ASSIGNMENTS 2020-21
Course: B.Sc. (H)
CBCS in Computer Science
Year: Semester III
PAPER: CMSACOR07P (Computer Networks Lab)

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1. Write an NS2 script to create scenario and study the performance of token bus protocol through simulation.

Aim: To create and study the performance of the token bus protocol.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

Token bus is a LAN protocol operating in the MAC layer. Token bus is standardized as per IEEE 802.4. Token bus can operate at speeds of 5Mbps, 10 Mbps and 20 Mbps. The operation of token bus is as follows: Unlike token ring in token bus the ring topology is virtually created and maintained by the protocol. A node can receive data even if it is not part of the virtual ring, a node joins the virtual ring only if it has data to transmit. In token bus data is transmitted to the destination node only where as other control frames is hop to hop. After each data transmission there is a solicit_successsor control frame transmitted which reduces the performance of the protocol.

Algorithm :

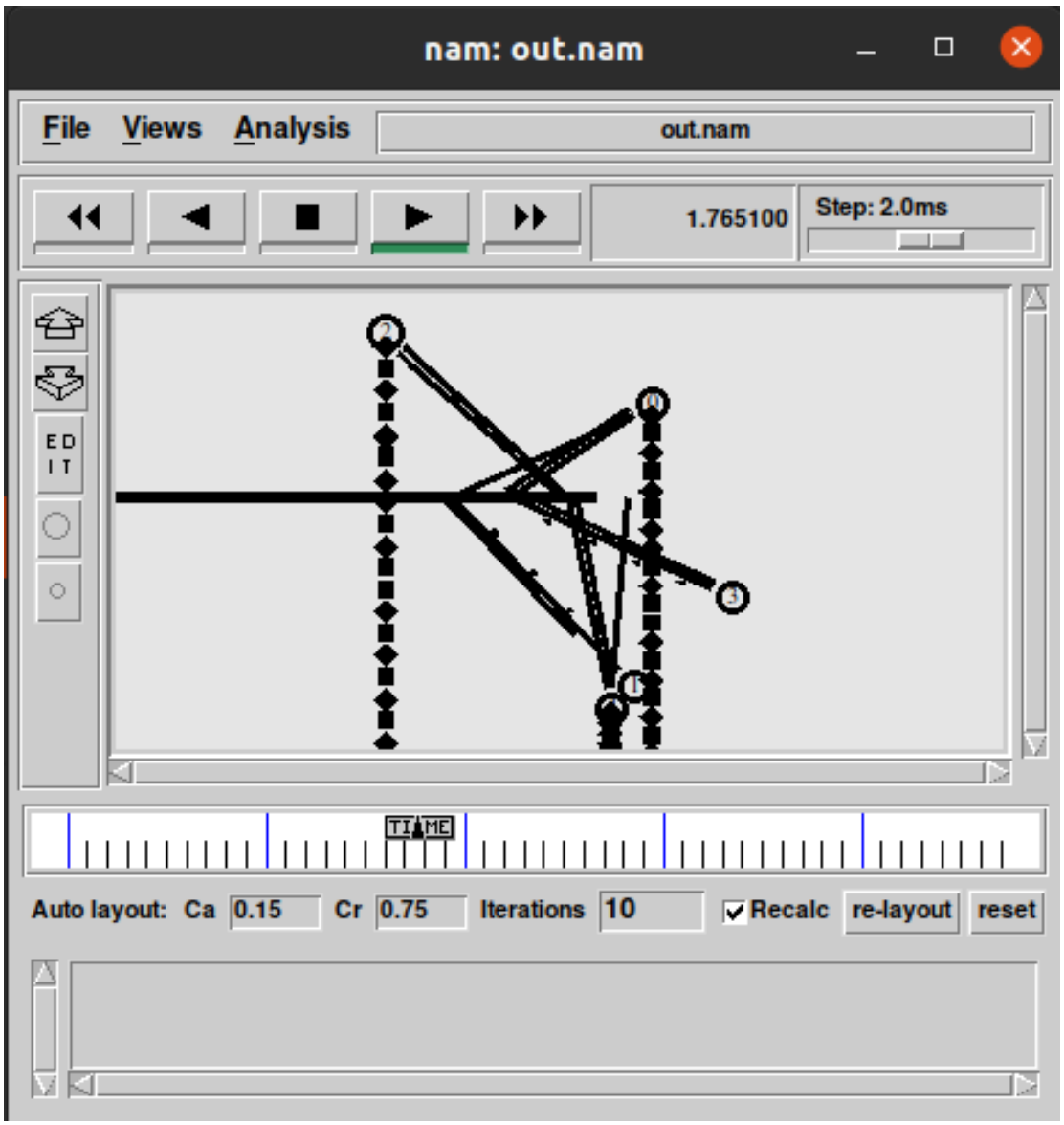
1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create five nodes that forms a network numbered from 0 to 4
5. Create duplex links between the nodes and add Orientation to the nodes for setting a LAN topology
6. Setup TCP Connection between n(1) and n(3)
7. Apply CBR Traffic over TCP. 8. Schedule events and run the program.

Program:

```
#Create a simulator object
set ns [new Simulator]
#Open the nam trace file
set nf [open out.nam w]
$ns namtrace-all $nf
#Define a 'finish' procedure
```

```
proc finish {} {
global ns nf
$ns flush-trace
#Close the trace file
close $nf
#Executenam on the trace file
exec nam out.nam &
exit 0
}
#Create five nodes
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
#CreatLea n between the nodes
set lan0 [$ns newLan "$n0 $n1 $n2 $n3 $n4" 0.5Mb 40ms LL Queue/DropTail MAC/Csma/Cd
Channel]
#Create a TCP agent and attach it to node n0
set tcp0 [new Agent/TCP]
$tcp0 set class_ 1
$ns attach-agent $n1 $tcp0
#Create a TCP Sink agent (a traffic sink) for TCP and attach it to node n3
set sink0 [new Agent/TCPSink]
$ns attach-agent $n3 $sink0
#Connect the traffic sources with the traffic sink
$ns connect $tcp0 $sink0
# Create a CBR traffic source and attach it to tcp0
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.01
$cbr0 attach-agent $tcp0
#Schedule events for the CBR agents
$ns at 0.5 "$cbr0 start"
$ns at 4.5 "$cbr0 stop"
#Call the finish procedure after 5 seconds of simulation time
$ns at 5.0 "finish"
#Run the simulation
$ns run
```

Output:



Discussion:

Token bus is a network implementing a Token Ring protocol over a virtual ring on a coaxial cable. A token is passed around the network nodes and only the node possessing the token may transmit. If a node doesn't have anything to send, the token is passed on to the next node on the virtual ring. Each node must know the address of its neighbour in the ring, so a special protocol is needed to notify the other nodes of connections to, and disconnections from, the ring.\

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2. Write an NS2 script to create scenario and study the performance of token ring protocols through simulation.

Aim: To create scenario and study the performance of token ring protocols through simulation.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory :

Token ring is a LAN protocol operating in the MAC layer. Token ring is standardized as per IEEE 802.5. Token ring can operate at speeds of 4mbps and 16 mbps. The operation of token ring is as follows: When there is no traffic on the network a simple 3-byte token circulates the ring. If the token is free (no reserved by a station of higher priority as explained later) then the station may seize the token and start sending the data frame. As the frame travels around the ring ach station examines the destination address and is either forwarded (if the recipient is another node) or copied. After copying4 bits of the last byte is changed. This packet then continues around the ring till it reaches the originating station. After the frame makes a round trip the sender receives the frame and releases a new token onto the ring.

Algorithm :

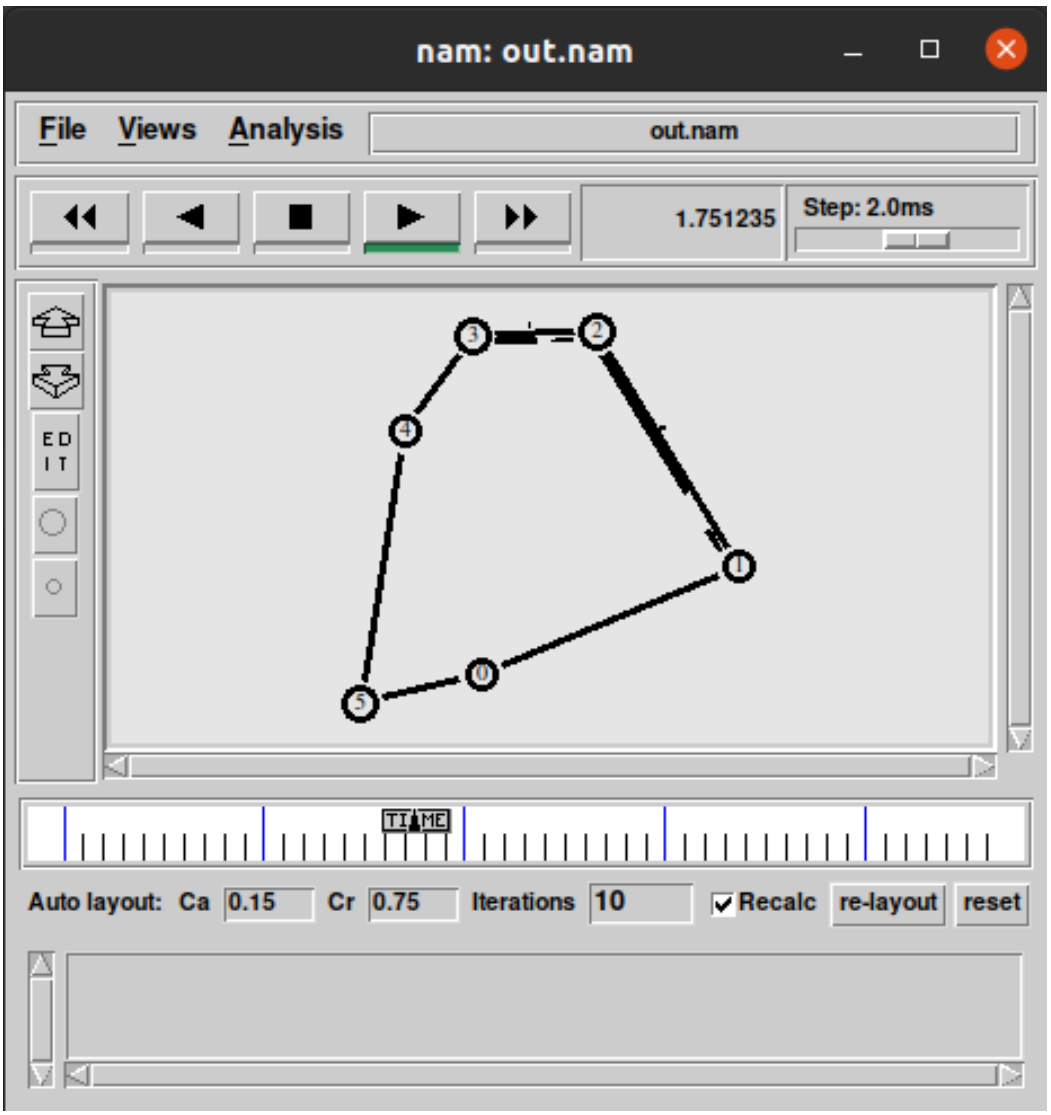
1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create five nodes that forms a network numbered from 0 to 4
5. Create duplex links between the nodes to form a Ring Topology.
6. Setup TCP Connection between n(1) and n(3)
7. Apply CBR Traffic over TCP
8. Schedule events and run the program.

Program:

```
#Create a simulator object
set ns [new Simulator]
#Open the nam trace file
set nf [open out.nam w]
$ns namtrace-all $nf
#Define a 'finish' procedure
proc finish {} {
global ns nf
$ns flush-trace
#Close the trace file
close $nf
#Executenam on the trace file
exec nam out.nam &
exit0
}
#Create five nodes
set n0 [$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 $n1 1Mb 10ms DropTail
$ns duplex-link $n1 $n2 1Mb 10ms DropTail
$ns duplex-link $n2 $n3 1Mb 10ms DropTail
$ns duplex-link $n3 $n4 1Mb 10ms DropTail
```

```
$ns duplex-link $n4 $n5 1Mb 10ms DropTail
$ns duplex-link $n5 $n0 1Mb 10ms DropTail
#Create a TCP agent and attach it to node n0
set tcp0 [new Agent/TCP]
$tcp0 set class_ 1
$ns attach-agent $n1 $tcp0
#Create a TCP Sink agent (a traffic sink) for TCP and attach it to node n3
set sink0 [new Agent/TCPSink]
$ns attach-agent $n3 $sink0
#Connect the traffic sources with the traffic sink
$ns connect $tcp0 $sink0
# Create a CBR traffic source and attach it to tcp0
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.01
$cbr0 attach-agent $tcp0
#Schedule events for the CBR agents
$ns at 0.5 "$cbr0 start"
$ns at 4.5 "$cbr0 stop"
#Call the finish procedure after 5 seconds of simulation time
$ns at 5.0 "finish"
#Run the simulation
$ns run
```

Output:



Discussion:

Token Ring is a computer networking technology used to build local area networks. It was introduced by IBM in 1984, and standardized in 1989 as IEEE 802.5.

It uses a special three-byte frame called a token that travels around a logical ring of workstations or servers. This token passing is a channel access method providing fair access for all stations, and eliminating the collisions of contention-based access methods.

Token Ring was a successful technology, particularly in corporate environments, but was gradually eclipsed by the later versions of Ethernet.

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3. Write an NS2 script to create scenario and study the performance of token ring protocols through simulation.

Aim: To create scenario and study the performance of token ring protocols through simulation.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory :

Token ring is a LAN protocol operating in the MAC layer. Token ring is standardized as per IEEE 802.5. Token ring can operate at speeds of 4mbps and 16 mbps. The operation of token ring is as follows: When there is no traffic on the network a simple 3-byte token circulates the ring. If the token is free (no reserved by a station of higher priority as explained later) then the station may seize the token and start sending the data frame. As the frame travels around the ring ach station examines the destination address and is either forwarded (if the recipient is another node) or copied. After copying4 bits of the last byte is changed. This packet then continues around the ring till it reaches the originating station. After the frame makes a round trip the sender receives the frame and releases a new token onto the ring.

Algorithm :

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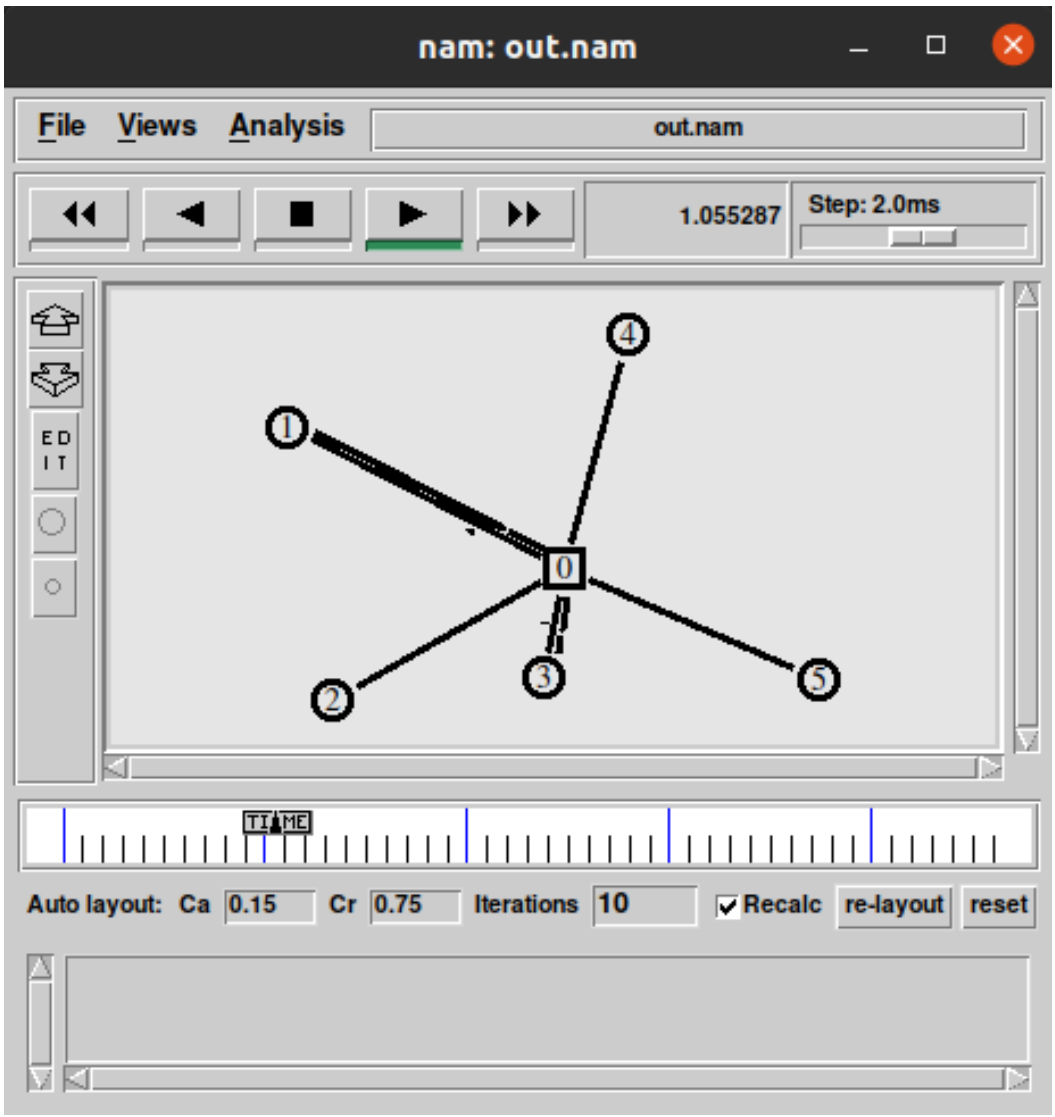
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create five nodes that forms a network numbered from 0 to 4
5. Create duplex links between the nodes to form a Ring Topology.
6. Setup TCP Connection between n(1) and n(3)
7. Apply CBR Traffic over TCP
8. Schedule events and run the program.

Program:

```
#Create a simulator object
set ns [new Simulator]
#Open the nam trace file
set nf [open out.nam w]
$ns namtrace-all $nf
#Define a 'finish' procedure
proc finish {} {
global ns nf
$ns flush-trace
#Close the trace file
close $nf
#Executenam on the trace file
exec nam out.nam &
exit0
}
#Create six nodes
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
#Change the shape of center node in a star topology
$n0 shape square
#Create links between the nodes
$ns duplex-link $n0 $n1 1Mb 10ms DropTail
```

```
$ns duplex-link $n0 $n2 1Mb 10ms DropTail
$ns duplex-link $n0 $n3 1Mb 10ms DropTail
$ns duplex-link $n0 $n4 1Mb 10ms DropTail
$ns duplex-link $n0 $n5 1Mb 10ms DropTail
#Create a TCP agent and attach it to node n0
set tcp0 [new Agent/TCP]
$tcp0 set class_ 1
$ns attach-agent $n1 $tcp0
#Create a TCP Sink agent (a traffic sink) for TCP and attach it to node n3
set sink0 [new Agent/TCPSink]
$ns attach-agent $n3 $sink0
#Connect the traffic sources with the traffic sink
$ns connect $tcp0 $sink0
# Create a CBR traffic source and attach it to tcp0
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.01
$cbr0 attach-agent $tcp0
#Schedule events for the CBR agents
$ns at 0.5 "$cbr0 start"
$ns at 4.5 "$cbr0 stop"
#Call the finish procedure after 5 seconds of simulation time
$ns at 5.0 "finish"
#Run the simulation
$ns run
```

Output:



Discussion:

Token Ring is a computer networking technology used to build local area networks. It was introduced by IBM in 1984, and standardized in 1989 as IEEE 802.5.

It uses a special three-byte frame called a token that travels around a logical ring of workstations or servers. This token passing is a channel access method providing fair access for all stations, and eliminating the collisions of contention-based access methods.

Token Ring was a successful technology, particularly in corporate environments, but was gradually eclipsed by the later versions of Ethernet.

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4. Write an NS2 script to simulate and study the Distance Vector routing algorithm using simulation.

Aim: To create and study the performance of the token bus protocol.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

Distance Vector Routing is one of the routing algorithm in a Wide Area Network for computing shortest path between source and destination. The Router is one main devices used in a wide area network. The main task of the router is Routing. It forms the routing table and delivers the packets depending upon the routes in the tableeither directly or via an intermediate devices. Each router initially has information about its all neighbors. Then this information will be shared among nodes.

Algorithm:

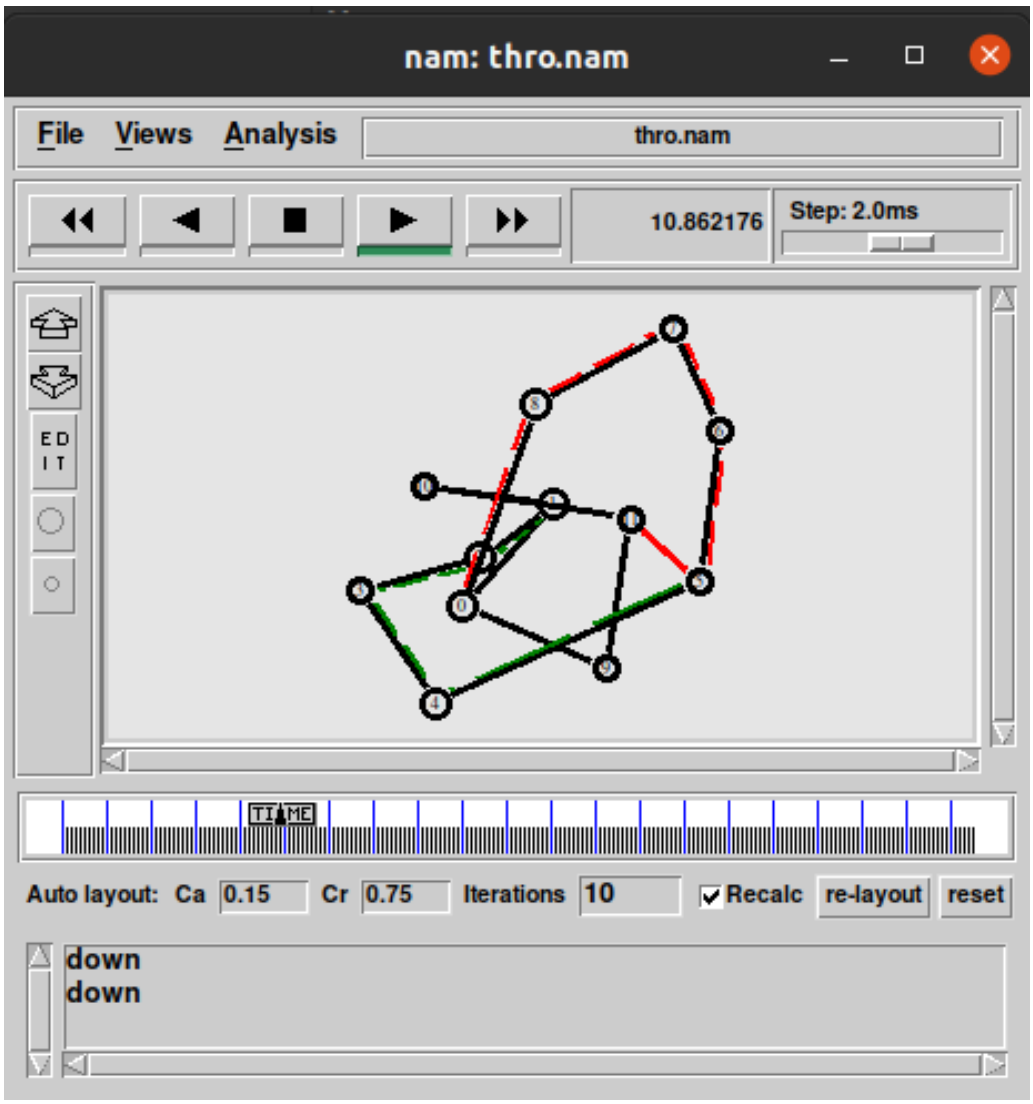
1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create n number of nodes using for loop
5. Create duplex links between the nodes
6. Setup UDP Connection between n(0) and n(5)
7. Setup another UDP connection between n(1) and n(5)
8. Apply CBR Traffic over both UDP connections
9. Choose distance vector routing protocol to transmit data from sender to receiver.
10. Schedule events and run the program.

Program:

```
set ns [new Simulator]
set nr [open thro.tr w]
$ns trace-all $nr
set nf [open thro.nam w]
$ns namtrace-all $nf
proc finish { } {
global ns nr nf
$ns flush-trace
close $nf
close $nr
exec nam thro.nam &
exit 0
}
for { set i 0 } { $i < 12} { incr i 1 } {
set n($i) [$ns node]}
for {set i 0} {$i < 8} {incr i} {
$ns duplex-link $n($i) $n([expr $i+1]) 1Mb 10ms DropTail }
$ns duplex-link $n(0) $n(8) 1Mb 10ms DropTail
$ns duplex-link $n(1) $n(10) 1Mb 10ms DropTail
$ns duplex-link $n(0) $n(9) 1Mb 10ms DropTail
$ns duplex-link $n(9) $n(11) 1Mb 10ms DropTail
$ns duplex-link $n(10) $n(11) 1Mb 10ms DropTail
$ns duplex-link $n(11) $n(5) 1Mb 10ms DropTail
set udp0 [new Agent/UDP]
$ns attach-agent $n(0) $udp0
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.005
$cbr0 attach-agent $udp0
```

```
set null0 [new Agent/Null]
$ns attach-agent $n(5) $null0
$ns connect $udp0 $null0
set udp1 [new Agent/UDP]
$ns attach-agent $n(1) $udp1
set cbr1 [new Application/Traffic/CBR]
$cbr1 set packetSize_ 500
$cbr1 set interval_ 0.005
$cbr1 attach-agent $udp1
set null0 [new Agent/Null]
$ns attach-agent $n(5) $null0
$ns connect $udp1 $null0
$ns rtproto DV
$ns rtmodel-at 10.0 down $n(11) $n(5)
$ns rtmodel-at 15.0 down $n(7) $n(6)
$ns rtmodel-at 30.0 up $n(11) $n(5)
$ns rtmodel-at 20.0 up $n(7) $n(6)
$udp0 set fid_ 1
$udp1 set fid_ 2
$ns color 1 Red
$ns color 2 Green
$ns at 1.0 "$cbr0 start"
$ns at 2.0 "$cbr1 start"
$ns at 45 "finish"
$ns run
```

Output:



Discussion:

A distance-vector routing protocol in data networks determines the best route for data packets based on distance. Distance-vector routing protocols measure the distance by the number of routers a packet has to pass, one router counts as one hop. Some distance-vector protocols also take into account network latency and other factors that influence traffic on a given route. To determine the best route across a network, routers, on which a distance-vector protocol is implemented, exchange information with one another, usually routing tables plus hop counts for destination networks and possibly other traffic information. Distance-vector routing protocols also require that a router informs its neighbours of network topology changes periodically.

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5. Write an NS2 script to simulate and study the Link State routing algorithm using simulation.

Aim: To simulate and study the Link State routing algorithm using simulation.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

In link state routing, each router shares its knowledge of its neighborhood with every other router in the
internet work. (i) Knowledge about Neighborhood: Instead of sending its entire routing table a router sends
info about its neighborhood only. (ii) To all Routers: each router sends this information to every other router
on the internet work not just to its neighbor .It does so by a process called flooding. (iii)Information sharing
when there is a change: Each router sends out information about the neighbors when there is change.

Algorithm:

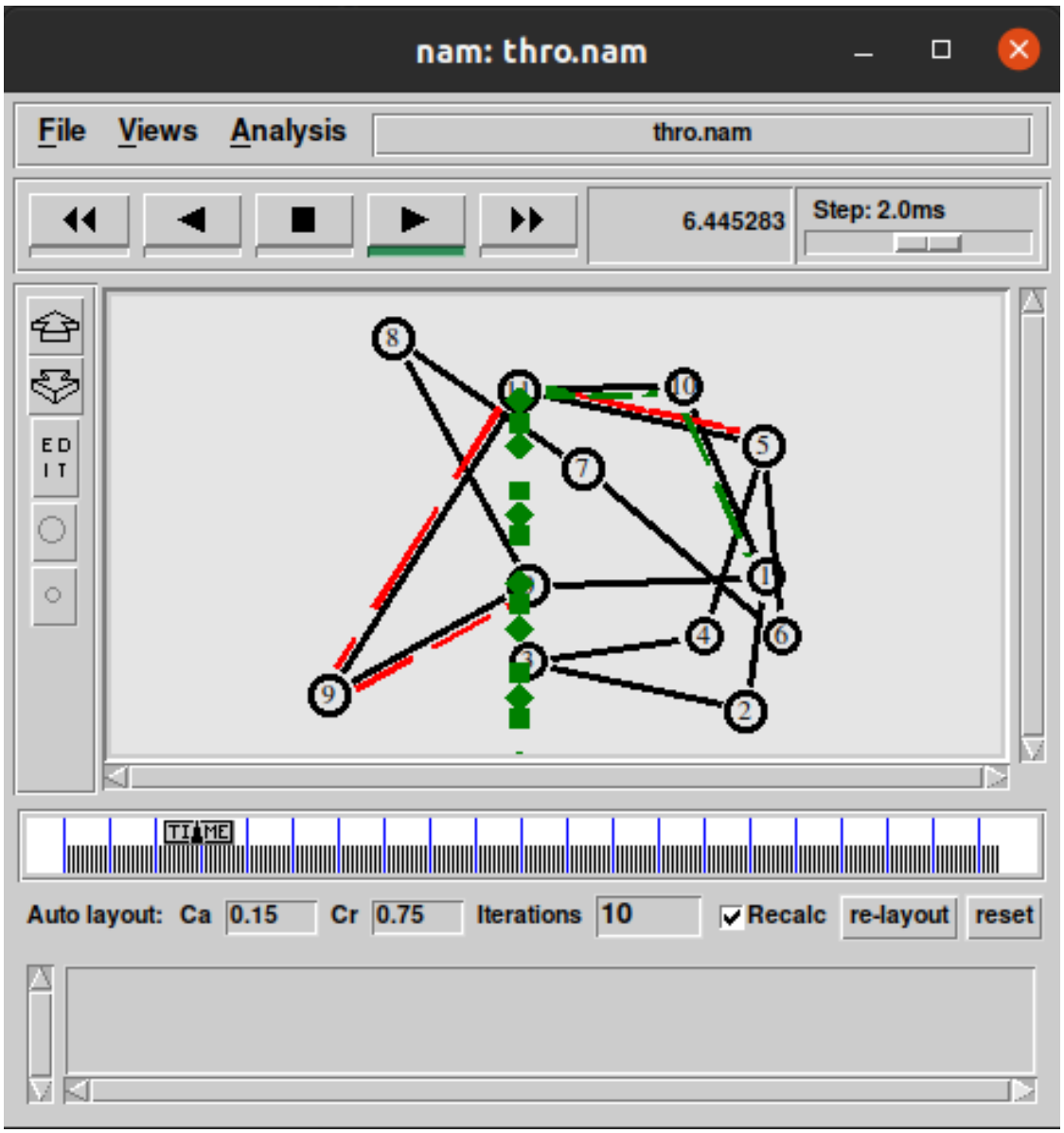
1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create n number of nodes using for loop
5. Create duplex links between the nodes
6. Setup UDP Connection between n(0) and n(5)
7. Setup another UDP connection between n(1) and n(5)
8. Apply CBR Traffic over both UDP connections
9. Choose Link state routing protocol to transmit data from sender to receiver.
10. Schedule events and run the program.

Program:

```
set ns [new Simulator]
set nr [open thro.tr w]
$ns trace-all $nr
set nf [open thro.nam w]
$ns namtrace-all $nf
proc finish { } {
global ns nr nf
$ns flush-trace
close $nf
close $nr
exec nam thro.nam &
exit 0
}
for { set i 0 } { $i < 12} { incr i 1 } {
set n($i) [$ns node]}
for {set i 0} {$i < 8} {incr i} {
$ns duplex-link $n($i) $n([expr $i+1]) 1Mb 10ms DropTail }
$ns duplex-link $n(0) $n(8) 1Mb 10ms DropTail
$ns duplex-link $n(1) $n(10) 1Mb 10ms DropTail
$ns duplex-link $n(0) $n(9) 1Mb 10ms DropTail
$ns duplex-link $n(9) $n(11) 1Mb 10ms DropTail
$ns duplex-link $n(10) $n(11) 1Mb 10ms DropTail
$ns duplex-link $n(11) $n(5) 1Mb 10ms DropTail
set udp0 [new Agent/UDP]
$ns attach-agent $n(0) $udp0
```

```
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.005
$cbr0 attach-agent $udp0
set null0 [new Agent/Null]
$ns attach-agent $n(5) $null0
$ns connect $udp0 $null0
set udp1 [new Agent/UDP]
$ns attach-agent $n(1) $udp1
set cbr1 [new Application/Traffic/CBR]
$cbr1 set packetSize_ 500
$cbr1 set interval_ 0.005
$cbr1 attach-agent $udp1
set null0 [new Agent/Null]
$ns attach-agent $n(5) $null0
$ns connect $udp1 $null0
$ns rtproto LS
$ns rtmodel-at 10.0 down $n(11) $n(5)
$ns rtmodel-at 15.0 down $n(7) $n(6)
$ns rtmodel-at 30.0 up $n(11) $n(5)
$ns rtmodel-at 20.0 up $n(7) $n(6)
$udp0 set fid_ 1
$udp1 set fid_ 2
$ns color 1 Red
$ns color 2 Green
$ns at 1.0 "$cbr0 start"
$ns at 2.0 "$cbr1 start"
$ns at 45 "finish"
$ns run
```

Output:



Discussion:

Link state routing is a technique in which each router shares the knowledge of its neighborhood with every other router in the internetwork.

The three keys to understand the Link State Routing algorithm:

Knowledge about the neighborhood: Instead of sending its routing table, a router sends the information about its neighborhood only. A router broadcast its identities and cost of the directly attached links to other routers.
Flooding: Each router sends the information to every other router on the internetwork except its neighbors. This process is known as Flooding. Every router that receives the packet sends the copies to all its neighbors. Finally, each and every router receives a copy of the same information.
Information sharing: A router sends the information to every other router only when the change occurs in the information.

6. Write an NS2 script to create scenario and study the performance of CSMA / CD protocol through simulation.

Aim: To create scenario and study the performance of CSMA / CD protocol through simulation.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

Ethernet is a LAN (Local area Network) protocol operating at the MAC (Medium Access Control) layer. Ethernet has been standardized as per IEEE 802.3. The underlying protocol in Ethernet is known as the CSMA / CD – Carrier Sense Multiple Access / Collision Detection. The working of the Ethernet protocol is as explained below, A node which has data to transmit senses the channel. If the channel is idle then, the data is transmitted. If the channel is busy then, the station defers transmission until the channel is sensed to be idle and then immediately transmitted. If more than one node starts data transmission at the same time, the data collides. This collision is heard by the transmitting nodes which enter into contention phase. The contending nodes resolve contention using an algorithm called Truncated binary exponential back off.

Algorithm:

1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create six nodes that forms a network numbered from 0 to 5
5. Create duplex links between the nodes and add Orientation to the nodes for setting a LAN topology
6. Setup TCP Connection between n(0) and n(4)
7. Apply FTP Traffic over TCP
8. Setup UDP Connection between n(1) and n(5)
9. Apply CBR Traffic over UDP.
10. Apply CSMA/CA and CSMA/CD mechanisms and study their performance
11. Schedule events and run the program.

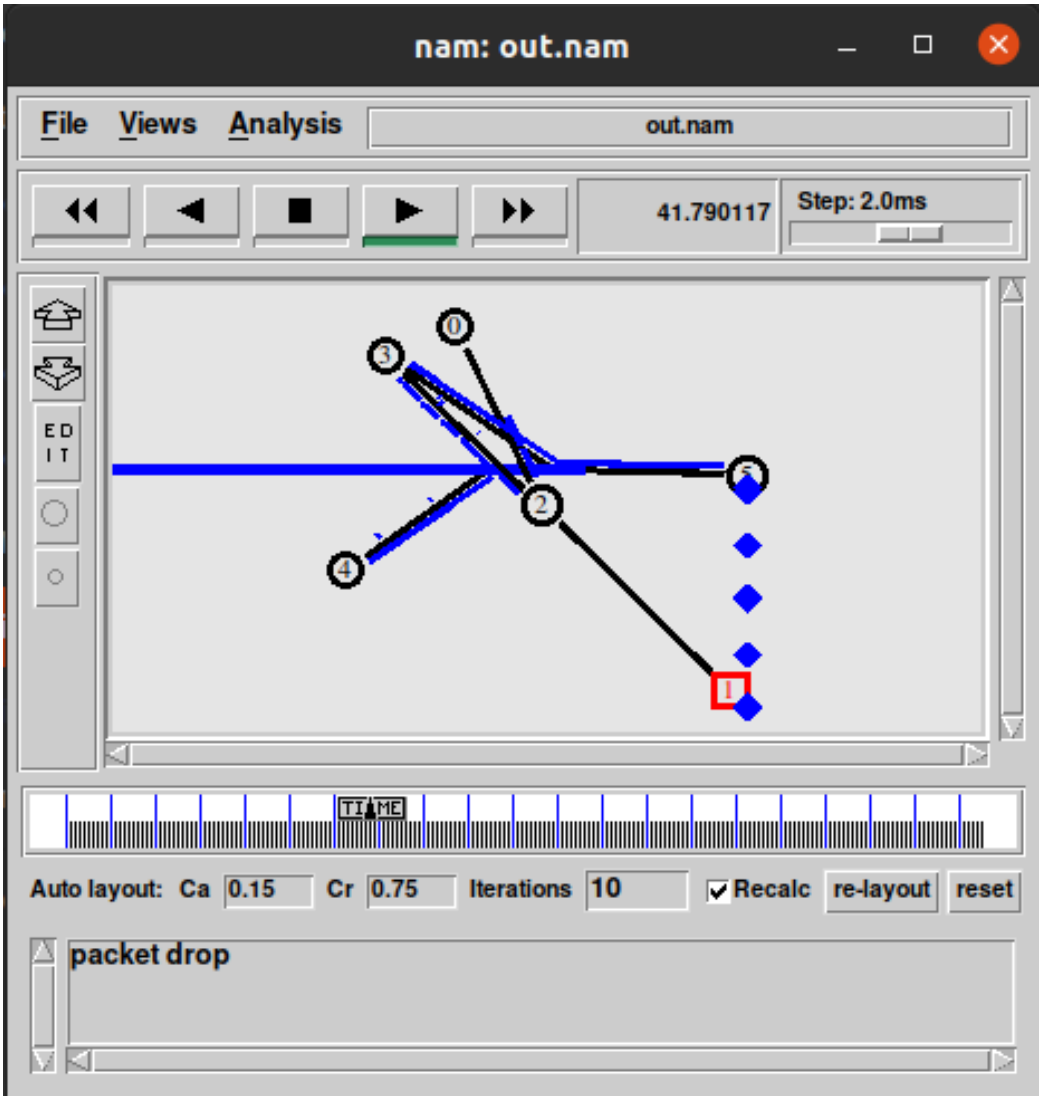
Program:

```
set ns [new Simulator]
#Define different colors for data flows (for NAM)
$ns color 1 Blue
$ns color 2 Red
#Open the Trace files
set file1 [open out.tr w]
set winfile [open WinFile w]
$ns trace-all $file1
#Open the NAM trace file
set file2 [open out.nam w]
$ns namtrace-all $file2
#Define a 'finish' procedure
proc finish {} {
global ns file1 file2
$ns flush-trace
```

```
close $file1
close $file2
exec nam out.nam &
exit 0
}
#Create six nodes
set n0 [$ns node]
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
$n1 color red
$n1 shape box
#Create links between the nodes
$ns duplex-link $n0 $n2 2Mb 10ms DropTail
$ns duplex-link $n1 $n2 2Mb 10ms DropTail
$ns simplex-link $n2 $n3 0.3Mb 100ms DropTail
$ns simplex-link $n3 $n2 0.3Mb 100ms DropTail
set lan [$ns newLan "$n3 $n4 $n5" 0.5Mb 40ms LL Queue/DropTail MAC/Csma/Ca Channel]
#Setup a TCP connection
set tcp [new Agent/TCP/Newreno]
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink/DelAck]
$ns attach-agent $n4 $sink
$ns connect $tcp $sink
$tcp set fid_ 1
$tcp set window_ 8000
$tcp set packetSize_ 552
#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 $n5 $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_ 0.01mb
$cbr set random_ false
$ns at 0.1 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 124.0 "$ftp stop"
$ns at 124.5 "$cbr stop"
# next procedure gets two arguments: the name of the
```

```
# tcp source node, will be called here "tcp",
# and the name of output file.
proc plotWindow {tcpSource file} {
global ns
set time 0.1
set now [$ns now]
set cwnd [$tcpSource set cwnd_]
set wnd [$tcpSource set window_]
puts $file "$now $cwnd"
$ns at [expr $now+$time] "plotWindow $tcpSource $file" }
$ns at 0.1 "plotWindow $tcp $winfile"
$ns at 5 "$ns trace-annotate \"packet drop\""
# PPP
$ns at 125.0 "finish"
$ns run
```

Output:



Discussion:

Carrier-sense multiple access with collision avoidance (CSMA/CA) in computer networking, is a network multiple access method in which carrier sensing is used, but nodes attempt to avoid collisions by beginning transmission only after the channel is sensed to be "idle". When they do transmit, nodes transmit their packet data in its entirety.

It is particularly important for wireless networks, where the collision detection of the alternative CSMA/CD is not possible due to wireless transmitters desensing their receivers during packet transmission.

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7. Write an NS2 script to simulate and to study of Go Back N protocol.

Aim: To simulate and to study of Go Back N protocol.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

Go Back N is a connection oriented transmission. The sender transmits the frames continuously. Each frame in the buffer has a sequence number starting from 1 and increasing up to the window size. The sender has a window i.e. a buffer to store the frames. This buffer size is the number of frames to be transmitted continuously. The size of the window depends on the protocol designer.

Algorithm:

1. The source node transmits the frames continuously.
2. Each frame in the buffer has a sequence number starting from 1 and increasing up to the window size.
3. The source node has a window i.e. a buffer to store the frames. This buffer size is the number of frames to be transmitted continuously.
4. The size of the window depends on the protocol designer.
5. For the first frame, the receiving node forms a positive acknowledgement if the frame is received without error.
6. If subsequent frames are received without error (up to window size) cumulative positive acknowledgement is formed.
7. If the subsequent frame is received with error, the cumulative acknowledgment error-free frames are transmitted. If in the same window two frames or more frames are received with error, the second and the subsequent error frames are neglected. Similarly even the frames received without error after the receipt of a frame with error are neglected.
8. The source node retransmits all frames of window from the first error frame.
9. If the frames are errorless in the next transmission and if the acknowledgment is error free, the window slides by the number of error-free frames being transmitted.
10.If the acknowledgment is transmitted with error, all the frames of window at source are retransmitted, and window doesn’t slide.
11.This concept of repeating the transmission from the first error frame in the window is called as GOBACKN transmission flow control protocol

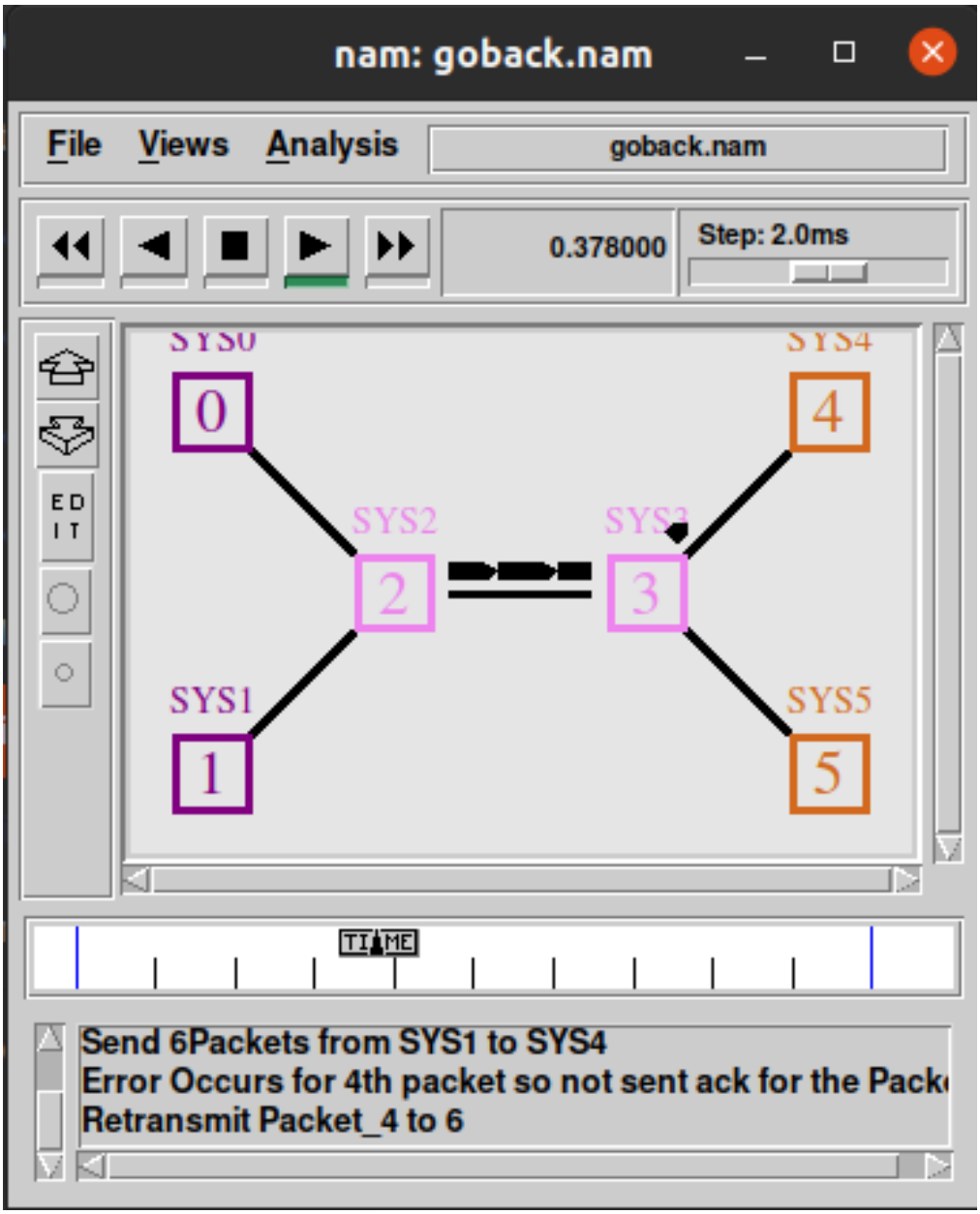
Program:

```
#send packets one by one
set ns [new Simulator]
set n0 [$ns node]
```

```
set n1 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
set n4 [$ns node]
set n5 [$ns node]
$n0 color "purple"
$n1 color "purple"
$n2 color "violet"
$n3 color "violet"
$n4 color "chocolate"
$n5 color "chocolate"
$n0 shape box ;
$n1 shape box ;
$n2 shape box ;
$n3 shape box ;
$n4 shape box ;
$n5 shape box ;
$ns at 0.0 "$n0 label SYS0"
$ns at 0.0 "$n1 label SYS1"
$ns at 0.0 "$n2 label SYS2"
$ns at 0.0 "$n3 label SYS3"
$ns at 0.0 "$n4 label SYS4"
$ns at 0.0 "$n5 label SYS5"
set nf [open goback.nam w]
$ns namtrace-all $nf
set f [open goback.tr w]
$ns trace-all $f
$ns duplex-link $n0 $n2 1Mb 20ms DropTail
$ns duplex-link-op $n0 $n2 orient right-down
$ns queue-limit $n0 $n2 5
$ns duplex-link $n1 $n2 1Mb 20ms DropTail
$ns duplex-link-op $n1 $n2 orient right-up
$ns duplex-link $n2 $n3 1Mb 20ms DropTail
$ns duplex-link-op $n2 $n3 orient right
$ns duplex-link $n3 $n4 1Mb 20ms DropTail
$ns duplex-link-op $n3 $n4 orient right-up
$ns duplex-link $n3 $n5 1Mb 20ms DropTail
$ns duplex-link-op $n3 $n5 orient right-down
Agent/TCP set_nam_tracevar_true
set tcp [new Agent/TCP]
$tcp set fid 1
$ns attach-agent $n1 $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $n4 $sink
$ns connect $tcp $sink
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ns at 0.05 "$ftp start"
$ns at 0.06 "$tcp set windowlnit 6"
$ns at 0.06 "$tcp set maxcwnd 6"
$ns at 0.25 "$ns queue-limit $n3 $n4 0"
$ns at 0.26 "$ns queue-limit $n3 $n4 10"
```

```
$ns at 0.305 "$tcp set windowlnit 4"
$ns at 0.305 "$tcp set maxcwnd 4"
$ns at 0.368 "$ns detach-agent $n1 $tcp ; $ns detach-agent $n4 $sink"
$ns at 1.5 "finish"
$ns at 0.0 "$ns trace-annotate \"Goback N end\""
$ns at 0.05 "$ns trace-annotate \"FTP starts at 0.01\""
$ns at 0.06 "$ns trace-annotate \"Send 6Packets from SYS1 to SYS4\""
$ns at 0.26 "$ns trace-annotate \"Error Occurs for 4th packet so not sent ack for the Packet\""
$ns at 0.30 "$ns trace-annotate \"Retransmit Packet_4 to 6\""
$ns at 1.0 "$ns trace-annotate \"FTP stops\""
proc finish {} {
global ns nf
$ns flush-trace
close $nf
puts "filtering..."
#exec tclsh../bin/namfilter.tcl goback.nam
#puts "running nam..."
exec nam goback.nam &
exit 0
}
$ns run
```

Output:



Discussion:

Go-Back-N ARQ is a specific instance of the automatic repeat request (ARQ) protocol, in which the sending process continues to send a number of frames specified by a window size even without receiving an acknowledgement (ACK) packet from the receiver. It is a special case of the general sliding window protocol with the transmit window size of N and receive window size of 1. It can transmit N frames to the peer before requiring an ACK.

---

8. Write an NS2 script to simulate and to study stop and Wait protocol.

Aim: To simulate and to study stop and Wait protocol.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

Stop and Wait is a reliable transmission flow control protocol. This protocol works only in Connection Oriented (Point to Point) Transmission. The Source node has window size of ONE. After transmission of a frame the transmitting (Source) node waits for an Acknowledgement from the destination node. If the transmitted frame reaches the destination without error, the destination transmits a positive acknowledgement. If the transmitted frame reaches the Destination with error, the receiver destination does not transmit an acknowledgement. If the transmitter receives a positive acknowledgement it transmits the next frame if any. Else if its acknowledgement receive timer expires, it retransmits the same frame.

Algorithm:

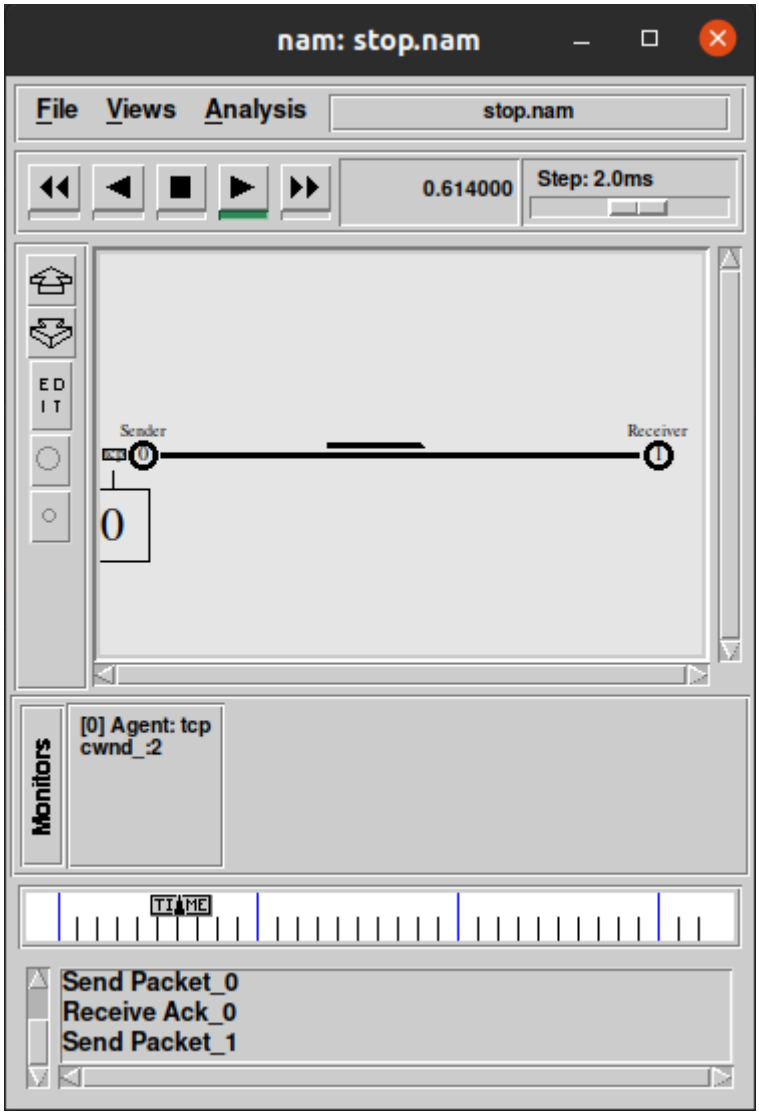
1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create two nodes that forms a network numbered 0 and 1
5. Create duplex links between the nodes to form a STAR Topology
6. Setup TCP Connection between n(1) and n(3)
7. Apply CBR Traffic over TCP
8. Schedule events and run the program.

Program:

```
# stop and wait protocol in normal situation
# features : labeling, annotation, nam-graph, and window size monitoring
set ns [new Simulator]
set n0 [$ns node]
set n1 [$ns node]
$ns at 0.0 "$n0 label Sender"
$ns at 0.0 "$n1 label Receiver"
set nf [open stop.nam w]
$ns namtrace-all $nf
set f [open stop.tr w]
$ns trace-all $f
$ns duplex-link $n0 $n1 0.2Mb 200ms DropTail
$ns duplex-link-op $n0 $n1 orient right
$ns queue-limit $n0 $n1 10
Agent/TCP set nam_tracevar_ true
set tcp [new Agent/TCP]
$tcp set window_ 1
$tcp set maxcwnd_ 1
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $n1 $sink
$ns connect $tcp $sink
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ns add-agent-trace $tcp tcp
$ns monitor-agent-trace $tcp
$tcp tracevar cwnd_
$ns at 0.1 "$ftp start"
$ns at 3.0 "$ns detach-agent $n0 $tcp ; $ns detach-agent $n1 $sink"
```

```
$ns at 3.5 "finish"
$ns at 0.0 "$ns trace-annotate \"Stop and Wait with normal operation\""
$ns at 0.05 "$ns trace-annotate \"FTP starts at 0.1\""
$ns at 0.11 "$ns trace-annotate \"Send Packet_0\""
$ns at 0.35 "$ns trace-annotate \"Receive Ack_0\""
$ns at 0.56 "$ns trace-annotate \"Send Packet_1\""
$ns at 0.79 "$ns trace-annotate \"Receive Ack_1\""
$ns at 0.99 "$ns trace-annotate \"Send Packet_2\""
$ns at 1.23 "$ns trace-annotate \"Receive Ack_2 \""
$ns at 1.43 "$ns trace-annotate \"Send Packet_3\""
$ns at 1.67 "$ns trace-annotate \"Receive Ack_3\""
$ns at 1.88 "$ns trace-annotate \"Send Packet_4\""
$ns at 2.11 "$ns trace-annotate \"Receive Ack_4\""
$ns at 2.32 "$ns trace-annotate \"Send Packet_5\""
$ns at 2.55 "$ns trace-annotate \"Receive Ack_5 \""
$ns at 2.75 "$ns trace-annotate \"Send Packet_6\""
$ns at 2.99 "$ns trace-annotate \"Receive Ack_6\""
$ns at 3.1 "$ns trace-annotate \"FTP stops\""
proc finish {} {
global ns nf
$ns flush-trace
close $nf
puts "running nam..."
exec nam stop.nam &
exit 0
}
$ns run
```

Output:



Discussion:

Here stop and wait means, whatever the data that sender wants to send, he sends the data to the receiver. After sending the data, he stops and waits until he receives the acknowledgment from the receiver. The stop and wait protocol is a flow control protocol where flow control is one of the services of the data link layer.

It is a data-link layer protocol which is used for transmitting the data over the noiseless channels. It provides unidirectional data transmission which means that either sending or receiving of data will take place at a time. It provides flow-control mechanism but does not provide any error control mechanism.

---

9. Write an NS2 script to build 3-node point to point network. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.

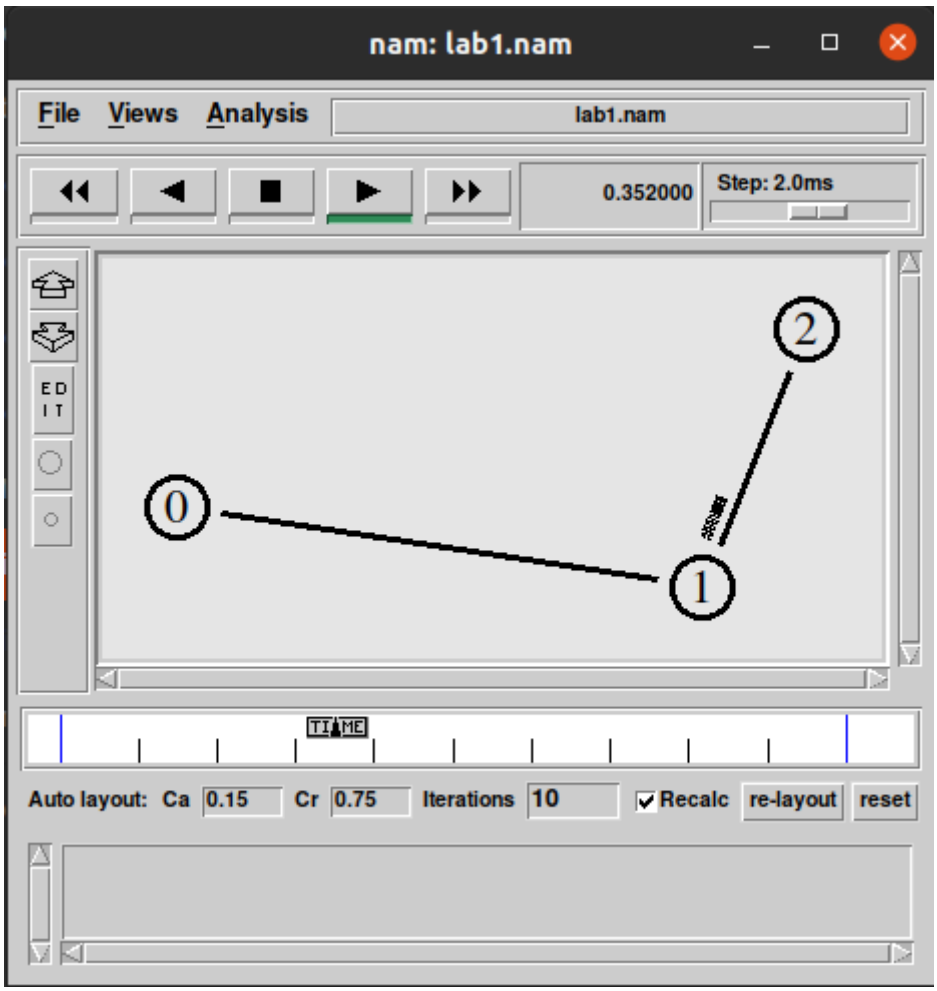
Aim: to build a 3 point to point network and to find the no. of packets dropped.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Program:

```
set ns [new Simulator]
# Letter S is capital
set nf [open lab1.nam w]
# open a nam trace file in write mode
$ns namtrace-all $nf
# nf nam filename
set tf [open lab1.tr w]
# tf trace filename
$ns trace-all $tf
proc finish { } {
global ns nf tf
$ns flush-trace
# clears trace file contents
close $nf
close $tf
exec nam lab1.nam &
exit 0
}
# creates 3 nodes
set n0 [$ns node]
set n2 [$ns node]
set n3 [$ns node]
$ns duplex-link $n0 $n2 200Mb 10ms DropTail # establishing links
$ns duplex-link $n2 $n3 1Mb 1000ms DropTail
$ns queue-limit $n0 $n2 10
set udp0 [new Agent/UDP]
# attaching transport layer protocols
$ns attach-agent $n0 $udp0
# attaching application layer protocols
set cbr0 [new Application/Traffic/CBR]
$cbr0 set packetSize_ 500
$cbr0 set interval_ 0.005
$cbr0 attach-agent $udp0
set null0 [new Agent/Null]
# creating sink(destination) node
$ns attach-agent $n3 $null0
$ns connect $udp0 $null0
$ns at 0.1 "$cbr0 start"
$ns at 1.0 "finish"
$ns run
```

Output:



Discussion:

In computer networking, Point-to-Point Protocol (PPP) is a data link layer (layer 2) communication protocol between two routers directly without any host or any other networking in between. It can provide connection authentication, transmission encryption, and data compression. PPP is used over many types of physical networks, including serial cable, phone line, trunk line, cellular telephone, specialized radio links, and fiber optic links, such as SONET. Internet service providers (ISPs) have used PPP for customer dial-up access to the Internet, since IP packets cannot be transmitted over a modem line on their own without some data link protocol that can identify where the transmitted frame starts and where it ends.

---

10. Write an NS2 script to simulate and to Sliding Window protocol.

Aim: To simulate and to Sliding Window protocol.

Software Requirement: Network Simulator 2 and Netowrk Animator 1.5

Theory:

Stop and Wait is a reliable transmission flow control protocol. This protocol works only in Connection Oriented (Point to Point) Transmission. The Source node has window size of ONE. After transmission of a frame the transmitting (Source) node waits for an Acknowledgement from the destination node. If the transmitted frame reaches the destination without error, the destination transmits a positive acknowledgement. If the transmitted frame reaches the Destination with error,

the receiver destination does not transmit an acknowledgement. If the transmitter receives a positive acknowledgement it transmits the next frame if any. Else if its acknowledgement receive timer expires, it retransmits the same frame.

Algorithm:

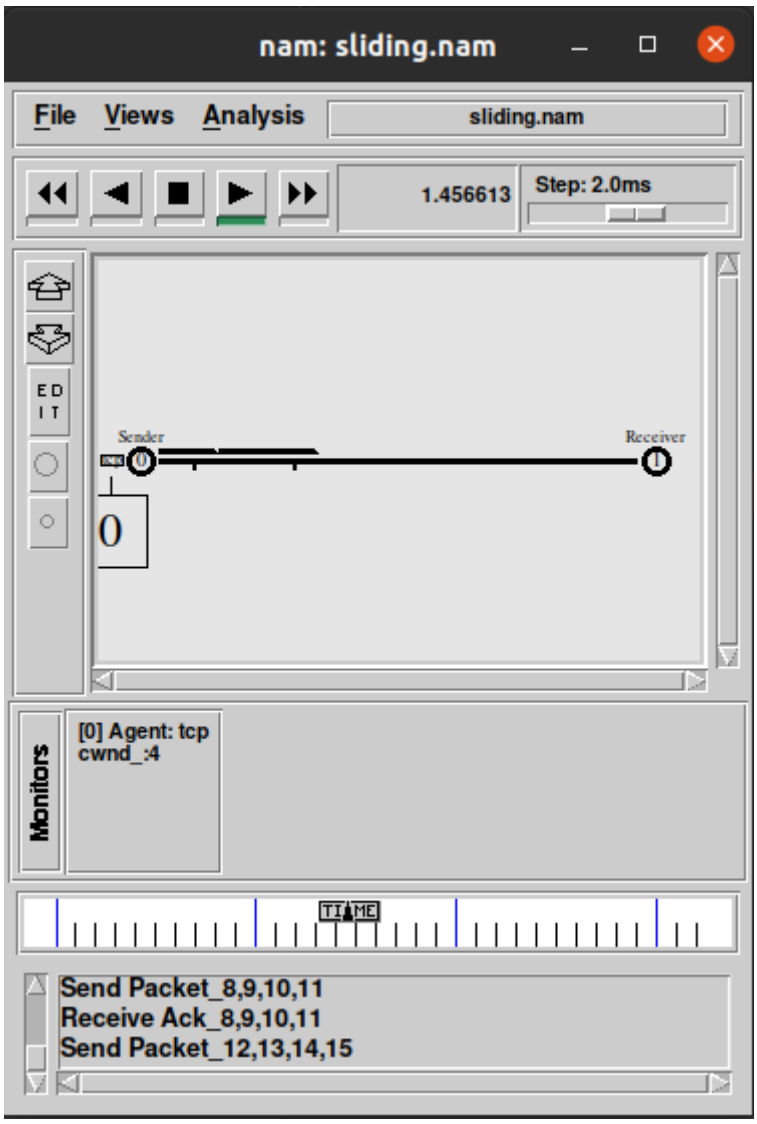
1. Create a simulator object
2. Define different colors for different data flows
3. Open a nam trace file and define finish procedure then close the trace file, and execute nam on trace file.
4. Create two nodes that forms a network numbered 0 and 1
5. Create duplex links between the nodes to form a STAR Topology
6. Setup TCP Connection between n(1) and n(3)
7. Apply CBR Traffic over TCP 8. Schedule events and run the program.

Program:

```
# sliding window mechanism with some features
# such as labeling, annotation, nam-graph, and window size monitoring
set ns [new Simulator]
set n0 [$ns node]
set n1 [$ns node]
$ns at 0.0 "$n0 label Sender"
$ns at 0.0 "$n1 label Receiver"
set nf [open sliding.nam w]
$ns namtrace-all $nf
set f [open sliding.tr w]
$ns trace-all $f
$ns duplex-link $n0 $n1 0.2Mb 200ms DropTail
$ns duplex-link-op $n0 $n1 orient right
$ns queue-limit $n0 $n1 10
Agent/TCP set nam_tracevar_ true
set tcp [new Agent/TCP]
$tcp set windowInit_ 4
$tcp set maxcwnd_ 4
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $n1 $sink
$ns connect $tcp $sink
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ns add-agent-trace $tcp tcp
$ns monitor-agent-trace $tcp
$tcp tracevar cwnd_
$ns at 0.1 "$ftp start"
$ns at 3.0 "$ns detach-agent $n0 $tcp ; $ns detach-agent $n1 $sink"
$ns at 3.5 "finish"
$ns at 0.0 "$ns trace-annotate \"Sliding Window with window size 4 (normal operation)\""
$ns at 0.05 "$ns trace-annotate \"FTP starts at 0.1\""
$ns at 0.11 "$ns trace-annotate \"Send Packet_0,1,2,3\""
$ns at 0.34 "$ns trace-annotate \"Receive Ack_0,1,2,3\""
$ns at 0.56 "$ns trace-annotate \"Send Packet_4,5,6,7\""
```

```
$ns at 0.79 "$ns trace-annotate \"Receive Ack_4,5,6,7\""
$ns at 0.99 "$ns trace-annotate \"Send Packet_8,9,10,11\""
$ns at 1.23 "$ns trace-annotate \"Receive Ack_8,9,10,11 \""
$ns at 1.43 "$ns trace-annotate \"Send Packet_12,13,14,15\""
$ns at 1.67 "$ns trace-annotate \"Receive Ack_12,13,14,15\""
$ns at 1.88 "$ns trace-annotate \"Send Packet_16,17,18,19\""
$ns at 2.11 "$ns trace-annotate \"Receive Ack_16,17,18,19\""
$ns at 2.32 "$ns trace-annotate \"Send Packet_20,21,22,23\""
$ns at 2.56 "$ns trace-annotate \"Receive Ack_24,25,26,27\""
$ns at 2.76 "$ns trace-annotate \"Send Packet_28,29,30,31\""
$ns at 3.00 "$ns trace-annotate \"Receive Ack_28\""
$ns at 3.1 "$ns trace-annotate \"FTP stops\""
proc finish {} {
global ns
$ns flush-trace
# close $nf
puts "running nam..."
exec nam sliding.nam &
exit 0
}
$ns run
```

Output:



Discussion:

A sliding window protocol is a feature of packet-based data transmission protocols. Sliding window protocols are used where reliable in-order delivery of packets is required, such as in the data link layer (OSI layer 2) as well as in the Transmission Control Protocol (TCP). They are also used to improve efficiency when the channel may include high latency.