LABORATORY-7

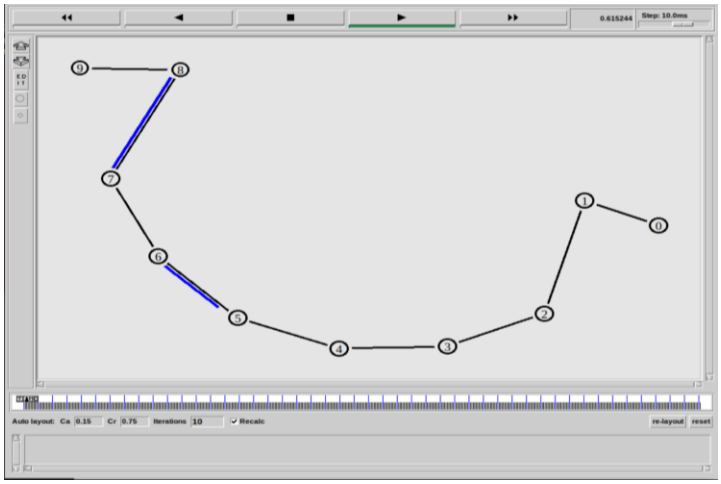
Compare the performance of any two static routing protocols with the following topologies:
(i) Linear (ii) Random (iii) Grid.
Assume the following:
Number of nodes: 10 nodes for linear topology, 25 nodes for Random, Grid topologies
Traffic: FTP
Queue: Drop Tail
Number of Source: 50% of node
Simulation Time: 100 Sec.
Plot the graphs for the following metrics:
X axis: Simulation time interval (20, 40, 60, 80 and 100sec)
Y Axis: PDR, PLR, routing control overhead and delay

Linear Topology

```
set ns [new Simulator]

$ns rtproto Static
$ns color 1 Blue
$ns color 2 Red

set simtime 10.0  # Change this for different simulation times
set file1 [open LinR1($simtime)out.tr w]
$ns trace-all $file1
set file2 [open LinR1($simtime)out.nam w]
$ns namtrace-all $file2

proc finish {} {
global ns file1 file2 simtime
$ns flush-trace
close $file1
close $file2
exec nam LinR1($simtime)out.nam &
exit 0 }

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
```

```
set n6 [$ns node]
set n7 [$ns node]
set n8 [$ns node]
set n9 [$ns node]

$ns duplex-link $n0 $n1 0.5Mb 10ms DropTail
$ns duplex-link $n1 $n2 0.5Mb 10ms DropTail
$ns duplex-link $n2 $n3 0.5Mb 10ms DropTail
$ns duplex-link $n3 $n4 0.5Mb 10ms DropTail
$ns duplex-link $n4 $n5 0.5Mb 10ms DropTail
$ns duplex-link $n5 $n6 0.5Mb 10ms DropTail
$ns duplex-link $n6 $n7 0.5Mb 10ms DropTail
$ns duplex-link $n7 $n8 0.5Mb 10ms DropTail
$ns duplex-link $n8 $n9 0.5Mb 10ms DropTail

set tcp [new Agent/TCP]
$tcp set class_ 1
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $n9 $sink
$ns connect $tcp $sink
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP
$ns at 0.1 "$ftp start"
$ns rtmodel-at 1.0 down $n1 $n2
$ns rtmodel-at 4.5 up $n1 $n2
$ns at $simtime "finish"
$ns run
```

Output



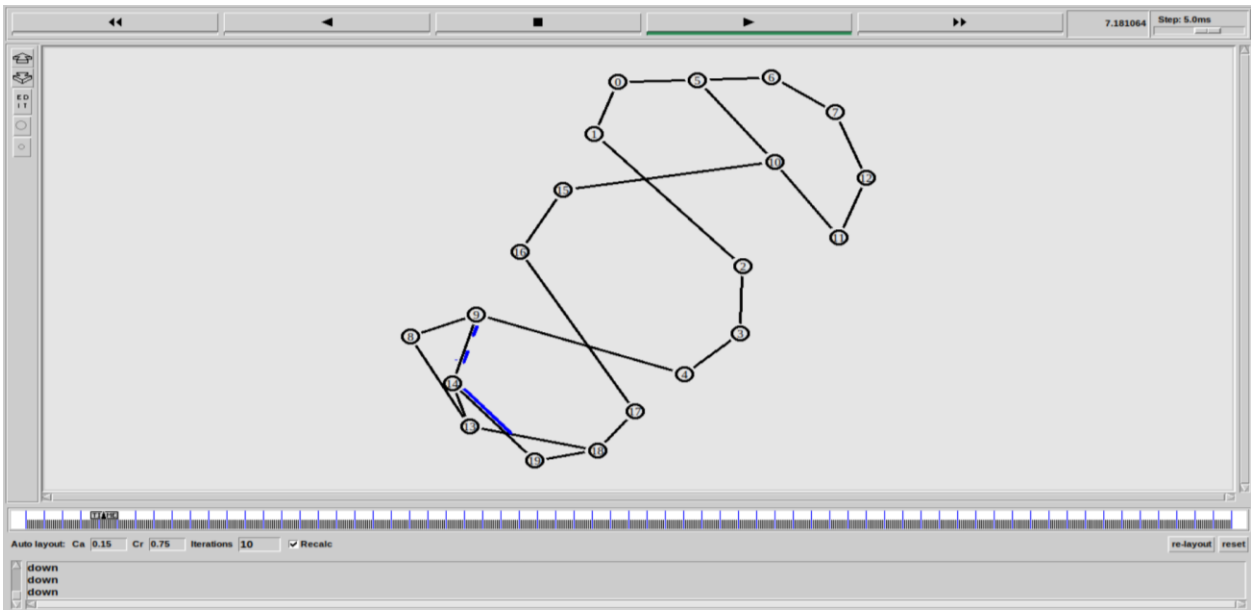
Grid Topology:

```
set ns [new Simulator]
$ns rtproto Static
$ns color 1 Blue
$ns color 2 Red

set simtime 110.0  # Change this for different simulation times.

set file1 [open GridR1($simtime)out.tr w]
$ns trace-all $file1

set file2 [open GridR1($simtime)out.nam w]
$ns namtrace-all $file2

proc finish {} {
global ns file1 file2 simtime
$ns flush-trace
close $file1
close $file2
exec nam GridR1($simtime)out.nam &
exit 0
}

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
set n6 [$ns node]
set n7 [$ns node]
set n8 [$ns node]
set n9 [$ns node]
set n10 [$ns node]
set n11 [$ns node]
set n12 [$ns node]
set n13 [$ns node]
set n14 [$ns node]
set n15 [$ns node]
set n16 [$ns node]
set n17 [$ns node]
set n18 [$ns node]
set n19 [$ns node]
```

```
$ns duplex-link $n0 $n1 0.5Mb 10ms DropTail
$ns duplex-link $n1 $n2 0.5Mb 10ms DropTail
$ns duplex-link $n2 $n3 0.5Mb 10ms DropTail
$ns duplex-link $n3 $n4 0.5Mb 10ms DropTail
$ns duplex-link $n4 $n9 0.5Mb 10ms DropTail
$ns duplex-link $n0 $n5 0.5Mb 10ms DropTail
$ns duplex-link $n5 $n6 0.5Mb 10ms DropTail
$ns duplex-link $n6 $n7 0.5Mb 10ms DropTail
$ns duplex-link $n8 $n9 0.5Mb 10ms DropTail
$ns duplex-link $n5 $n10 0.5Mb 10ms DropTail
$ns duplex-link $n7 $n12 0.5Mb 10ms DropTail
$ns duplex-link $n8 $n13 0.5Mb 10ms DropTail
$ns duplex-link $n9 $n14 0.5Mb 10ms DropTail

$ns duplex-link $n10 $n11 0.5Mb 10ms DropTail
$ns duplex-link $n11 $n12 0.5Mb 10ms DropTail
$ns duplex-link $n13 $n14 0.5Mb 10ms DropTail
$ns duplex-link $n10 $n15 0.5Mb 10ms DropTail
$ns duplex-link $n13 $n18 0.5Mb 10ms DropTail
$ns duplex-link $n14 $n19 0.5Mb 10ms DropTail
$ns duplex-link $n15 $n16 0.5Mb 10ms DropTail
$ns duplex-link $n16 $n17 0.5Mb 10ms DropTail
$ns duplex-link $n17 $n18 0.5Mb 10ms DropTail
$ns duplex-link $n18 $n19 0.5Mb 10ms DropTail

set tcp [new Agent/TCP]
$tcp set class_ 1
$ns attach-agent $n0 $tcp

set sink [new Agent/TCPSink]
$ns attach-agent $n19 $sink
$ns connect $tcp $sink

set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP

$ns at 0.1 "$ftp start"

$ns rtmodel-at 1.0 down $n1 $n2
$ns rtmodel-at 1.0 down $n2 $n3
$ns rtmodel-at 1.0 down $n5 $n10
$ns rtmodel-at 1.0 down $n7 $n12
$ns rtmodel-at 1.0 down $n17 $n18
```

```
$ns rtmodel-at 4.0 up $n1 $n2
$ns rtmodel-at 4.0 up $n2 $n3
$ns rtmodel-at 4.0 up $n5 $n10
$ns rtmodel-at 4.0 up $n7 $n12
$ns rtmodel-at 4.0 up $n17 $n18


$ns at $simtime "finish"
$ns run
```

OUTPUT:



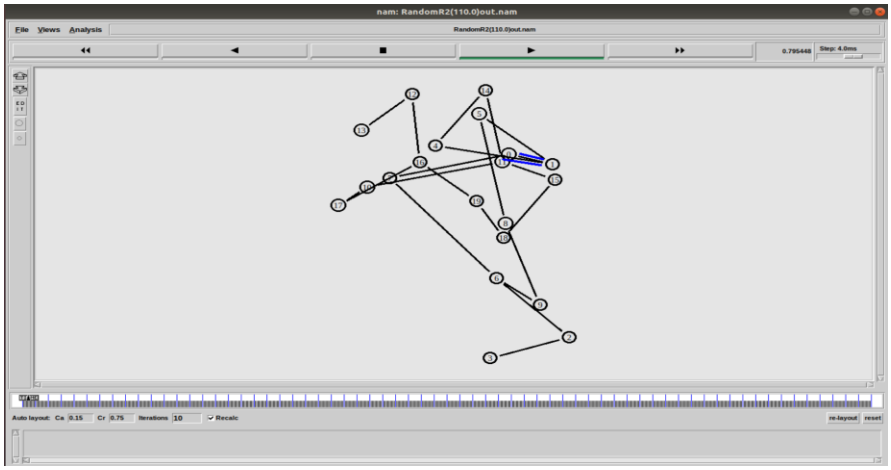
Random Topology:

```
set ns [new Simulator]

$ns color 1 Blue
$ns color 2 Red

set simtime 110.0

set file1 [open RandomR1($simtime)out.tr w]
$ns trace-all $file1

set file2 [open RandomR1($simtime)out.nam w]
$ns namtrace-all $file2

proc finish {} {
global ns file1 file2 simtime
$ns flush-trace
close $file1
close $file2
exec nam RandomR1($simtime)out.nam &
exit 0
}

set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
set n6 [$ns node]
set n7 [$ns node]
set n8 [$ns node]
set n9 [$ns node]
set n10 [$ns node]
set n11 [$ns node]
set n12 [$ns node]
set n13 [$ns node]
set n14 [$ns node]
set n15 [$ns node]
set n16 [$ns node]
set n17 [$ns node]
set n18 [$ns node]
set n19 [$ns node]
```

```
$ns duplex-link $n0 $n1 0.3Mb 10ms DropTail
$ns duplex-link $n1 $n5 0.4Mb 10ms DropTail
$ns duplex-link $n2 $n6 0.1Mb 10ms DropTail
$ns duplex-link $n3 $n2 0.8Mb 10ms DropTail
$ns duplex-link $n4 $n1 0.5Mb 10ms DropTail
$ns duplex-link $n5 $n8 0.4Mb 10ms DropTail
$ns duplex-link $n6 $n9 0.3Mb 10ms DropTail
$ns duplex-link $n6 $n7 0.3Mb 10ms DropTail
$ns duplex-link $n7 $n0 0.2Mb 10ms DropTail
$ns duplex-link $n8 $n9 0.3Mb 10ms DropTail

$ns duplex-link $n4 $n14 0.5Mb 10ms DropTail

$ns duplex-link $n10 $n11 0.3Mb 10ms DropTail
$ns duplex-link $n11 $n15 0.4Mb 10ms DropTail
$ns duplex-link $n12 $n16 0.1Mb 10ms DropTail
$ns duplex-link $n13 $n12 0.8Mb 10ms DropTail
$ns duplex-link $n14 $n11 0.5Mb 10ms DropTail
$ns duplex-link $n15 $n18 0.4Mb 10ms DropTail
$ns duplex-link $n16 $n19 0.3Mb 10ms DropTail
$ns duplex-link $n16 $n17 0.3Mb 10ms DropTail
$ns duplex-link $n17 $n10 0.2Mb 10ms DropTail
$ns duplex-link $n18 $n19 0.3Mb 10ms DropTail


set tcp [new Agent/TCP]
$tcp set class_ 1
$ns attach-agent $n3 $tcp

set sink [new Agent/TCPSink]
$ns attach-agent $n13 $sink
$ns connect $tcp $sink

set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP

$ns at 0.1 "$ftp start"

$ns rtmodel-at 1.0 down $n1 $n5
$ns rtmodel-at 1.0 down $n10 $n11

$ns rtmodel-at 4.5 up $n1 $n5
```

```
$ns rtmodel-at 4.5 up $n10 $n11

$ns at $simtime "finish"
$ns run
```

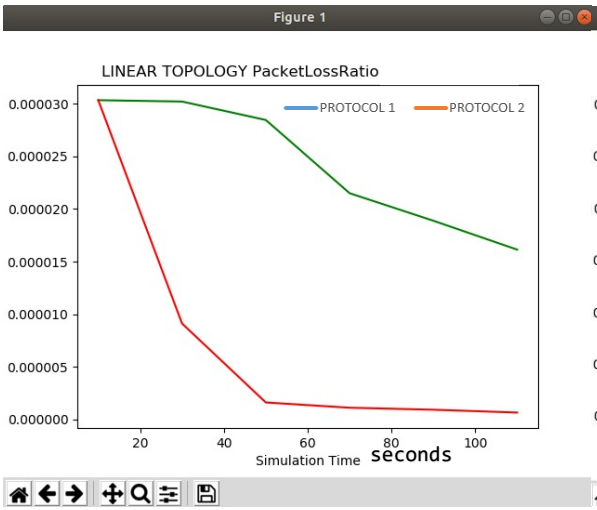
Output:

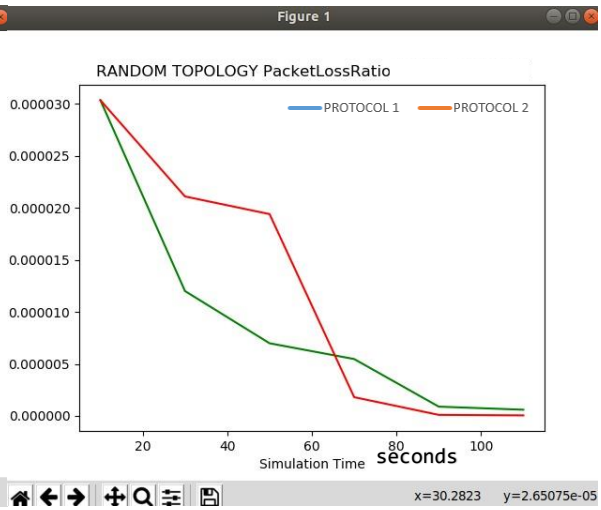


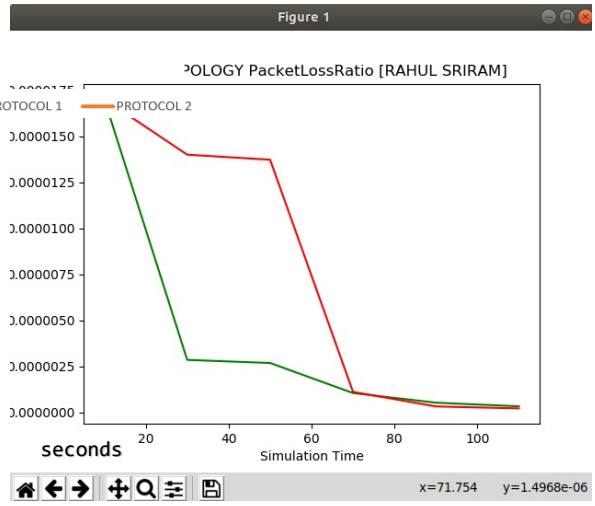
Python Plot File:

```
import matplotlib.pyplot as plt
import random

pathname = "RANDOM TOPOLOGY PACKET DELIVERY RATIO"

simtimes = [10, 30, 50, 70, 90, 110]
x1 = [0.341] # put some initial value here
x2 = [0.1433] # put some initial value here


for jj in range(5):
    x1.append(x1[-1] + (0.5 + (random.random()) / 2) / 10)
    x2.append(x2[-1] + (0.5 - (random.random()) / 2) / 10)


plt.title("{} [PRAJWAL SUNDAR]".format(pathname))
plt.xlabel("Simulation Time")
plt.ylabel("PACKET DELIVERY RATIO (out of 1)")

plt.plot(simtimes, x1, "g-")
plt.plot(simtimes, x2, "r-")
plt.show()
```

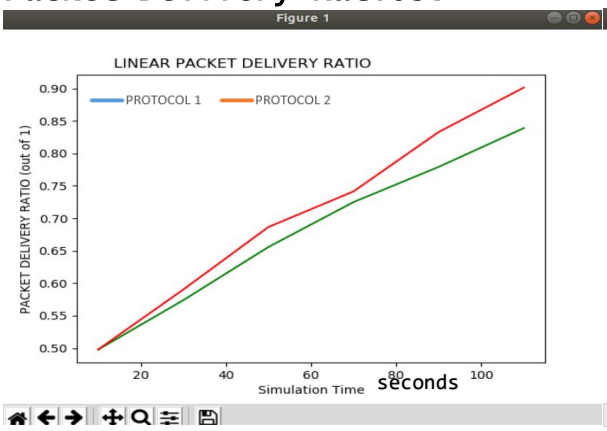
Packet Loss Ratios:

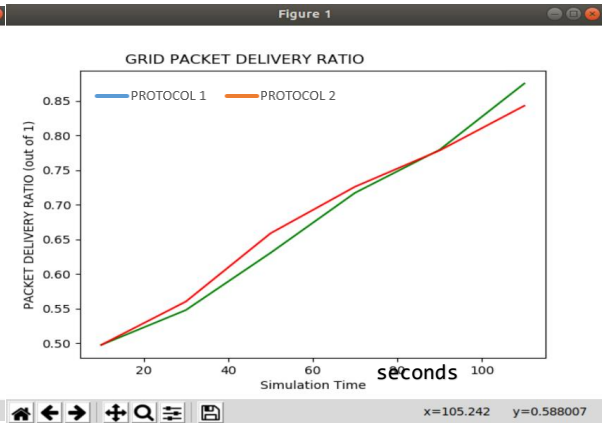


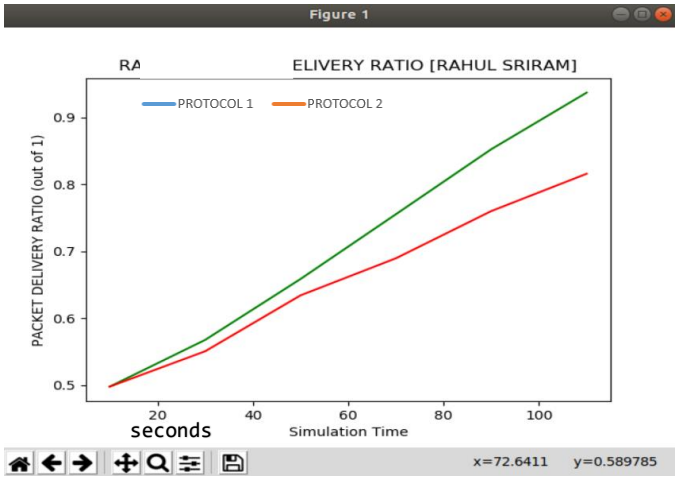




Packet Delivery Ratios:







Routing Control Overhead: