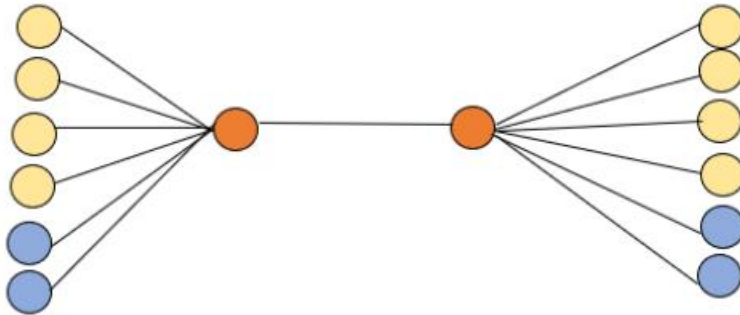


- 2) Write a Tcl script that forms a network consisting of 6 nodes, numbered from 1 to 6. Each of source and destination has bandwidth of 300 Mbps and delay of 20 ms. Set the bottleneck link bandwidth as 500 sec and delay 10ms. Set the routing protocol to Droptail. Define different colors for different data flows. Send TCP packet from node 1 to node 4 and UDP packet from node 5 to 6. Start the TCP data transmission at 1 sec and UDP at 15 sec. Finish the transmission at 100 sec. Then run nam to view the results.



Calculate the following performance metrics using awk script:

- Throughput
- Delay
- Packet loss ratio
- Jain Fairness index.
- Plot throughput graph using gnuplot (Tahoe vs Reno)
- Plot Jain Fairness index graph using gnuplot

a) *Throughput* .

--tahoe.tcl code ---

```

set ns [new Simulator]

$ns color 1 Blue
$ns color 2 Red
$ns color 3 Yellow
$ns color 4 Pink

```

```
$ns color 5 Black
$ns color 6 Green

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

set namfile [open tahoe.nam w]
$ns namtrace-all $namfile

for {set i 0} {$i < 6} {incr i} {
    set n($i) [$ns node]
}

for {set i 0} { $i < 6} {incr i} {
    set r($i) [$ns node]
}

set b(0) [$ns node]
set b(1) [$ns node]

for {set i 0} { $i < 6} {incr i} {
    $ns duplex-link $n($i) $b(0) 300Mb 20ms DropTail
}

$ns duplex-link $b(0) $b(1) 500Mb 10ms DropTail

for {set i 0} { $i < 6} {incr i} {
    $ns duplex-link $r($i) $b(1) 300Mb 20ms DropTail
}
```

```
#tcp setup
```

```
for {set i 0} { $i < 4} {incr i} {  
    set tcp($i) [new Agent/TCP]  
    set sink($i) [new Agent/TCPSink]  
    $ns attach-agent $n($i) $tcp($i)  
    $ns attach-agent $r($i) $sink($i)  
    set ftp($i) [new Application/FTP]  
    $ftp($i) attach-agent $tcp($i)  
  
    $ns connect $tcp($i) $sink($i)  
    $tcp($i) set fid_ $i+1  
  
}
```

```
#udp setup
```

```
set udp(0) [new Agent/UDP]  
set udp(1) [new Agent/UDP]  
set null(0) [new Agent/Null]  
set null(1) [new Agent/Null]  
  
$ns attach-agent $n(4) $udp(0)  
$ns attach-agent $r(4) $null(0)  
set cbr(0) [new Application/Traffic/CBR]  
  
$cbr(0) attach-agent $udp(0)
```

```
$ns connect $udp(0) $null(0)
$udp(0) set fid_ 5

$ns attach-agent $n(5) $udp(1)
$ns attach-agent $r(5) $null(1)
set cbr(1) [new Application/Traffic/CBR]

$cbr(1) attach-agent $udp(1)

$ns connect $udp(1) $null(1)
$udp(1) set fid_ 6

$ns at 1.0 "$ftp(0) start"
$ns at 1.0 "$ftp(1) start"
$ns at 1.0 "$ftp(2) start"
$ns at 1.0 "$ftp(3) start"

$ns at 15.0 "$cbr(0) start"
$ns at 15.0 "$cbr(1) start"

$ns at 100.0 "finish"

proc finish {} {
    global ns tracefile namfile
    $ns flush-trace
    close $tracefile
    close $namfile
    exit 0
}
```

```
$ns run  
--reno.tcl--
```

```
#Reno  
set ns [new Simulator]  
  
$ns color 1 Blue  
$ns color 2 Red  
$ns color 3 Yellow  
$ns color 4 Pink  
$ns color 5 Black  
$ns color 6 Green  
  
set tracefile [open reno.tr w]  
$ns trace-all $tracefile  
  
set namfile [open reno.nam w]  
$ns namtrace-all $namfile  
  
for {set i 0} {$i < 6} {incr i} {  
    set n($i) [$ns node]  
}  
  
for {set i 0} { $i < 6} {incr i} {  
    set r($i) [$ns node]  
}  
  
set b(0) [$ns node]  
set b(1) [$ns node]  
  
for {set i 0} { $i < 6} {incr i} {
```

```
$ns duplex-link $n($i) $b(0) 300Kb 20ms DropTail
}
```

```
$ns duplex-link $b(0) $b(1) 150Kb 10ms DropTail
```

```
for {set i 0} { $i < 6} {incr i} {
$ns duplex-link $r($i) $b(1) 300Kb 20ms DropTail
}
```

```
#tcp setup
```

```
for {set i 0} { $i < 4} {incr i} {
    set tcp($i) [new Agent/TCP/Reno]
    set sink($i) [new Agent/TCPSink]
    $ns attach-agent $n($i) $tcp($i)
    $ns attach-agent $r($i) $sink($i)
    set ftp($i) [new Application/FTP]
    $ftp($i) attach-agent $tcp($i)

    $ns connect $tcp($i) $sink($i)
    $tcp($i) set fid_ $i+1
}
```

```
#udp setup
```

```
set udp(0) [new Agent/UDP]
```

```
set udp(1) [new Agent/UDP]
set null(0) [new Agent/Null]
set null(1) [new Agent/Null]

$ns attach-agent $n(4) $udp(0)
$ns attach-agent $r(4) $null(0)
set cbr(0) [new Application/Traffic/CBR]

$cbr(0) attach-agent $udp(0)

$ns connect $udp(0) $null(0)
$udp(0) set fid_ 5

$ns attach-agent $n(5) $udp(1)
$ns attach-agent $r(5) $null(1)
set cbr(1) [new Application/Traffic/CBR]

$cbr(1) attach-agent $udp(1)

$ns connect $udp(1) $null(1)
$udp(1) set fid_ 6

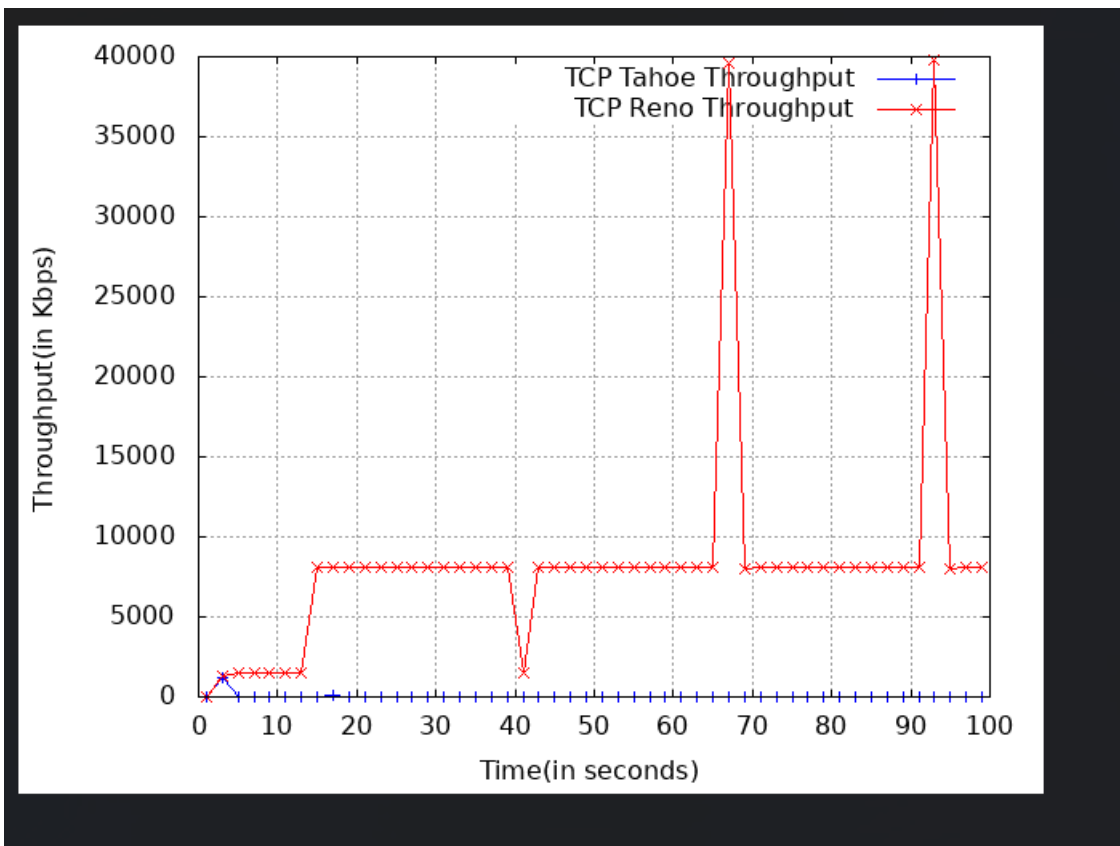
$ns at 1.0 "$ftp(0) start"
$ns at 1.0 "$ftp(1) start"
$ns at 1.0 "$ftp(2) start"
$ns at 1.0 "$ftp(3) start"

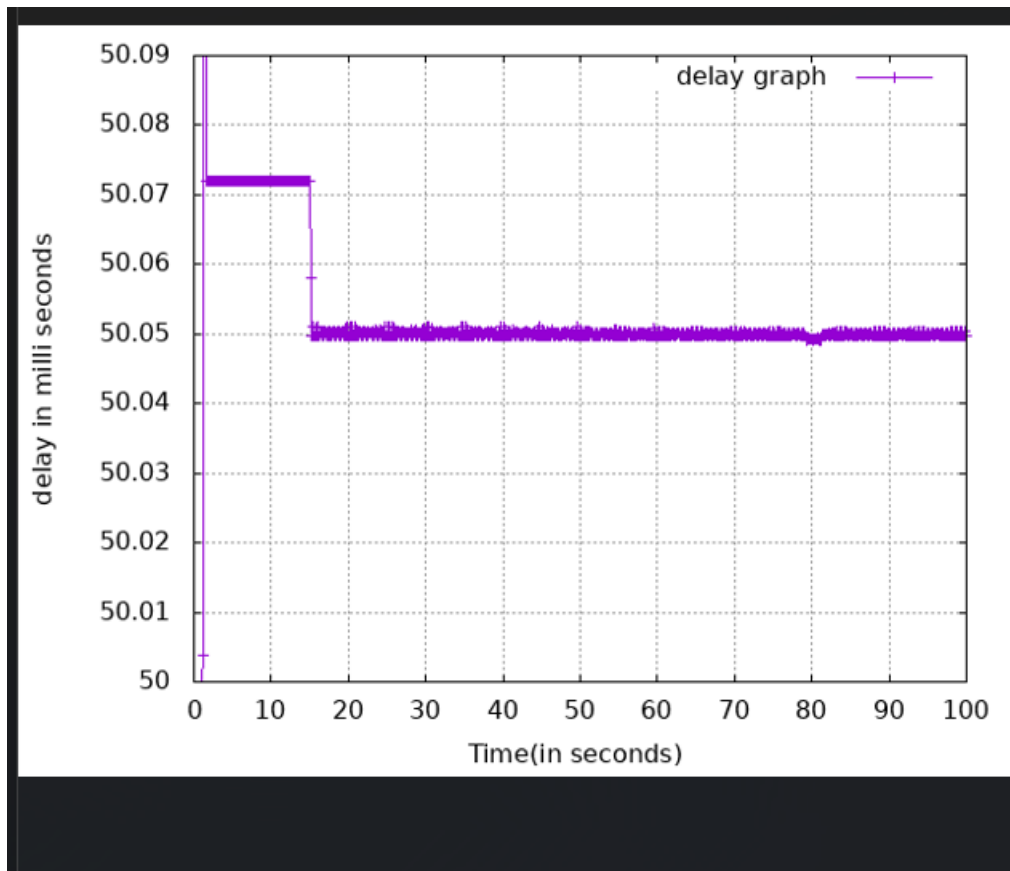
$ns at 15.0 "$cbr(0) start"
$ns at 15.0 "$cbr(1) start"

$ns at 100.0 "finish"
```

```
proc finish {} {  
    global ns tracefile namfile  
    $ns flush-trace  
    close $tracefile  
    close $namfile  
    exit 0  
}  
  
$ns run
```

Throughput Graph:



b) Delay graph (tahoe vs reno)

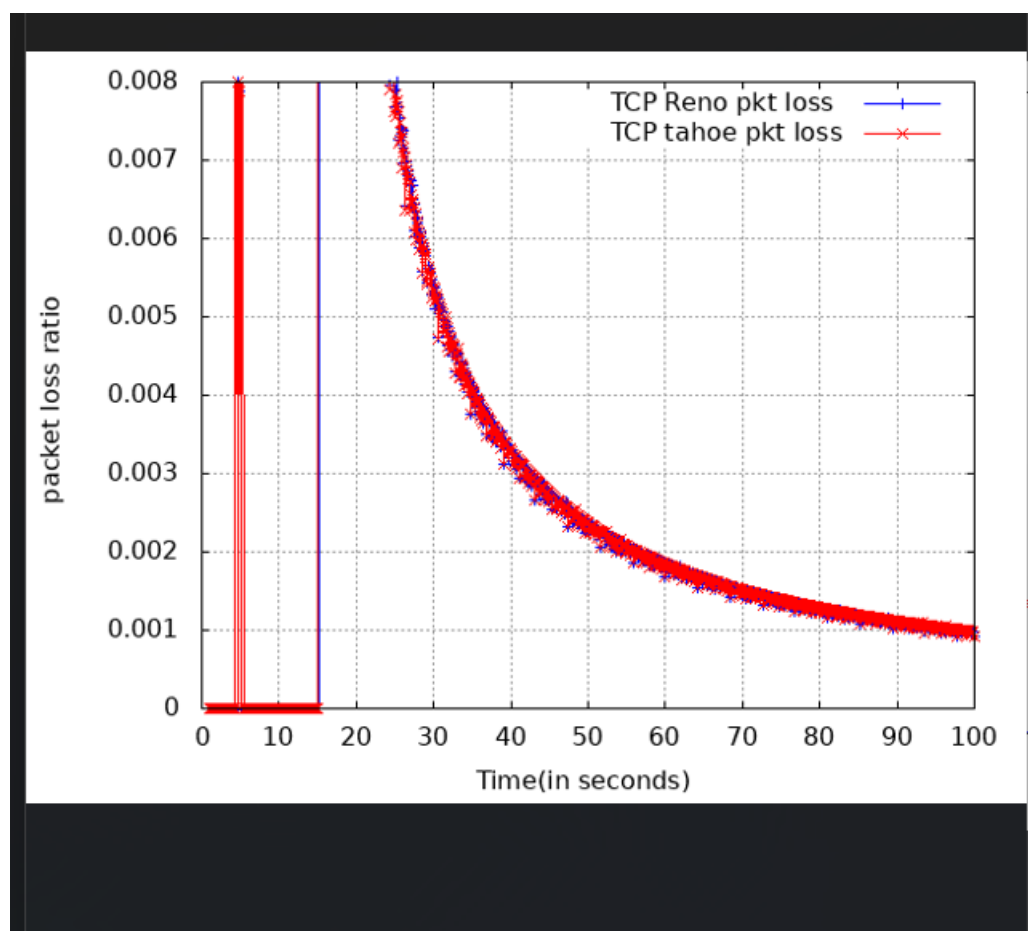
c) Pkt loss ratio (tahoe Vs reno)

Here, senders bandwidth is reduced to 300Kbps from 300Mbps and

Bottleneck bandwidth is reduced to 50Kbps from 500Mbps ,in order to

Obtain dropped packets.

Remaining code part will be same .



d) Jain fairness Index (TCP vs Reno)

