Computer Networks Laboratory
Lab-3
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Q1

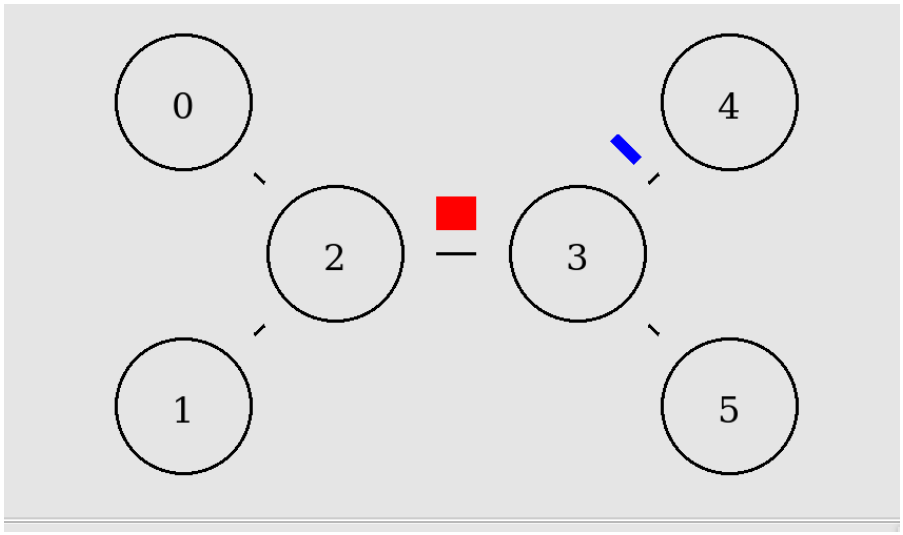
Code:

```
#Create a simulator object
set ns [new Simulator]

#Define different colors for data flows
$ns color 1 Blue
$ns color 2 Red

#Open the nam trace file
set nf [open out.nam w]
$ns namtrace-all $nf

set all_trace [open all.tr w]
$ns trace-all $all_trace

#Define a 'finish' procedure
proc finish {} {
        global ns nf all_trace
        $ns flush-trace
        #Close the trace file
        close $nf
        close $all_trace
        #Execute nam on the trace file
        exec nam out.nam &
        exit 0
}
```

```
#Create four nodes
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]

#Create links between the nodes
$ns duplex-link $n0 $n2 10Mb 1ms DropTail
$ns duplex-link $n1 $n2 10Mb 1ms DropTail
$ns duplex-link $n2 $n3 1Mb 3ms DropTail

$ns duplex-link $n3 $n4 10Mb 1ms DropTail
$ns duplex-link $n3 $n5 10Mb 1ms DropTail

$ns queue-limit $n2 $n3 30
$ns queue-limit $n3 $n2 30

$ns duplex-link-op $n0 $n2 orient right-down
$ns duplex-link-op $n1 $n2 orient right-up
$ns duplex-link-op $n2 $n3 orient right
$ns duplex-link-op $n4 $n3 orient left-down
$ns duplex-link-op $n5 $n3 orient left-up

#Create a TCP agent and attach it to node n0
set tcp0 [new Agent/TCP]
$tcp0 set class_ 1
$ns attach-agent $n0 $tcp0

set ftp0 [new Application/FTP]
$ftp0 attach-agent $tcp0
$ftp0 set type_ FTP

#Create a TCP agent and attach it to node n1
set tcp1 [new Agent/TCP]
$tcp1 set class_ 2
$ns attach-agent $n1 $tcp1

set ftp1 [new Application/FTP]
```

```
$ftp1 attach-agent $tcp1
$ftp1 set type_ FTP

#Create a TCPSink agent (a traffic sink) and attach it to node n4
set null0 [new Agent/TCPSink]
$ns attach-agent $n4 $null0

#Create a TCPSink agent (a traffic sink) and attach it to node n5
set null1 [new Agent/TCPSink]
$ns attach-agent $n5 $null1

#Connect the traffic sources with the traffic sink
$ns connect $tcp0 $null0
$tcp0 set fid_ 1
$ns connect $tcp1 $null1
$tcp1 set fid_ 2


#Schedule events for the CBR agents
$ns at 0.5 "$ftp0 start"
$ns at 0.5 "$ftp1 start"
$ns at 199.5 "$ftp0 stop"
$ns at 199.5 "$ftp1 stop"
#Call the finish procedure after 5 seconds of simulation time
$ns at 200.0 "finish"

#Run the simulation
$ns run
```

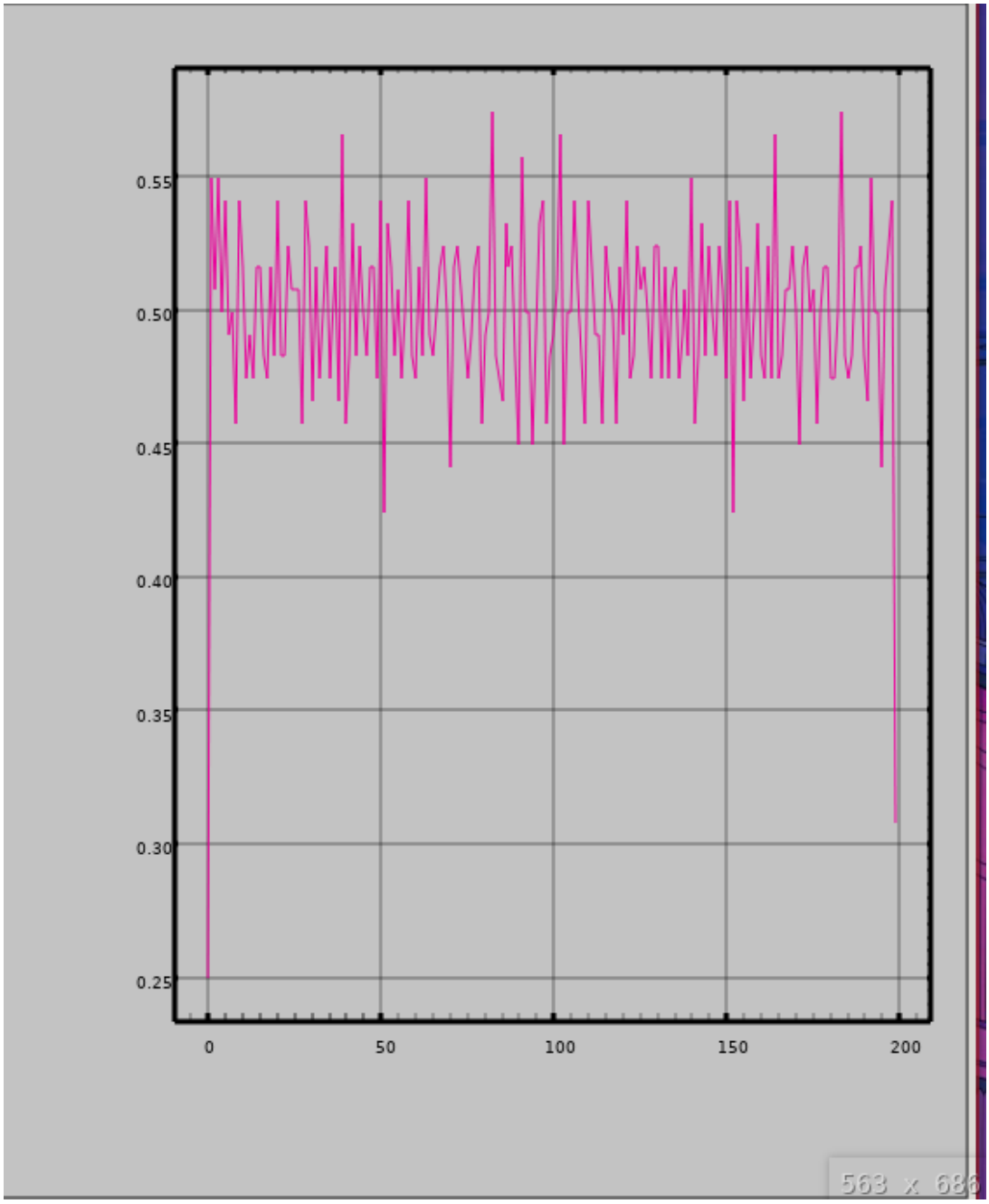
Output



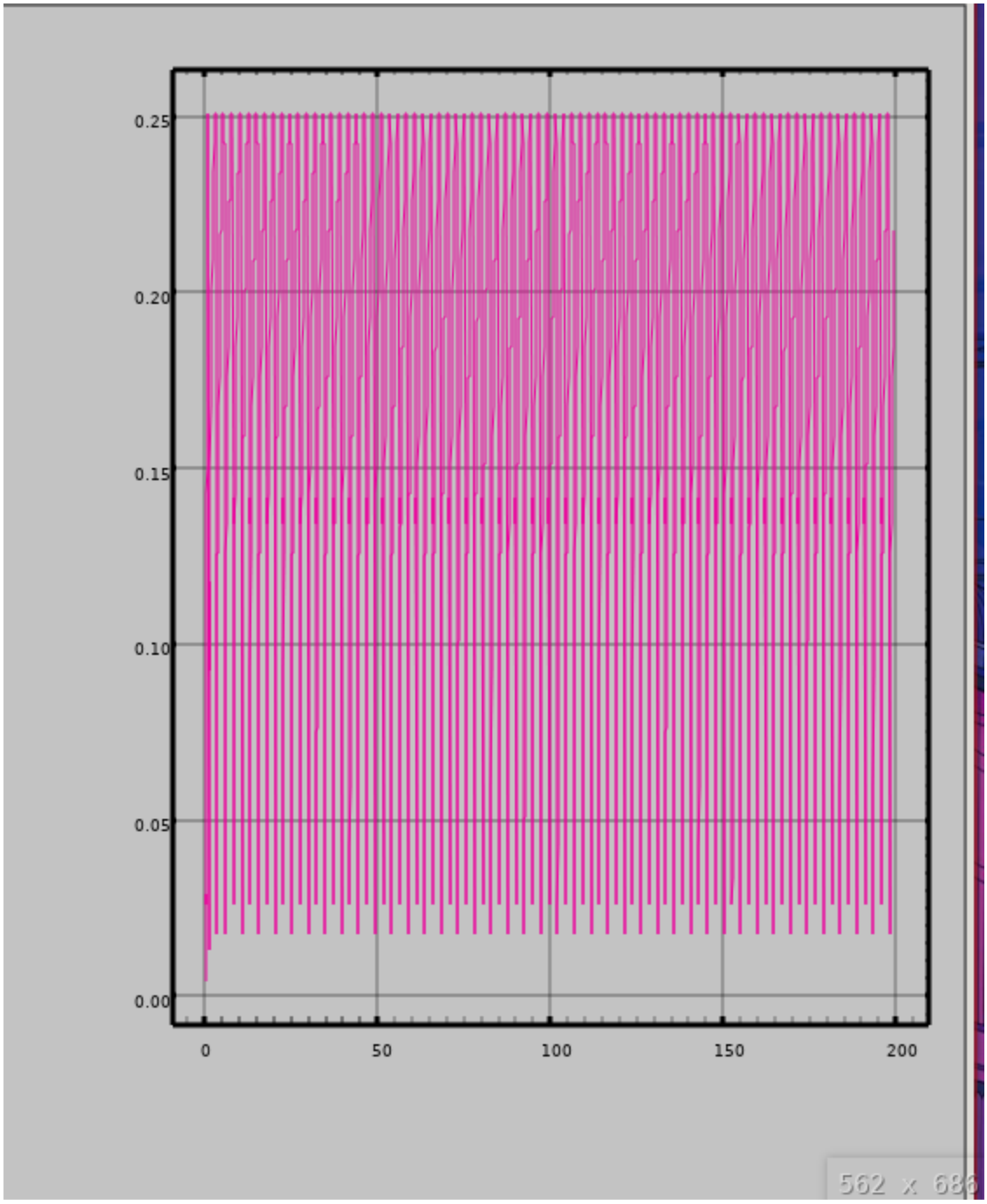

```
λ bash run_everything.sh
Avg throughput 0.0 - 4.0 = 0.498536MBytes/sec
Avg drop rate 0.0 - 4.0 = 0.0035776MBytes/sec
```

Graph:

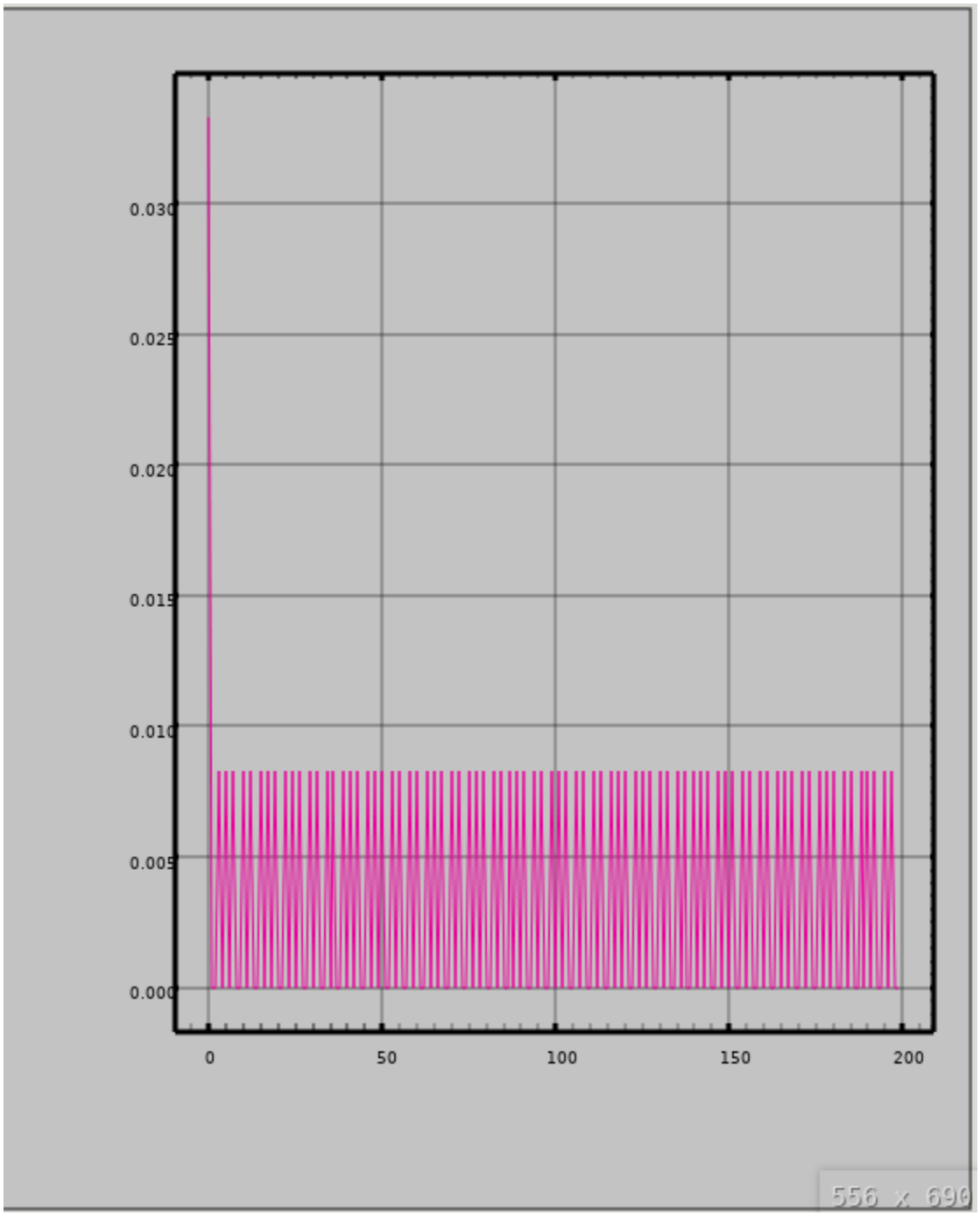
a) **Packet Throughput vs Simulation Time**



b) Packet Delays vs Simulation Time



c) Packet Loss vs Simulation Time

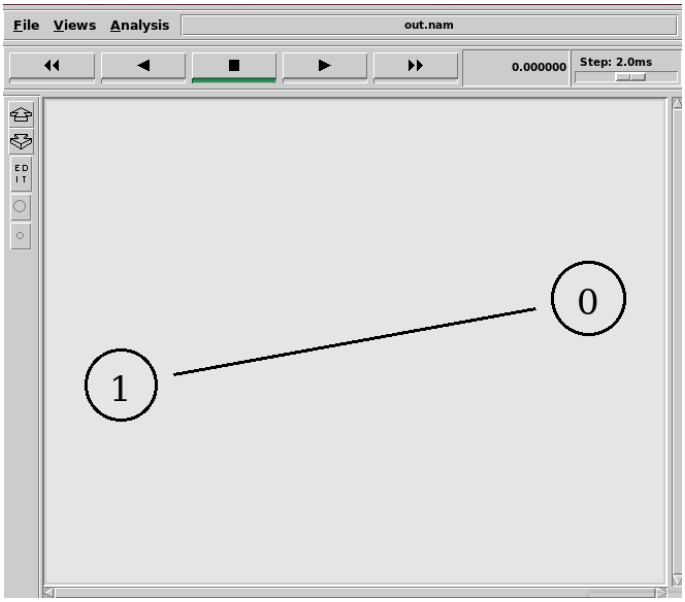


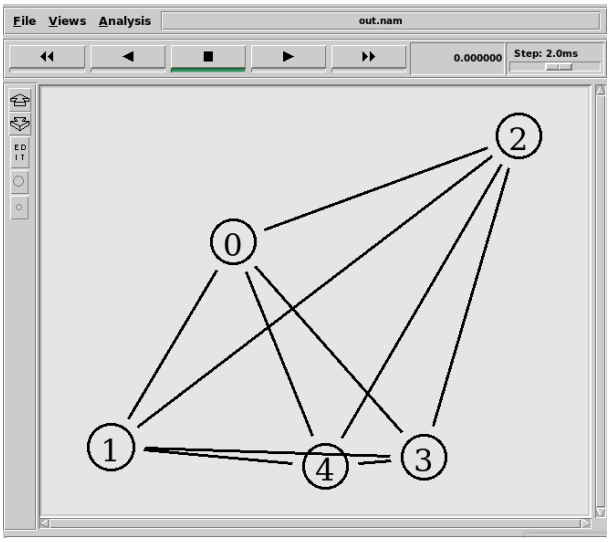
Q2

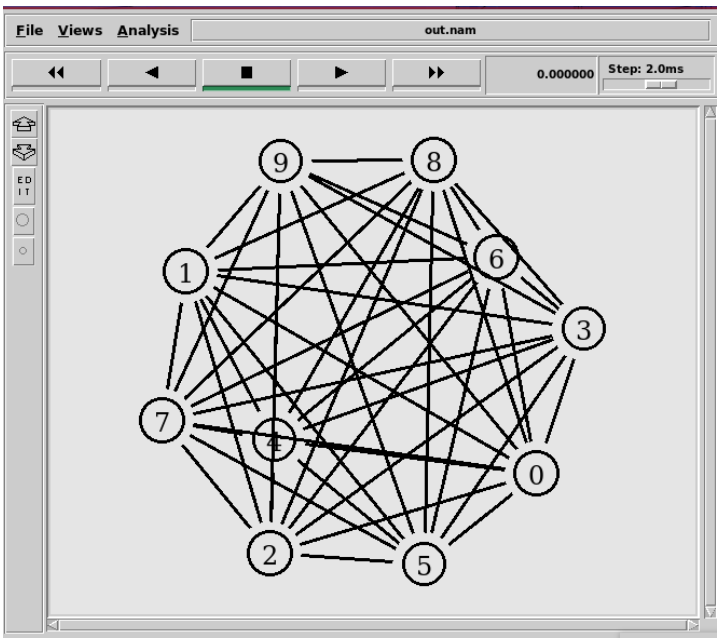
```
set ns [new Simulator]

#Open the nam trace file
set nf [open out.nam w]
$ns namtrace-all $nf

set all_trace [open all.tr w]
$ns trace-all $all_trace

#Define a 'finish' procedure
proc finish {} {
        global ns nf all_trace
        $ns flush-trace
    #Close the trace file
        close $nf
    close $all_trace
    #Execute nam on the trace file
        exec nam out.nam &
        exit 0
}

set N [lindex $argv 0]
set PACKETSIZE [lindex $argv 1]
for {set i 0} {$i < $N} {incr i} {
    set n($i) [$ns node]
}

# connect each node with all other nodes
for {set i 0} {$i < $N} {incr i} {
    for {set j [expr {$i + 1}]} {$j < $N} {incr j} {
            $ns duplex-link $n($i) $n($j) 1Mb 10ms DropTail
    }
}

# make all odd nodes as udp source and even nodes as null agents
for {set i 1} {$i < $N} {set i [expr {$i + 2}]} {
    # create udp agent
    set udp($i) [new Agent/UDP]
```

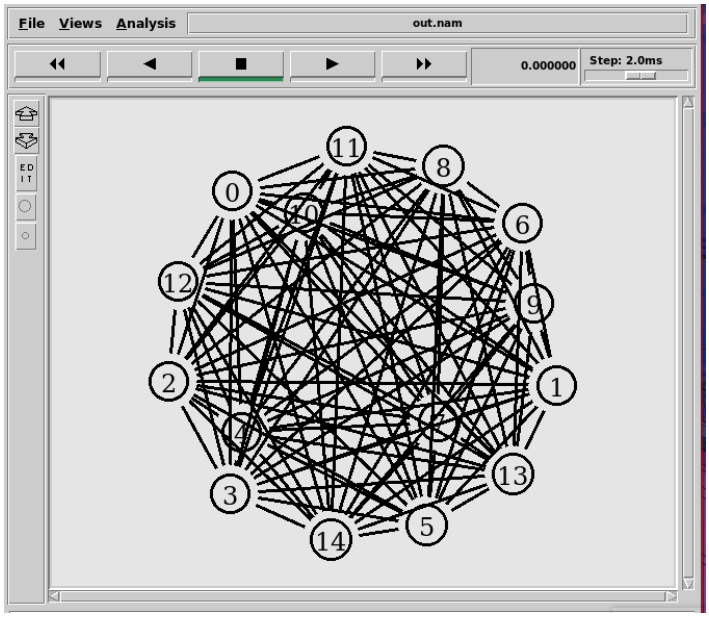
```
    $ns attach-agent $n($i) $udp($i)

    # create a cbr traffic
    set cbr($i) [new Application/Traffic/CBR]
    $cbr($i) set packetSize_ $PACKETSIZE
    $cbr($i) set interval_ 0.005
    $cbr($i) attach-agent $udp($i)
}

for {set i 0} {$i < $N} {set i [expr {$i + 2}]} {
    # create null agent
    set null($i) [new Agent/Null]
    $ns attach-agent $n($i) $null($i)
}

for {set i 1} {$i < $N} {set i [expr {$i + 2}]} {
    for {set j 0} {$j < $N} {set j [expr {$j + 2}]} {
        $ns connect $udp($i) $null($j)
    }
    $ns at 0.0 "$cbr($i) start"
    $ns at 200.0 "$cbr($i) stop"
}

# call finish after 200s
$ns at 200.0 "finish"

# run simulation
$ns run
```

Output:


File Views Analysis
out.nam
0.000000
Step: 2.0ms
0
1


File Views Analysis
out.nam
0.000000
Step: 2.0ms
2
0
1
4
3

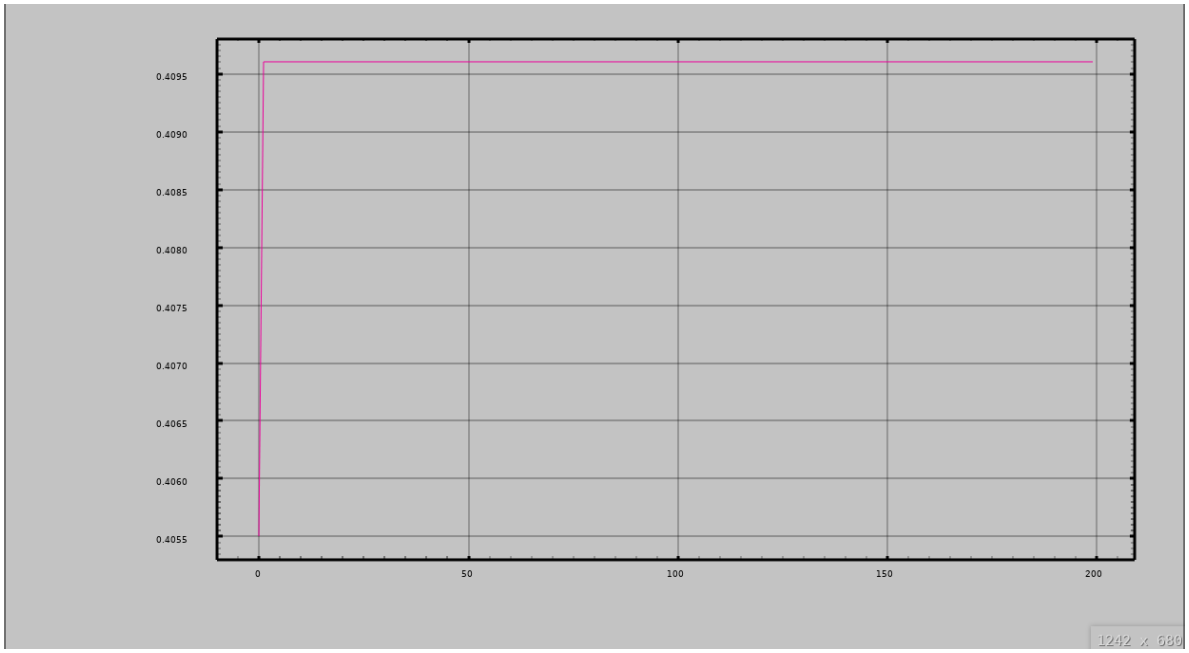

File Views Analysis
out.nam
0.000000
Step: 2.0ms
9
8
1
6
3
7
4
0
2
5


File Views Analysis
out.nam
0.000000
Step: 2.0ms
11
8
0
10
6
12
9
2
1
4
13
3
5
14

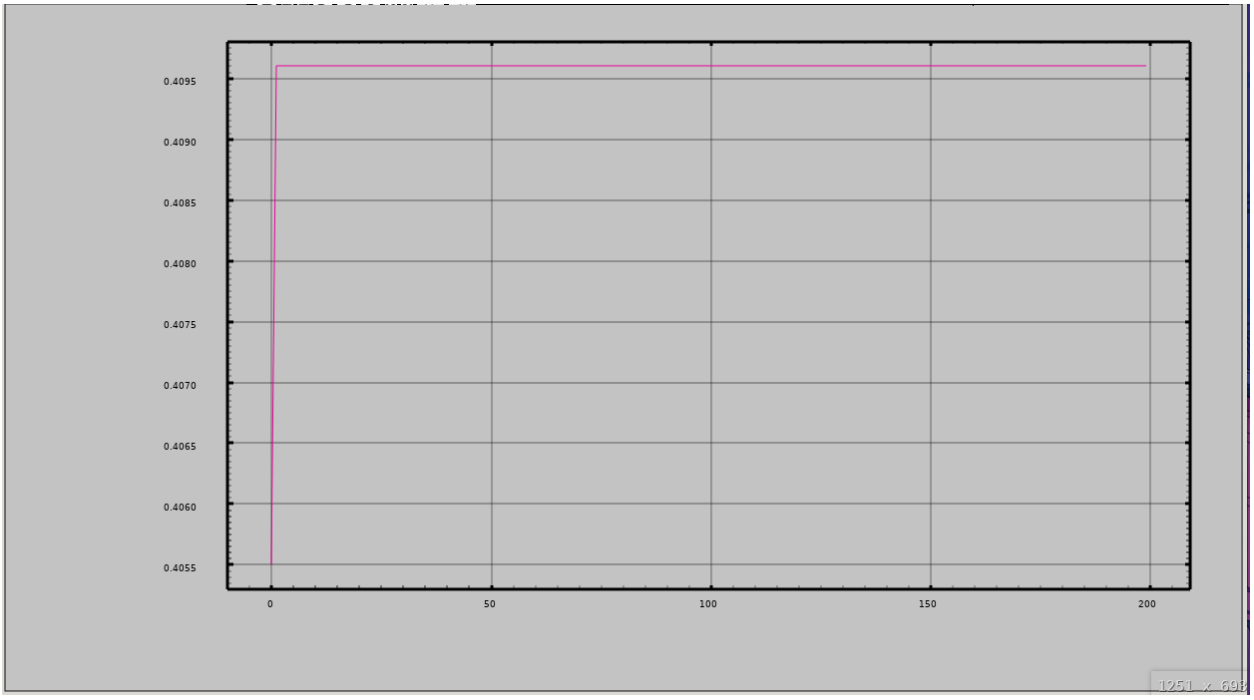
Graph:

a) UDP Throughput vs Simulation Time for different ‘N’

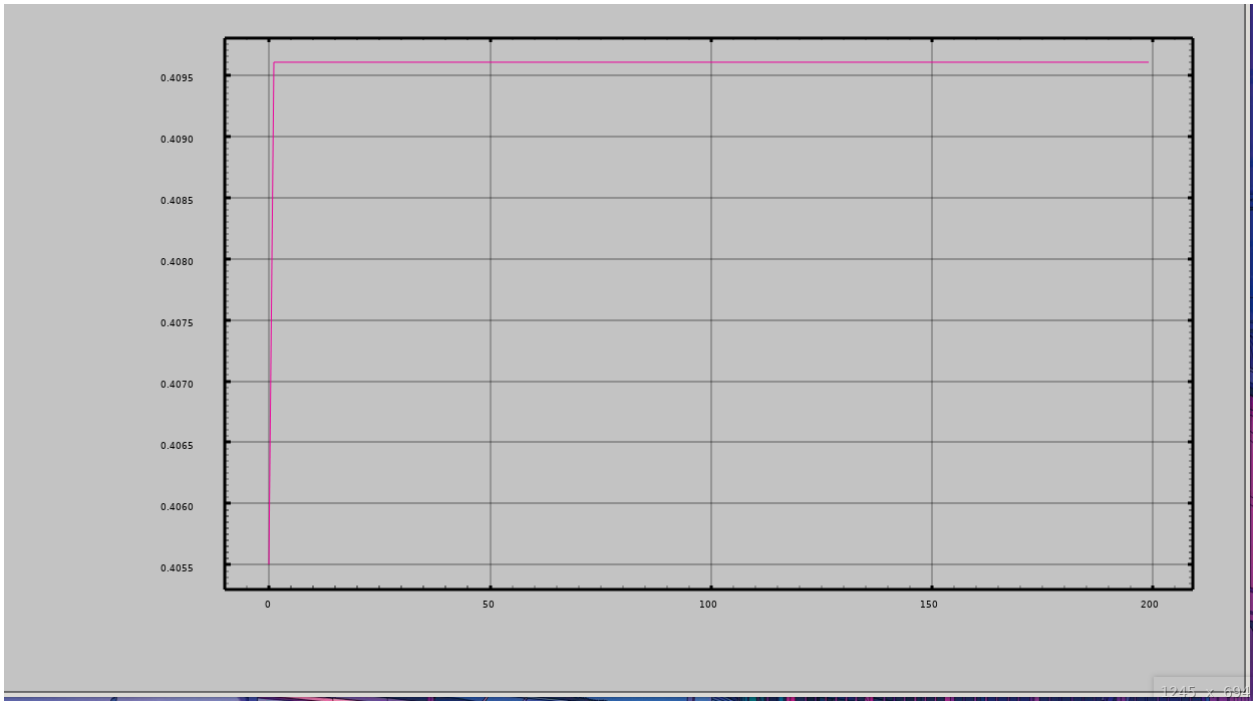
i) N=2



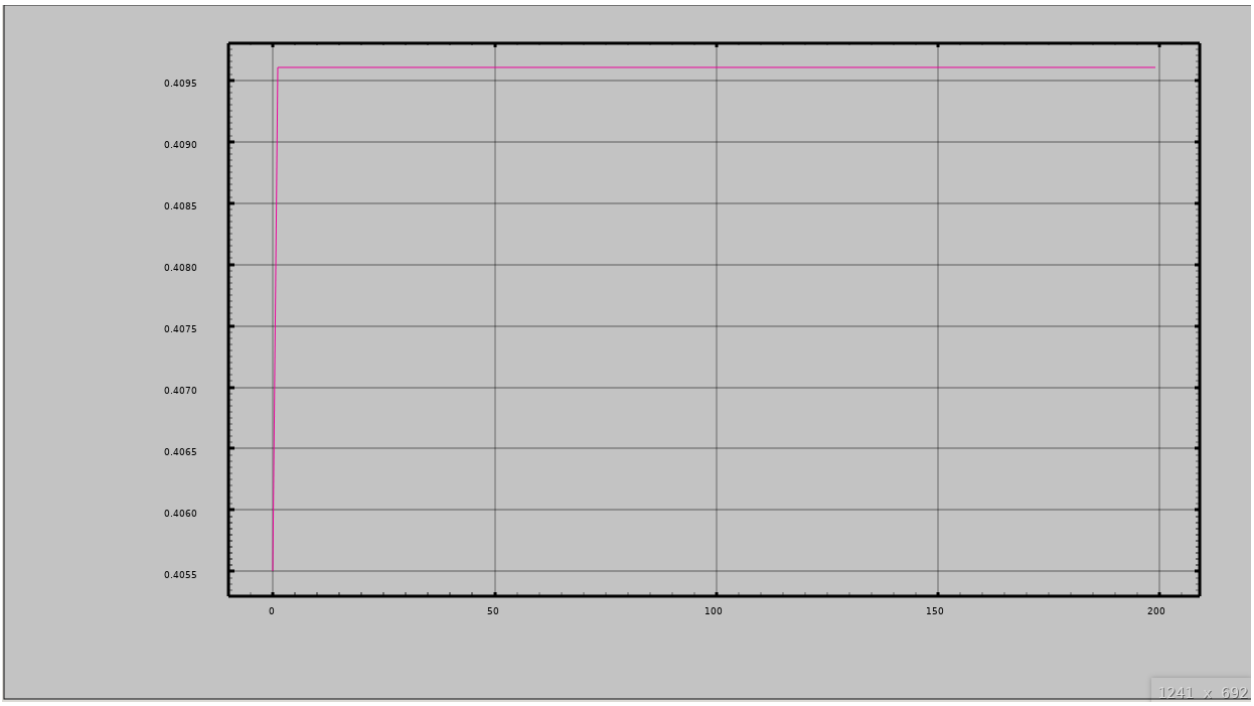
ii) N=5



iii) N=10

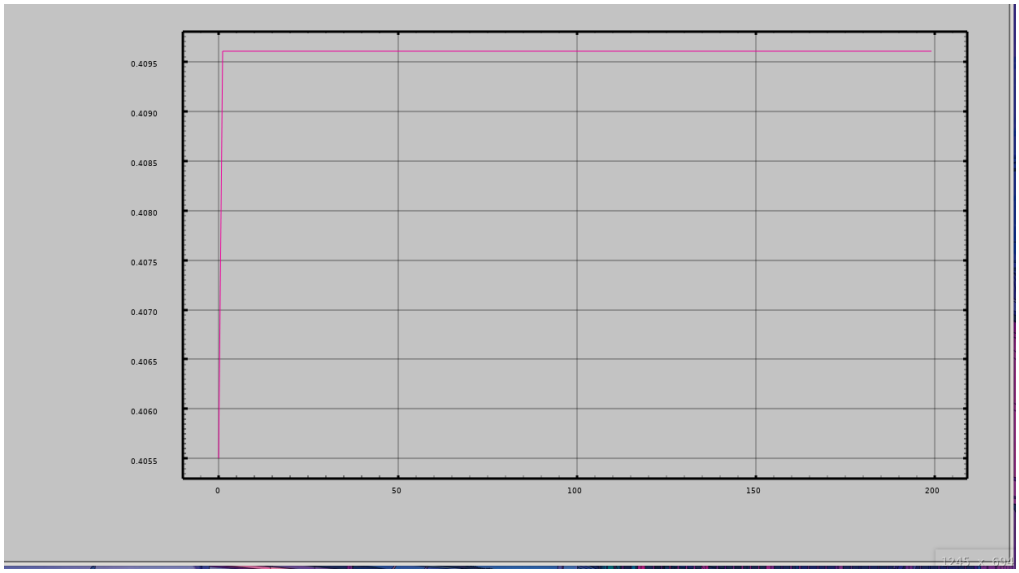


iv) N= 15

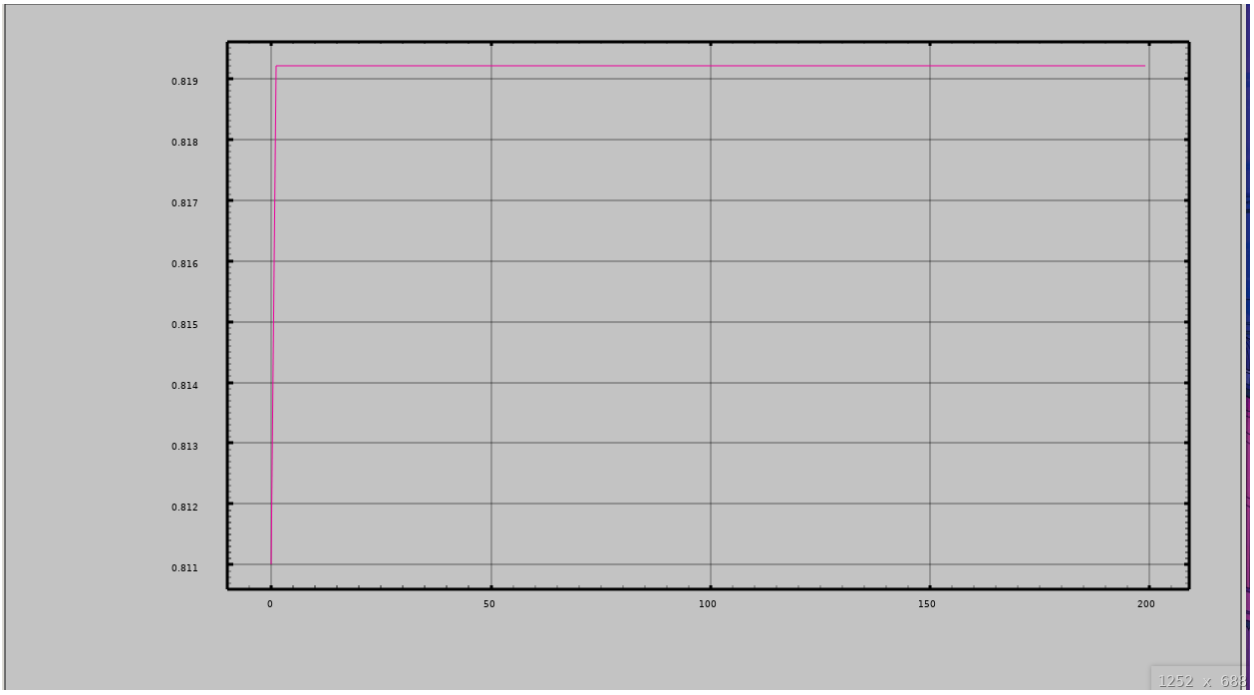


b) UDP Throughput vs Simulation Time for Different Packet Size

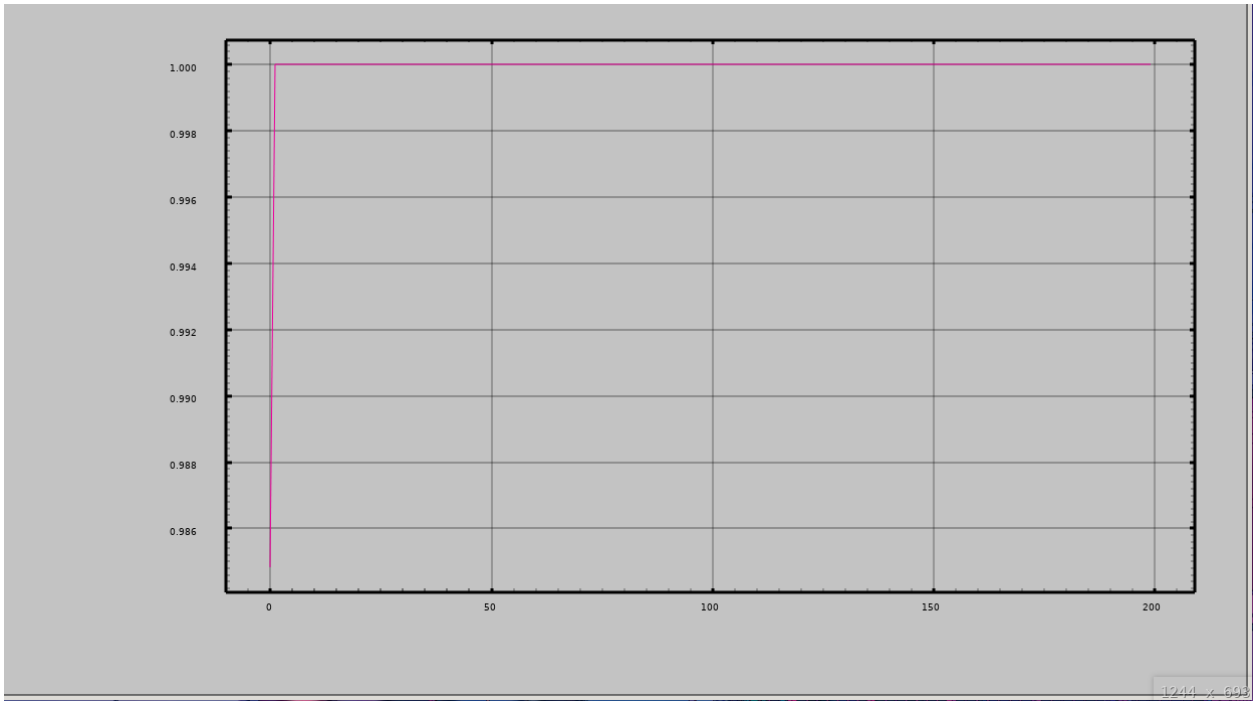
i) 256 bits



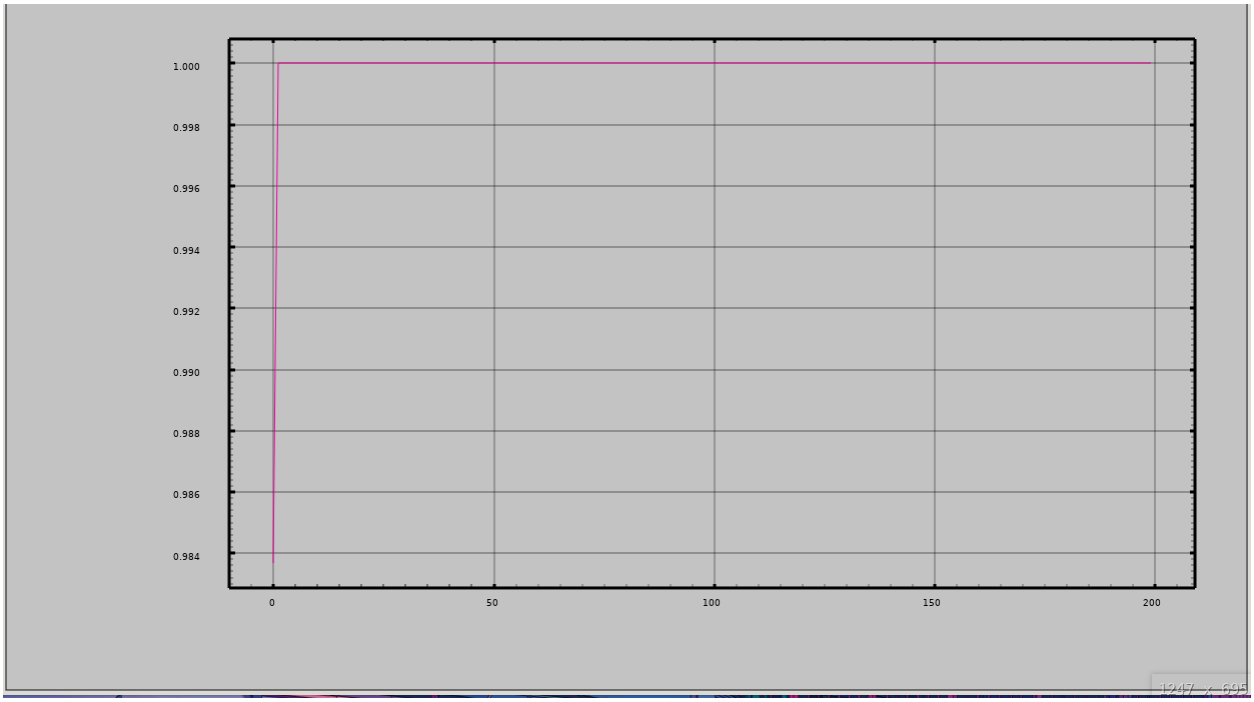
ii) 512 bits



iii) 2048 bits



iv) 8192


1.000
0.998
0.996
0.994
0.992
0.990
0.988
0.986
0.984
0
50
100
150
200