Create a network with a series of ‘n’ nodes connected one after another like a string. The nodes are spaced 150m apart from each other. The data communication between any two nodes is possible only by transfer of data between neighboring nodes and a single TCP connection is established between the source and the destination nodes for transfer of all packets in a specific communication. Each node has a buffer/queue which can hold a maximum of 50 packets and can aid in transmission of packets in first-in-first-out fashion. Simulate the following for 60 seconds:

1. communication by the first node to the last node, considering that the first node generates data at a rate of 4 packets/second with each packet having 1460 bytes for the following window sizes: 4, 8 and 32.

2. communication by a node to its neighboring node, considering that the former node generates data at a rate of 4 packets/second with each packet having 1460 bytes for the following window sizes: 4, 8 and 32.

3. keeping the window size as 8, simultaneous communications by the first node to ith node and jth node to the last node (if there are n nodes from 0 through n-1, 0 < i < j < n - 1).

4. keeping the window size as 8, simulate two communications, the first from node i to j and the second from node k to j - 1 (0 < k < j – 1 < i < n) in the following two scenarios: a. both communications start at the same time. b. the second communication start 10 seconds after the first.

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

$ns color 3 Green

$ns color 4 Purple

#Open the NAM trace file

set nf [open out2.nam w]

$ns namtrace-all $nf

#Define a 'finish' procedure

proc finish {} {

global ns nf

$ns flush-trace

#Close the NAM trace file

close $nf

#Execute NAM on the trace file

exec nam out2.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]

$ns duplex-link $n0 $n1 2Mb 10ms DropTail

$ns duplex-link $n1 $n2 2Mb 10ms DropTail

$ns duplex-link $n2 $n3 2Mb 10ms DropTail

$ns duplex-link $n3 $n4 2Mb 10ms DropTail

$ns queue-limit $n0 $n1 50

$ns queue-limit $n1 $n2 50

$ns queue-limit $n2 $n3 50

$ns queue-limit $n3 $n4 50

$ns duplex-link-op $n0 $n1 orient center

$ns duplex-link-op $n1 $n2 orient center-left

$ns duplex-link-op $n2 $n3 orient center-left

$ns duplex-link-op $n3 $n4 orient center-left

$ns duplex-link-op $n0 $n1 queuePos 0.5

$ns duplex-link-op $n1 $n2 queuePos 0.5

$ns duplex-link-op $n2 $n3 queuePos 0.5

$ns duplex-link-op $n3 $n4 queuePos 0.5

set tcp [new Agent/TCP]

$tcp set class\_ 2

$ns attach-agent $n0 $tcp

set sink [new Agent/TCPSink]

$ns attach-agent $n4 $sink

$ns connect $tcp $sink

set data\_source [new Application/Traffic/Exponential]

$data\_source set packet\_size\_ 1460

$data\_source set burst\_time\_ 0.125

$data\_source set idle\_time\_ 0.125

$data\_source attach-agent $tcp

$data\_source set rate\_ 1mb

set window\_sizes {4 8 32}

$tcp set window\_ 4

$ns at 0.1 "$data\_source start"

$ns at 10.0 "$data\_source stop"

$tcp set window\_ 8

$ns at 11.0 "$data\_source start"

$ns at 25.0 "$data\_source stop"

$tcp set window\_ 32

$ns at 26.0 "$data\_source start"

$ns at 40.0 "$data\_source stop"

$ns at 60.0 "finish"

#Run the simulation

$ns run

1. **Code:**

#Create a simulator object

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global ns nf

$ns flush-trace

#Close the NAM trace file

close $nf

#Execute NAM on the trace file

exec nam out2.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]

$ns duplex-link $n0 $n1 2Mb 10ms DropTail

$ns duplex-link $n1 $n2 2Mb 10ms DropTail

$ns duplex-link $n2 $n3 2Mb 10ms DropTail

$ns duplex-link $n3 $n4 2Mb 10ms DropTail

$ns queue-limit $n0 $n1 50

$ns queue-limit $n1 $n2 50

$ns queue-limit $n2 $n3 50

$ns queue-limit $n3 $n4 50

$ns duplex-link-op $n0 $n1 orient center

$ns duplex-link-op $n1 $n2 orient center-left

$ns duplex-link-op $n2 $n3 orient center-left

$ns duplex-link-op $n3 $n4 orient center-left

$ns duplex-link-op $n0 $n1 queuePos 0.5

$ns duplex-link-op $n1 $n2 queuePos 0.5

$ns duplex-link-op $n2 $n3 queuePos 0.5

$ns duplex-link-op $n3 $n4 queuePos 0.5

set tcp [new Agent/TCP]

$tcp set class\_ 2

$ns attach-agent $n0 $tcp

set sink [new Agent/TCPSink]

$ns attach-agent $n1 $sink

$ns connect $tcp $sink

set data\_source [new Application/Traffic/Exponential]

$data\_source set packet\_size\_ 1460

$data\_source set burst\_time\_ 0.125

$data\_source set idle\_time\_ 0.125

$data\_source attach-agent $tcp

$data\_source set rate\_ 1mb

set tcp1 [new Agent/TCP]

$tcp1 set class\_ 1

$ns attach-agent $n1 $tcp1

set sink1 [new Agent/TCPSink]

$ns attach-agent $n2 $sink1

$ns connect $tcp1 $sink1

set data\_source1 [new Application/Traffic/Exponential]

$data\_source1 set packet\_size\_ 1460

$data\_source1 set burst\_time\_ 0.125

$data\_source1 set idle\_time\_ 0.125

$data\_source1 attach-agent $tcp1

$data\_source1 set rate\_ 1mb

set tcp2 [new Agent/TCP]

$tcp2 set class\_ 3

$ns attach-agent $n2 $tcp2

set sink2 [new Agent/TCPSink]

$ns attach-agent $n3 $sink2

$ns connect $tcp2 $sink2

set data\_source2 [new Application/Traffic/Exponential]

$data\_source2 set packet\_size\_ 1460

$data\_source2 set burst\_time\_ 0.125

$data\_source2 set idle\_time\_ 0.125

$data\_source2 attach-agent $tcp2

$data\_source2 set rate\_ 1mb

set tcp3 [new Agent/TCP]

$tcp3 set class\_ 4

$ns attach-agent $n3 $tcp3

set sink3 [new Agent/TCPSink]

$ns attach-agent $n4 $sink3

$ns connect $tcp3 $sink3

set data\_source3 [new Application/Traffic/Exponential]

$data\_source3 set packet\_size\_ 1460

$data\_source3 set burst\_time\_ 0.125

$data\_source3 set idle\_time\_ 0.125

$data\_source3 attach-agent $tcp3

$data\_source3 set rate\_ 1mb

set window\_sizes {4 8 32}

$tcp set window\_ 4

$ns at 0.1 "$data\_source start"

$ns at 10.0 "$data\_source stop"

$tcp1 set window\_ 8

$ns at 1.0 "$data\_source1 start"

$ns at 45.0 "$data\_source1 stop"

$tcp2 set window\_ 8

$ns at 2.1 "$data\_source3 start"

$ns at 39.0 "$data\_source3 stop"

$tcp3 set window\_ 32

$ns at 2.0 "$data\_source2 start"

$ns at 40.0 "$data\_source2 stop"

$ns at 60.0 "finish"

#Run the simulation

$ns run

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

$ns color 3 Green

$ns color 4 Purple

#Open the NAM trace file

set nf [open out2.nam w]

$ns namtrace-all $nf

#Define a 'finish' procedure

proc finish {} {

global ns nf

$ns flush-trace

#Close the NAM trace file

close $nf

#Execute NAM on the trace file

exec nam out2.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]

$ns duplex-link $n0 $n1 2Mb 10ms DropTail

$ns duplex-link $n1 $n2 2Mb 10ms DropTail

$ns duplex-link $n2 $n3 2Mb 10ms DropTail

$ns duplex-link $n3 $n4 2Mb 10ms DropTail

$ns queue-limit $n0 $n1 50

$ns queue-limit $n1 $n2 50

$ns queue-limit $n2 $n3 50

$ns queue-limit $n3 $n4 50

$ns duplex-link-op $n0 $n1 orient center

$ns duplex-link-op $n1 $n2 orient center-left

$ns duplex-link-op $n2 $n3 orient center-left

$ns duplex-link-op $n3 $n4 orient center-left

$ns duplex-link-op $n0 $n1 queuePos 0.5

$ns duplex-link-op $n1 $n2 queuePos 0.5

$ns duplex-link-op $n2 $n3 queuePos 0.5

$ns duplex-link-op $n3 $n4 queuePos 0.5

set tcp [new Agent/TCP]

$tcp set class\_ 2

$ns attach-agent $n0 $tcp

set sink [new Agent/TCPSink]

$ns attach-agent $n1 $sink

$ns connect $tcp $sink

set data\_source [new Application/Traffic/Exponential]

$data\_source set packet\_size\_ 1460

$data\_source set burst\_time\_ 0.125

$data\_source set idle\_time\_ 0.125

$data\_source attach-agent $tcp

$data\_source set rate\_ 1mb

set tcp3 [new Agent/TCP]

$tcp3 set class\_ 4

$ns attach-agent $n3 $tcp3

set sink3 [new Agent/TCPSink]

$ns attach-agent $n4 $sink3

$ns connect $tcp3 $sink3

set data\_source3 [new Application/Traffic/Exponential]

$data\_source3 set packet\_size\_ 1460

$data\_source3 set burst\_time\_ 0.125

$data\_source3 set idle\_time\_ 0.125

$data\_source3 attach-agent $tcp3

$data\_source3 set rate\_ 1mb

set window\_sizes {4 8 32}

$tcp set window\_ 8

$ns at 0.1 "$data\_source start"

$ns at 10.0 "$data\_source stop"

$tcp3 set window\_ 8

$ns at 2.1 "$data\_source3 start"

$ns at 39.0 "$data\_source3 stop"

$ns at 60.0 "finish"

#Run the simulation

$ns run

**4a) 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

$ns color 3 Green

$ns color 4 Purple

#Open the NAM trace file

set nf [open out2.nam w]

$ns namtrace-all $nf

#Define a 'finish' procedure

proc finish {} {

global ns nf

$ns flush-trace

#Close the NAM trace file

close $nf

#Execute NAM on the trace file

exec nam out2.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]

$ns duplex-link $n0 $n1 2Mb 10ms DropTail

$ns duplex-link $n1 $n2 2Mb 10ms DropTail

$ns duplex-link $n2 $n3 2Mb 10ms DropTail

$ns duplex-link $n3 $n4 2Mb 10ms DropTail

$ns queue-limit $n0 $n1 50

$ns queue-limit $n1 $n2 50

$ns queue-limit $n2 $n3 50

$ns queue-limit $n3 $n4 50

$ns duplex-link-op $n0 $n1 orient center

$ns duplex-link-op $n1 $n2 orient center-left

$ns duplex-link-op $n2 $n3 orient center-left

$ns duplex-link-op $n3 $n4 orient center-left

$ns duplex-link-op $n0 $n1 queuePos 0.5

$ns duplex-link-op $n1 $n2 queuePos 0.5

$ns duplex-link-op $n2 $n3 queuePos 0.5

$ns duplex-link-op $n3 $n4 queuePos 0.5

set tcp [new Agent/TCP]

$tcp set class\_ 2

$ns attach-agent $n3 $tcp

set sink [new Agent/TCPSink]

$ns attach-agent $n2 $sink

$ns connect $tcp $sink

set data\_source [new Application/Traffic/Exponential]

$data\_source set packet\_size\_ 1460

$data\_source set burst\_time\_ 0.125

$data\_source set idle\_time\_ 0.125

$data\_source attach-agent $tcp

$data\_source set rate\_ 1mb

set tcp3 [new Agent/TCP]

$tcp3 set class\_ 4

$ns attach-agent $n1 $tcp3

set sink3 [new Agent/TCPSink]

$ns attach-agent $n2 $sink3

$ns connect $tcp3 $sink3

set data\_source3 [new Application/Traffic/Exponential]

$data\_source3 set packet\_size\_ 1460

$data\_source3 set burst\_time\_ 0.125

$data\_source3 set idle\_time\_ 0.125

$data\_source3 attach-agent $tcp3

$data\_source3 set rate\_ 1mb

set window\_sizes {4 8 32}

$tcp set window\_ 8

$ns at 0.1 "$data\_source start"

$ns at 39.0 "$data\_source stop"

$tcp3 set window\_ 8

$ns at 0.1 "$data\_source3 start"

$ns at 39.0 "$data\_source3 stop"

$ns at 60.0 "finish"

#Run the simulation

$ns run

**4b) 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

$ns color 3 Green

$ns color 4 Purple

#Open the NAM trace file

set nf [open out2.nam w]

$ns namtrace-all $nf

#Define a 'finish' procedure

proc finish {} {

global ns nf

$ns flush-trace

#Close the NAM trace file

close $nf

#Execute NAM on the trace file

exec nam out2.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]

$ns duplex-link $n0 $n1 2Mb 10ms DropTail

$ns duplex-link $n1 $n2 2Mb 10ms DropTail

$ns duplex-link $n2 $n3 2Mb 10ms DropTail

$ns duplex-link $n3 $n4 2Mb 10ms DropTail

$ns queue-limit $n0 $n1 50

$ns queue-limit $n1 $n2 50

$ns queue-limit $n2 $n3 50

$ns queue-limit $n3 $n4 50

$ns duplex-link-op $n0 $n1 orient center

$ns duplex-link-op $n1 $n2 orient center-left

$ns duplex-link-op $n2 $n3 orient center-left

$ns duplex-link-op $n3 $n4 orient center-left

$ns duplex-link-op $n0 $n1 queuePos 0.5

$ns duplex-link-op $n1 $n2 queuePos 0.5

$ns duplex-link-op $n2 $n3 queuePos 0.5

$ns duplex-link-op $n3 $n4 queuePos 0.5

set tcp [new Agent/TCP]

$tcp set class\_ 2

$ns attach-agent $n3 $tcp

set sink [new Agent/TCPSink]

$ns attach-agent $n2 $sink

$ns connect $tcp $sink

set data\_source [new Application/Traffic/Exponential]

$data\_source set packet\_size\_ 1460

$data\_source set burst\_time\_ 0.125

$data\_source set idle\_time\_ 0.125

$data\_source attach-agent $tcp

$data\_source set rate\_ 1mb

set tcp3 [new Agent/TCP]

$tcp3 set class\_ 4

$ns attach-agent $n1 $tcp3

set sink3 [new Agent/TCPSink]

$ns attach-agent $n2 $sink3

$ns connect $tcp3 $sink3

set data\_source3 [new Application/Traffic/Exponential]

$data\_source3 set packet\_size\_ 1460

$data\_source3 set burst\_time\_ 0.125

$data\_source3 set idle\_time\_ 0.125

$data\_source3 attach-agent $tcp3

$data\_source3 set rate\_ 1mb

set window\_sizes {4 8 32}

$tcp set window\_ 8

$ns at 0.1 "$data\_source start"

$ns at 39.0 "$data\_source stop"

$tcp3 set window\_ 8

$ns at 10.1 "$data\_source3 start"

$ns at 39.0 "$data\_source3 stop"

$ns at 60.0 "finish"

#Run the simulation

$ns run