file and save with ".awk" extension)*

```
BEGIN{
        count1=0
        count2=0
        pack1=0
        pack2=0
        time1=0
        time2=0
}
{       if($1= ="r"&& $3= ="_1_" && $4= ="AGT")
        {       count1++
                pack1=pack1+$8
                time1=$2       }
        if($1= ="r" && $3= ="_2_" && $4= ="AGT")
{

count2++

pack2=pack2+$8

time2=$2       }
}
END{
printf("The Throughput from n0 to n1: %f Mbps \n",
((count1*pack1*8)/(time1*1000000)));
printf("The Throughput from n1 to n2: %f Mbps",
((count2*pack2*8)/(time2*1000000)));
}
```

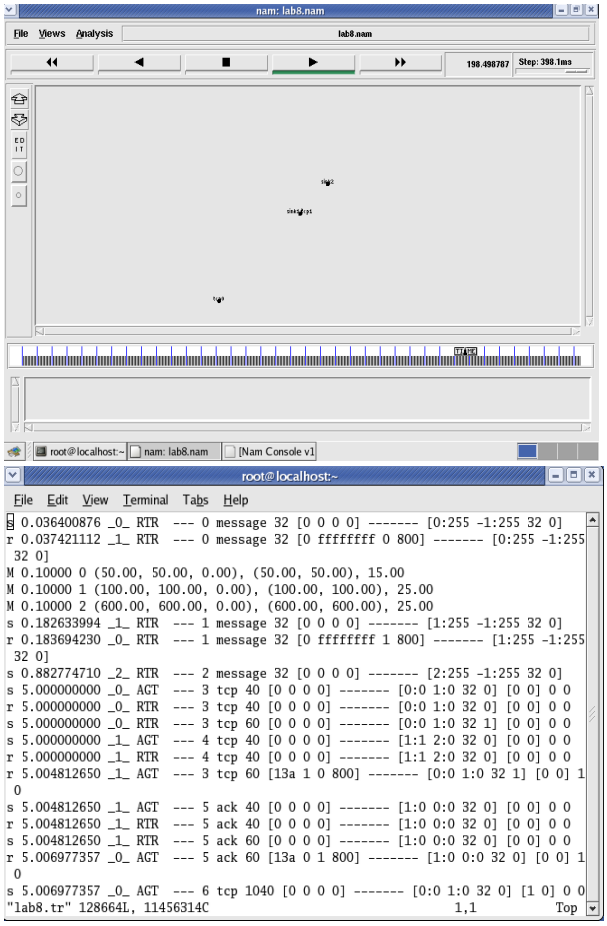
Steps for execution

- *Open vi editor and type program. Program name should have the extension " **.tcl** "*
  [root@localhost ~]# vi lab4.tcl
- *Save the program by pressing **"ESC key"** first, followed by **"Shift and :"** keys simultaneously and type **"wq"** and press **Enter key**.*
- *Open vi editor and type **awk** program. Program name should have the extension "**.awk** "*
  [root@localhost ~]# vi lab4.awk
- *Save the program by pressing **"ESC key"** first, followed by **"Shift and :"** keys simultaneously and type **"wq"** and press **Enter key**.*
- *Run the simulation program*
  [root@localhost~]# ns lab4.tcl
  - *Here **"ns"** indicates network simulator. We get the topology shown in the snapshot.*
  - *Now press the play button in the simulation window and the simulation will begins.*

- *After simulation is completed run **awk file** to see the output ,*
  [root@localhost~]# awk –f lab4.awk lab4.tr
- *To see the trace file contents open the file as ,*
  [root@localhost~]# vi lab4.tr



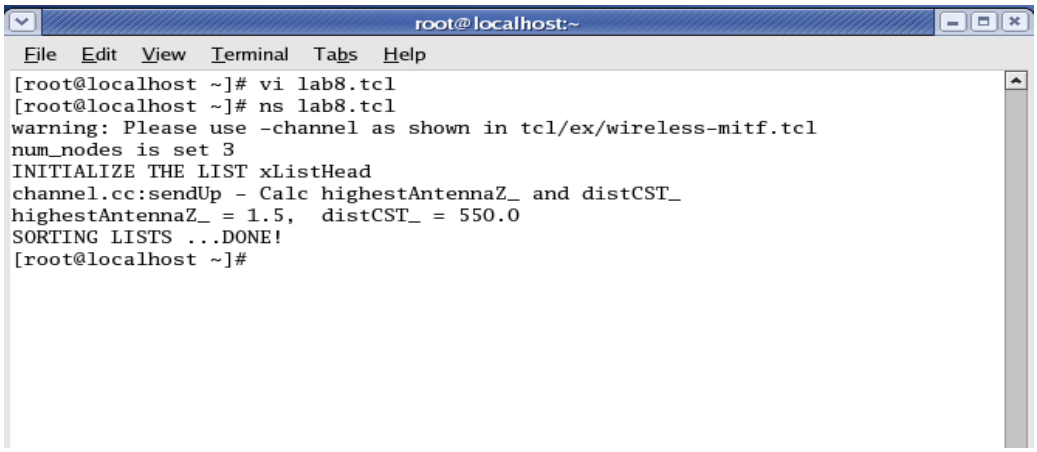
Node 1 and 2 are communicating Node 2 is moving towards node 3

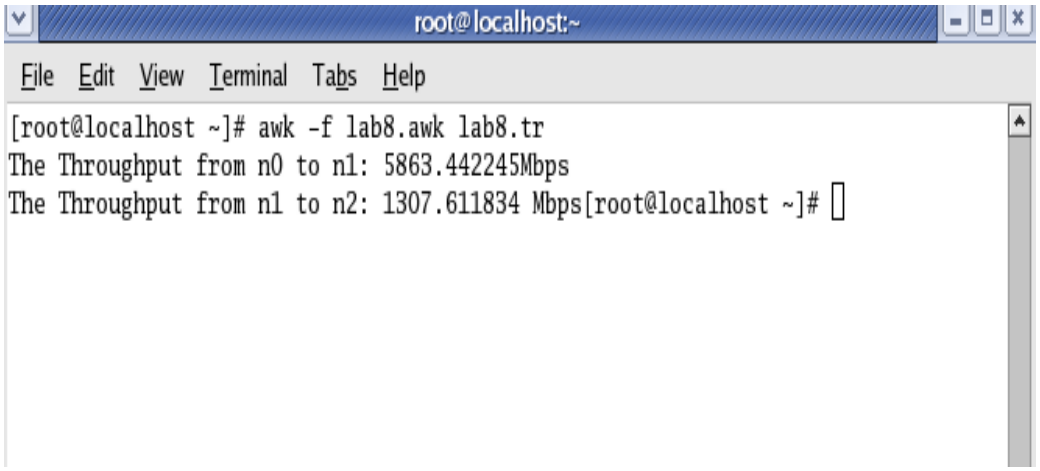


Node 2 is coming back from node 3 towards node1 Trace File

Here **"M"** indicates mobile nodes, **"AGT"** indicates Agent Trace, **"RTR"** indicates Router Trace

Output:




root@localhost:~
File Edit View Terminal Tabs Help
[root@localhost ~]# awk -f lab8.awk lab8.tr
The Throughput from n0 to n1: 5863.442245Mbps
The Throughput from n1 to n2: 1307.611834 Mbps[root@localhost ~]#