

Lab 4 Networks

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Question 1

Code

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

#Define different colors for data flows (for NAM)
$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]
```

```

#Create links between the nodes
$ns duplex-link $n0 $n2 2Mb 10ms DropTail
$ns duplex-link $n1 $n2 2Mb 10ms DropTail
$ns duplex-link $n2 $n3 1.7Mb 20ms DropTail

#Set Queue Size of link (n2-n3) to 10
$ns queue-limit $n2 $n3 10

#Give node position (for NAM)
$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

#Monitor the queue for link (n2-n3). (for NAM)
$ns duplex-link-op $n2 $n3 queuePos 0.5


#Setup a TCP connection
set tcp [new Agent/TCP]
$tcp set class_ 2
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $n3 $sink
$ns connect $tcp $sink
$tcp set fid_ 1


#Setup a FTP over TCP connection
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP


#Setup a UDP connection
set udp [new Agent/UDP]
$ns attach-agent $n1 $udp
set null [new Agent/Null]
$ns attach-agent $n3 $null
$ns connect $udp $null
$udp set fid_ 2


#Setup a CBR over UDP connection
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set type_ CBR
$cbr set packet_size_ 1000

```

```

$cbr set rate_ 1mb
$cbr set random_ false

#Schedule events for the CBR and FTP agents
$ns at 0.1 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 4.0 "$ftp stop"
$ns at 4.5 "$cbr stop"

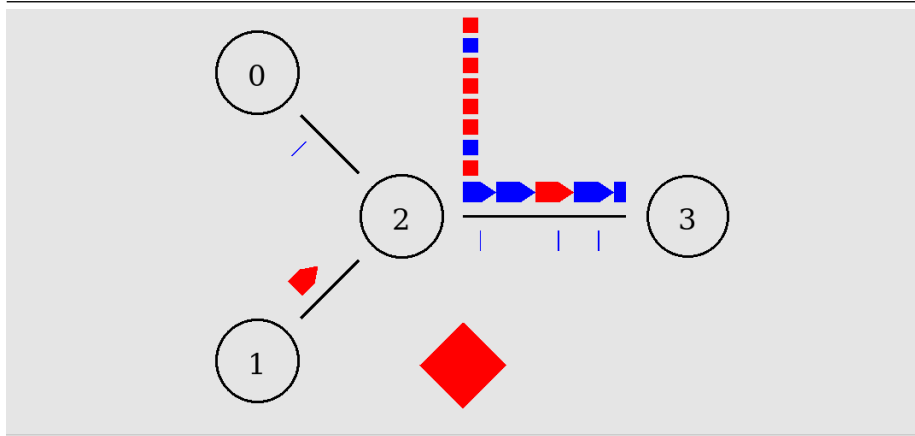
#Call the finish procedure after 5 seconds of simulation time
$ns at 5.0 "finish"

#Run the simulation
$ns run

```

Output

Nam Output



Analysis output

```

tcp Packets sent for 0.0→3.0 : {'tcp': 246}
tcp Packets received for 0.0→3.0 : {'tcp': 236}
cbr Packets sent for 1.0→3.1 : {'cbr': 550}
cbr Packets received for 1.0→3.1 : {'cbr': 542}
tcp dropped: 10
cbr dropped: 8

```

Question 2

Linear topology

Code

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

#Define different colors for data flows (for NAM)
$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
}

for {set i 0} {$i < 10} {incr i} {
    set n($i) [$ns node]
}

for {set i 0} {$i < 9} {incr i} {
    set j [expr {$i + 1}]
    $ns duplex-link $n($i) $n($j) 1Mb 1ms DropTail
    $ns duplex-link-op $n($i) $n($j) orient right
    $ns queue-limit $n($i) $n($j) 30
    $ns queue-limit $n($j) $n($i) 30
}

set s1 [lindex $argv 0]
set d1 [lindex $argv 1]
set s2 [lindex $argv 2]
```

```

set d2 [lindex $argv 3]

set tcp [new Agent/TCP]
$tcp set class_ 2
$ns attach-agent $n($s1) $tcp

set sink [new Agent/TCPSink]
$ns attach-agent $n($d1) $sink
$ns connect $tcp $sink
$tcp set fid_ 1

#Setup a FTP over TCP connection
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP

# Two udp connections
# set tcp [new Agent/UDP]
# $tcp set class_ 2
# $ns attach-agent $n($s1) $tcp

# set sink [new Agent/Null]
# $ns attach-agent $n($d1) $sink
# $ns connect $tcp $sink
# $tcp set fid_ 1

# #Setup a FTP over TCP connection
# set ftp [new Application/Traffic/CBR]
# $ftp attach-agent $tcp
# $ftp set packetSize_ 1000
# $ftp set type_ CBR
# $ftp set rate_ 1mb
# $ftp set random_ false

#Setup a UDP connection
set udp [new Agent/UDP]
$ns attach-agent $n($s2) $udp
set null [new Agent/Null]
$ns attach-agent $n($d2) $null
$ns connect $udp $null
$udp set fid_ 2

#Setup a CBR over UDP connection
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp

```

```

$cbr set type_ CBR
$cbr set packetSize_ 1000
$cbr set rate_ 1mb
$cbr set random_ false

#Schedule events for the CBR and FTP agents
$ns at 1.1 "$cbr start"
$ns at 1.2 "$ftp start"
$ns at 49.2 "$ftp stop"
$ns at 49.1 "$cbr stop"

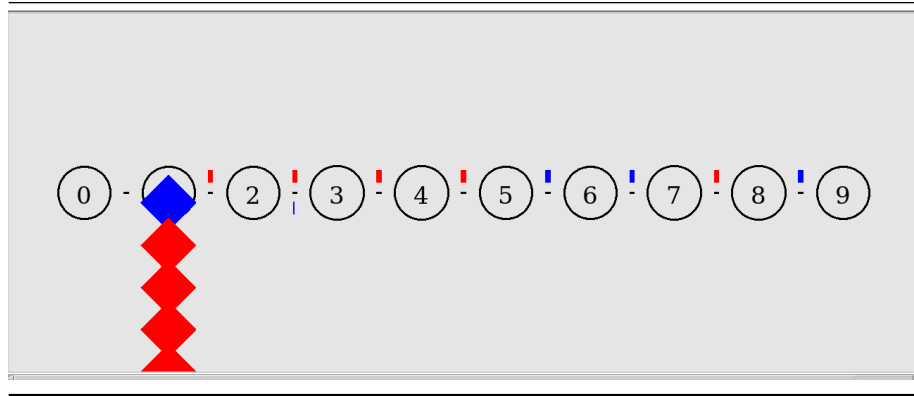
$ns at 50.0 "finish"

$ns run

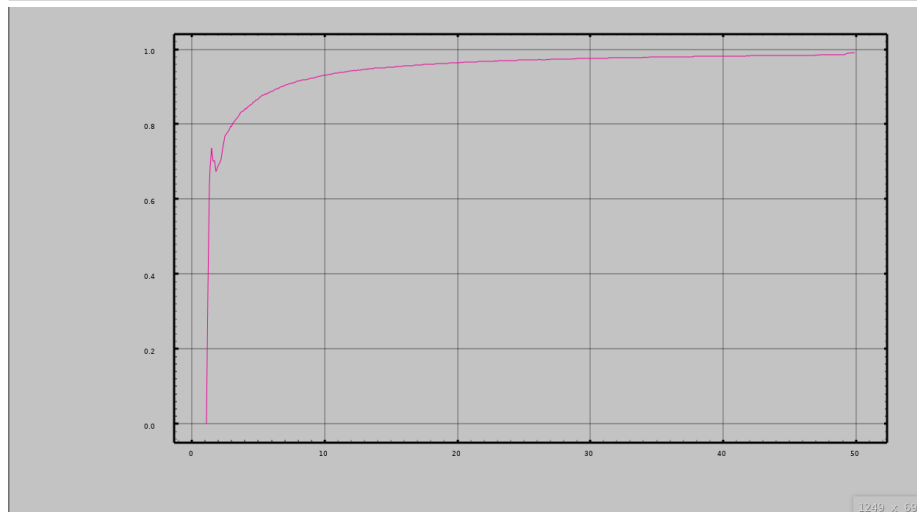
```

Output

Nam Output

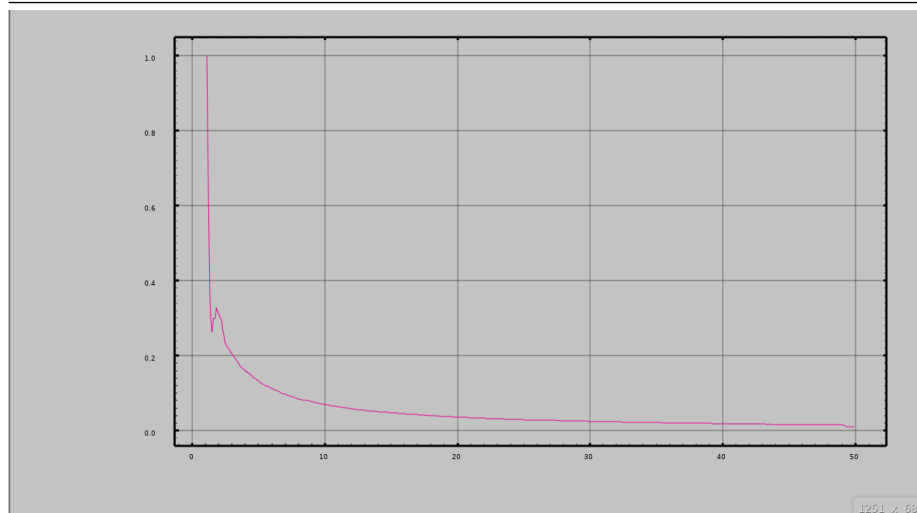


PDR Graph



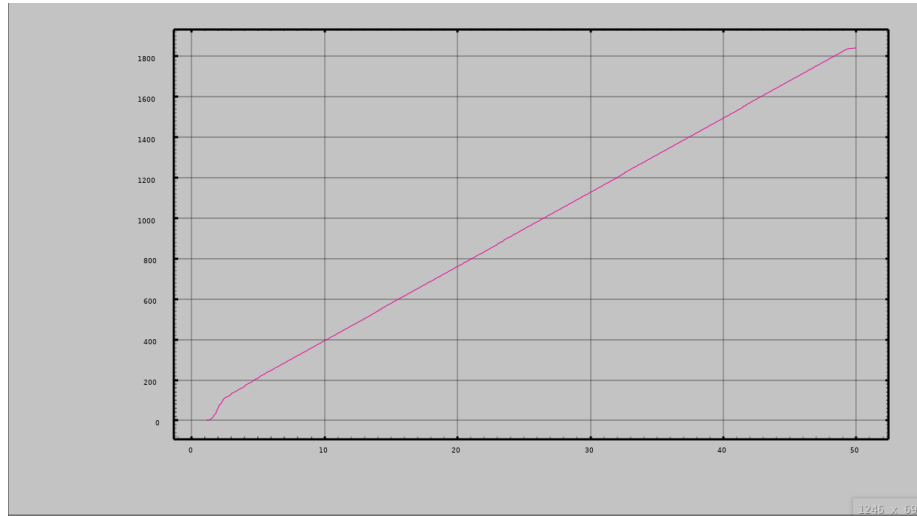
Time interval 0.1s

PLR Graph



Time interval 0.1s

End to End Delay Graph



Time interval 0.1s

Grid topology

Code

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

#Define different colors for data flows (for NAM)
$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
    }

    for {set i 0} {$i < 25} {incr i} {
        set n($i) [$ns node]
    }

    for {set i 0} {$i < 5} {incr i} {
        for {set j 0} {$j < 4} {incr j} {
            set k1 [expr {5*$i + $j}]
            set k2 [expr {$k1 + 1}]
            $ns duplex-link $n($k1) $n($k2) 1Mb 10ms DropTail
            $ns duplex-link-op $n($k1) $n($k2) orient right
            $ns queue-limit $n($k1) $n($k2) 30
            $ns queue-limit $n($k2) $n($k1) 30
            $ns duplex-link-op $n($k1) $n($k2) queuePos 0.5
        }
    }

    for {set i 0} {$i < 5} {incr i} {
        for {set j 0} {$j < 4} {incr j} {
            set k1 [expr {$i + 5*$j}]
            set k2 [expr {$k1 + 5}]
            $ns duplex-link $n($k1) $n($k2) 1Mb 10ms DropTail
            $ns duplex-link-op $n($k1) $n($k2) orient down
            $ns queue-limit $n($k1) $n($k2) 30
            $ns queue-limit $n($k2) $n($k1) 30
            $ns duplex-link-op $n($k1) $n($k2) queuePos 0.5
        }
    }

    set s1 [lindex $argv 0]
    set d1 [lindex $argv 1]
    set s2 [lindex $argv 2]
    set d2 [lindex $argv 3]

    #Setup a TCP connection
    set tcp [new Agent/TCP]
    $tcp set class_ 2
    $ns attach-agent $n($s1) $tcp

    set sink [new Agent/TCPSink]
    $ns attach-agent $n($d1) $sink
    $ns connect $tcp $sink
    $tcp set fid_ 1

```

```

#Setup a FTP over TCP connection
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP

#Setup a UDP connection
set udp [new Agent/UDP]
$ns attach-agent $n($s2) $udp
set null [new Agent/Null]
$ns attach-agent $n($d2) $null
$ns connect $udp $null
$udp set fid_ 2

#Setup a CBR over UDP connection
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set type_ CBR
$cbr set packet_size_ 1000
$cbr set rate_ 1mb
$cbr set random_ false

#Schedule events for the CBR and FTP agents
$ns at 1.0 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 49.0 "$ftp stop"
$ns at 49.0 "$cbr stop"

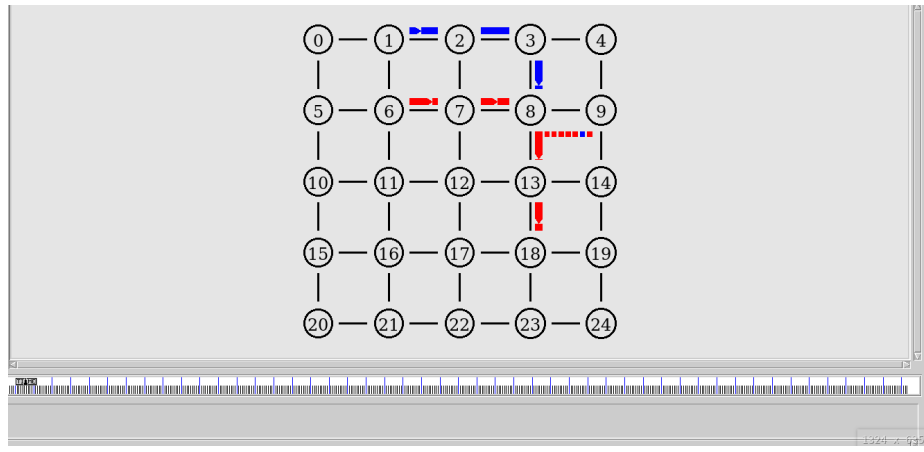
# call finish after 50s
$ns at 50.0 "finish"

# run ns
$ns run

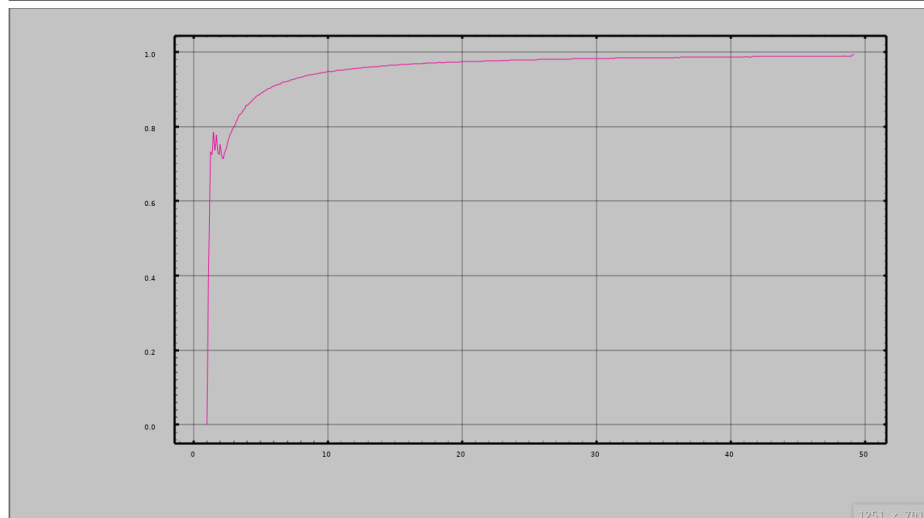
```

Output

Nam Output

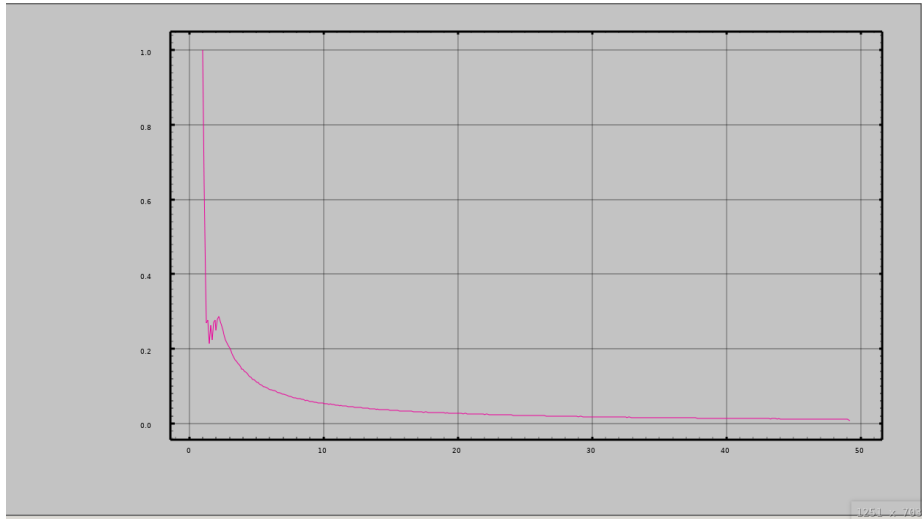


PDR Graph



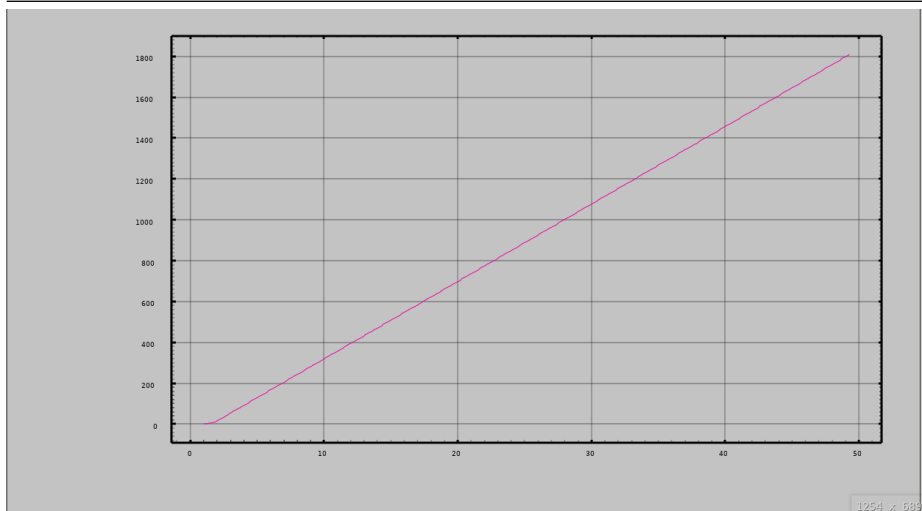
Time interval 0.1s

PLR Graph



Time interval 0.1s

End to End Delay Graph



Time interval 0.1s

Ring topology

Code

```

#Create a simulator object
set ns [new Simulator]

#Define different colors for data flows (for NAM)
$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
}

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

for {set i 0} {$i < 6} {incr i} {
    set j [expr {($i + 1) % 6}]
    $ns duplex-link $n($i) $n($j) 1Mb 1ms DropTail
    $ns queue-limit $n($i) $n($j) 30
    $ns queue-limit $n($i) $n($j) 30
    $ns duplex-link-op $n($i) $n($j) queuePos 0.5
}

set s1 [lindex $argv 0]
set d1 [lindex $argv 1]
set s2 [lindex $argv 2]
set d2 [lindex $argv 3]

#Setup a TCP connection
set tcp [new Agent/TCP]
$tcp set class_ 2
$ns attach-agent $n($s1) $tcp

```

```

set sink [new Agent/TCPSink]
$ns attach-agent $n($d1) $sink
$ns connect $tcp $sink
$tcp set fid_ 1

#Setup a FTP over TCP connection
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP

#Setup a UDP connection
set udp [new Agent/UDP]
$ns attach-agent $n($s2) $udp
set null [new Agent/Null]
$ns attach-agent $n($d2) $null
$ns connect $udp $null
$udp set fid_ 2

#Setup a CBR over UDP connection
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set type_ CBR
$cbr set packet_size_ 1000
$cbr set rate_ 1mb
$cbr set random_ false

#Schedule events for the CBR and FTP agents
$ns at 1.0 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 49.0 "$ftp stop"
$ns at 49.0 "$cbr stop"

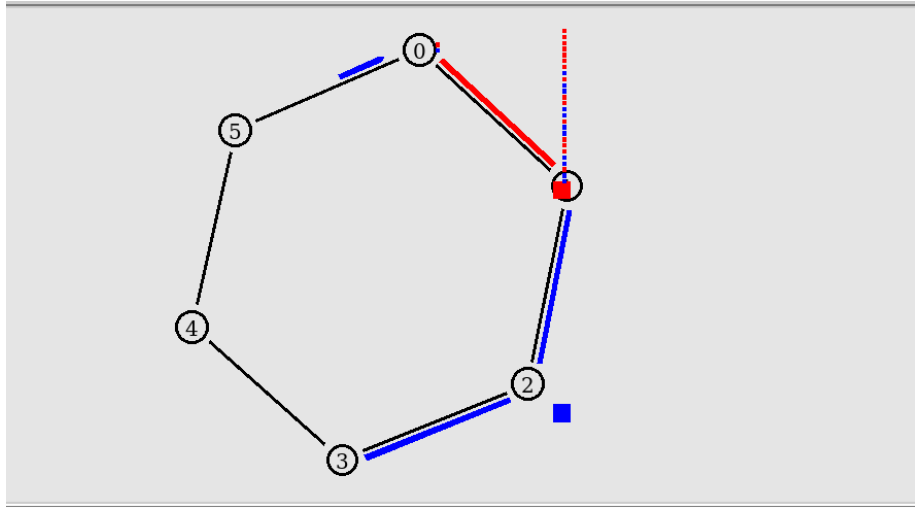
$ns at 50.0 "finish"

$ns run

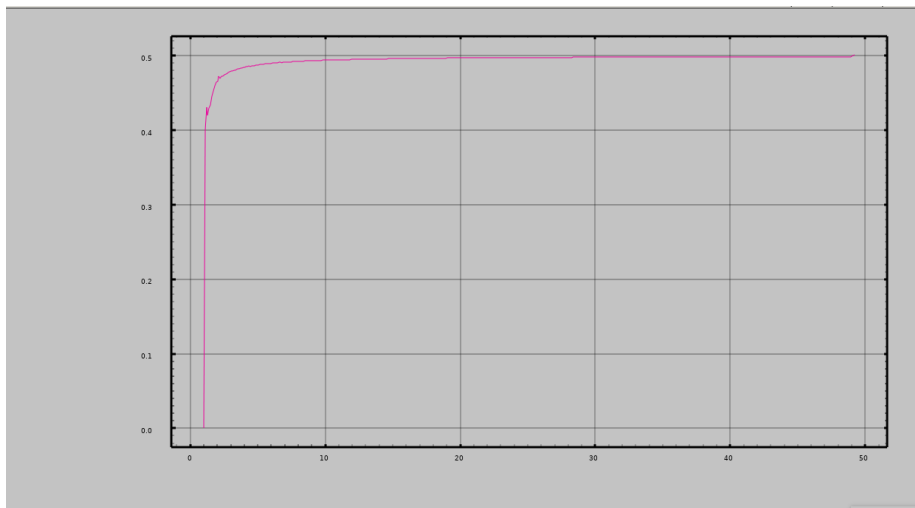
```

Output

Nam Output

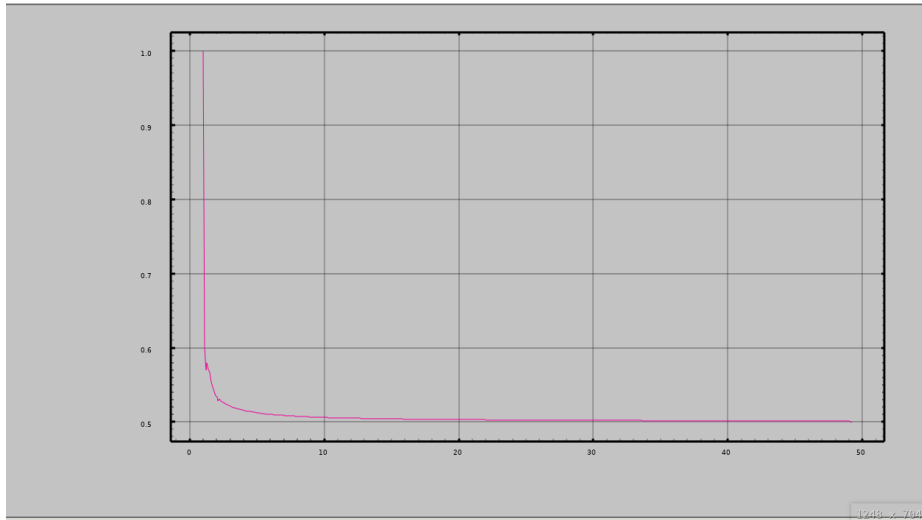


PDR Graph



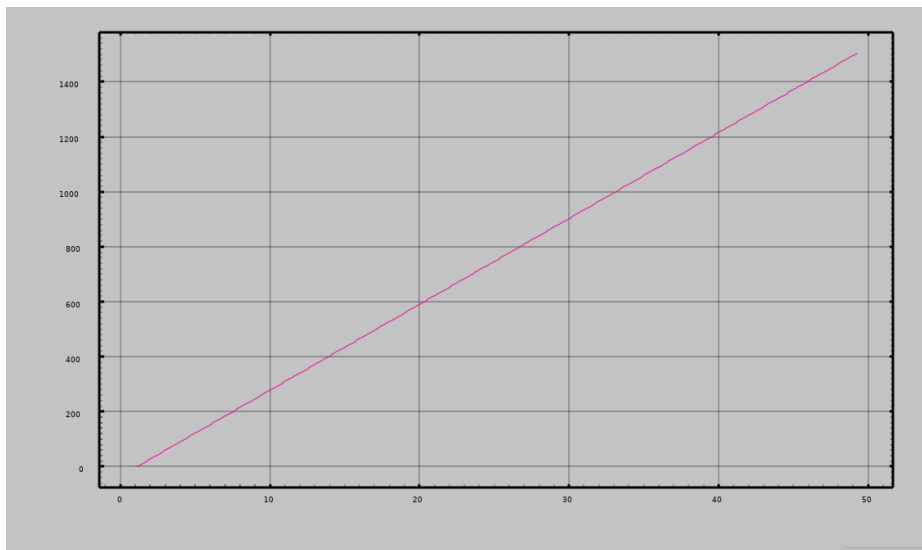
Time interval 0.1s

PLR Graph



Time interval 0.1s

End to End Delay Graph



Time interval 0.1s

Star topology

Code


```

#Create a simulator object
set ns [new Simulator]

#Define different colors for data flows (for NAM)
$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
}

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

for {set i 1} {$i < 6} {incr i} {
    $ns duplex-link $n(0) $n($i) 1Mb 1ms DropTail
    $ns queue-limit $n(0) $n($i) 5
    $ns queue-limit $n($i) $n(0) 5
    $ns duplex-link-op $n($i) $n(0) queuePos 0.5
}

set s1 [lindex $argv 0]
set d1 [lindex $argv 1]
set s2 [lindex $argv 2]
set d2 [lindex $argv 3]

#Setup a TCP connection
set tcp [new Agent/TCP]
$tcp set class_ 2
$ns attach-agent $n($s1) $tcp

```

```

set sink [new Agent/TCPSink]
$ns attach-agent $n($d1) $sink
$ns connect $tcp $sink
$tcp set fid_ 1

#Setup a FTP over TCP connection
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP

#Setup a UDP connection
set udp [new Agent/UDP]
$ns attach-agent $n($s2) $udp
set null [new Agent/Null]
$ns attach-agent $n($d2) $null
$ns connect $udp $null
$udp set fid_ 2

#Setup a CBR over UDP connection
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set type_ CBR
$cbr set packet_size_ 1000
$cbr set rate_ 1.1mb
$cbr set random_ false

#Schedule events for the CBR and FTP agents
$ns at 1.0 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 49.0 "$ftp stop"
$ns at 49.0 "$cbr stop"

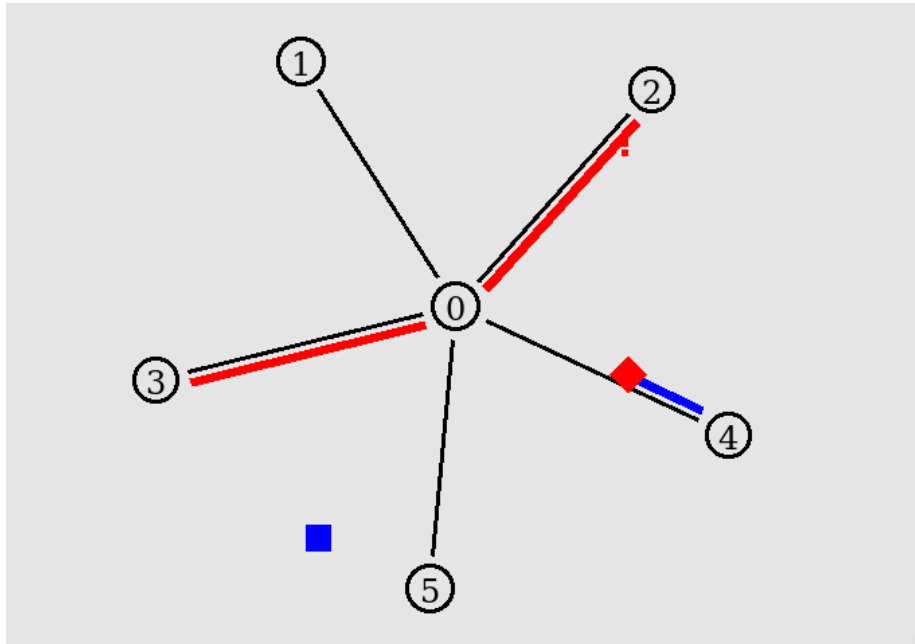
$ns at 50.0 "finish"

$ns run

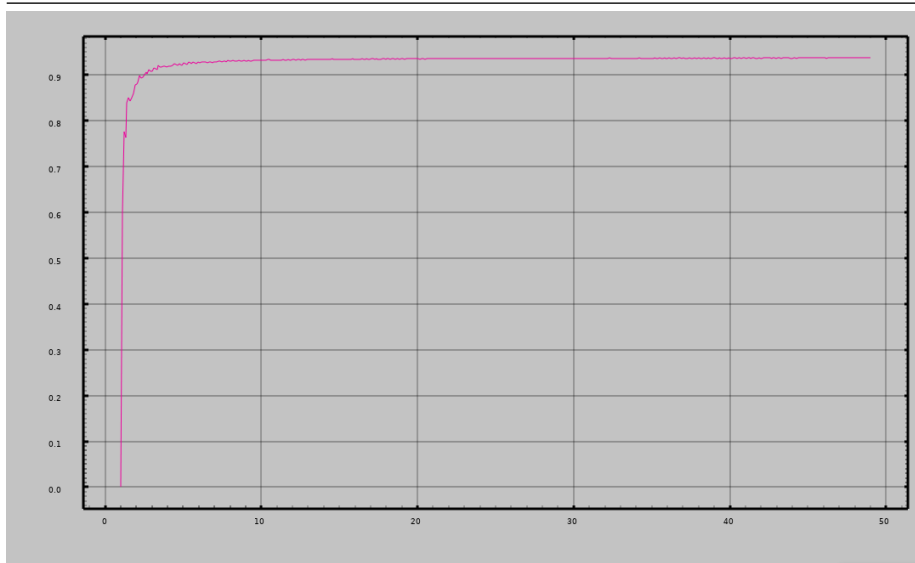
```

Output

Nam Output

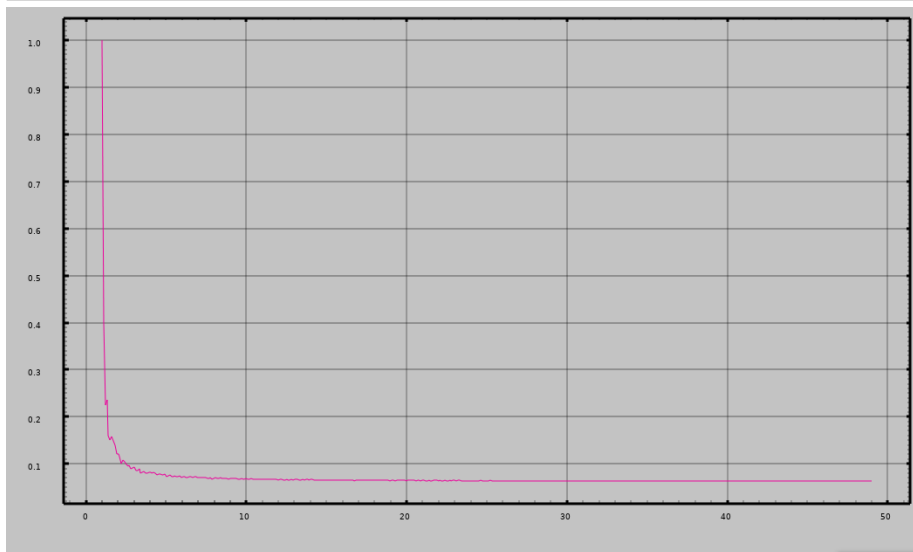


PDR Graph



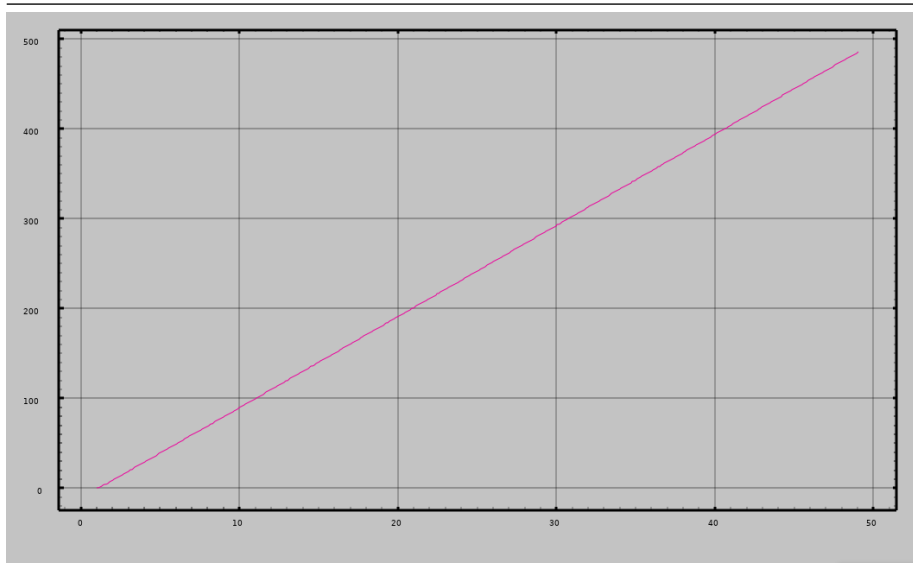
Time interval 0.1s

PLR Graph



Time interval 0.1s

End to End Delay Graph



Time interval 0.1s

Bus topology

Code

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

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

# Set all queue limit to 5
Queue set limit_ 5

#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 NAM trace file
    close $nf
    close $all_trace
    #Execute NAM on the trace file
    exec nam out.nam &
    exit 0
}

for {set i 0} {$i < 10} {incr i} {
    set n($i) [$ns node]
}

# make a string
set s ""
for {set i 0} {$i < 10} {incr i} {
    set s "$s $n($i)"
}

set lan [$ns newLan "$s" 10Mb 50ms LL Queue/DropTail MAC/Csma Channel]
```

```

set s1 [lindex $argv 0]
set d1 [lindex $argv 1]
set s2 [lindex $argv 2]
set d2 [lindex $argv 3]

#Setup a TCP connection
set tcp [new Agent/TCP]
$tcp set class_ 2
$ns attach-agent $n($s1) $tcp

set sink [new Agent/TCPSink]
$ns attach-agent $n($d1) $sink
$ns connect $tcp $sink
$tcp set fid_ 1

#Setup a FTP over TCP connection
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ftp set type_ FTP
$ftp set packetSize_ 1000
$ftp set rate_ 10Mb

#Setup a UDP connection
set udp [new Agent/UDP]
$ns attach-agent $n($s2) $udp
set null [new Agent/Null]
$ns attach-agent $n($d2) $null
$ns connect $udp $null
$udp set fid_ 2

#Setup a CBR over UDP connection
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set type_ CBR
$cbr set packetSize_ 1000
$cbr set rate_ 10Mb
$cbr set random_ false

#Schedule events for the CBR and FTP agents
$ns at 1.0 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 49.0 "$ftp stop"
$ns at 49.0 "$cbr stop"

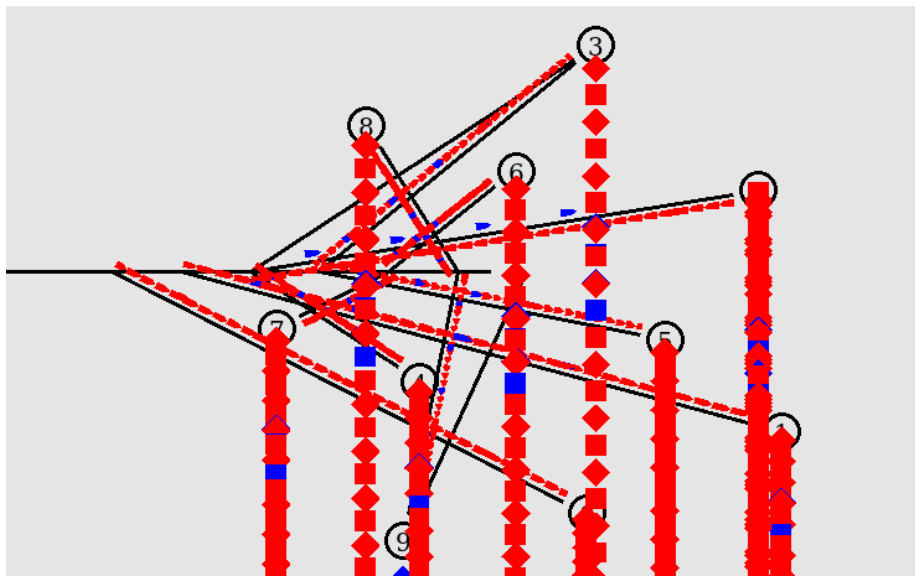
$ns at 50.0 "finish"

```

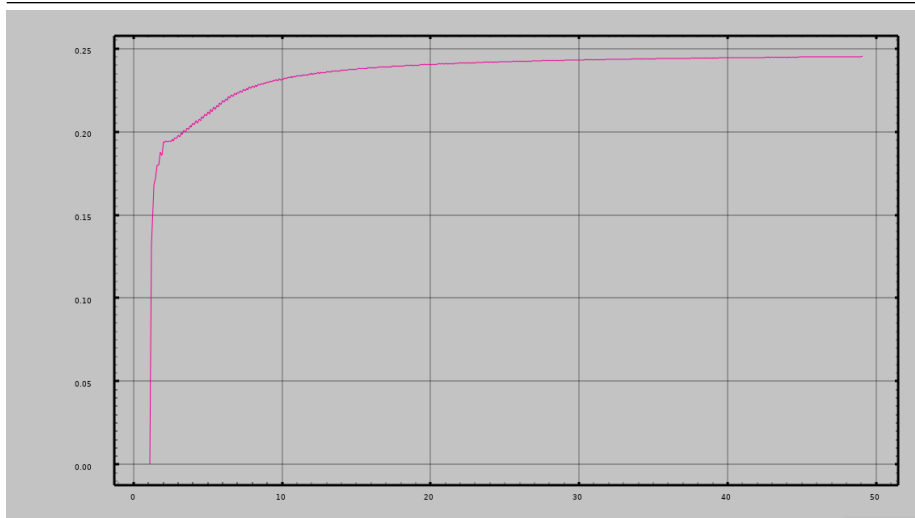
`$ns run`

Output

Nam Output



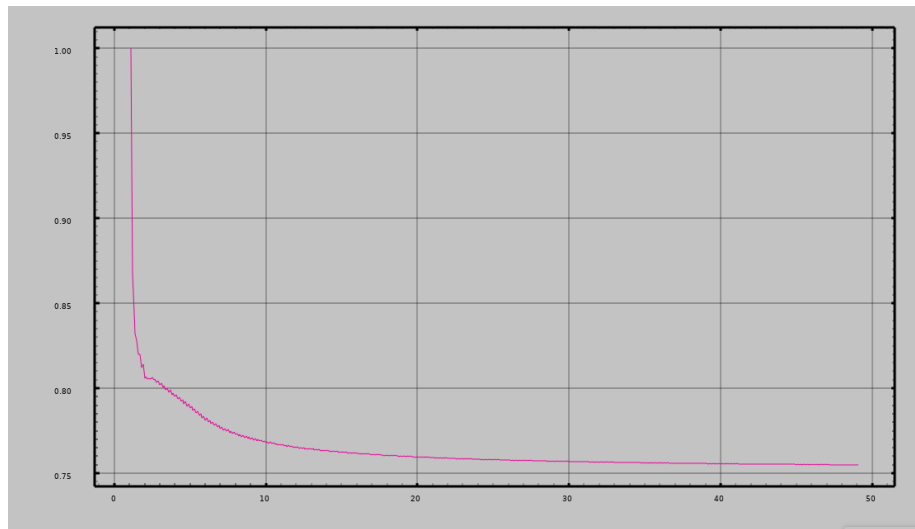
PDR Graph



PDR Graph

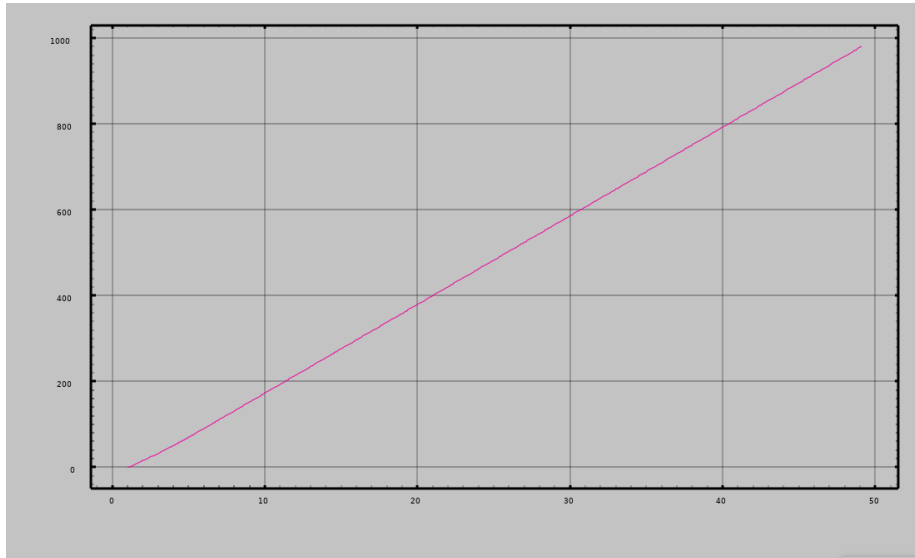
Time interval 0.1s

PLR Graph



Time interval 0.1s

End to End Delay Graph



Time interval 0.1s
