4. Lab 4

Monday, February 22, 2021   4:50 PM

Question:

Create a network of six nodes.

In this network node 3-5 are the part of LAN. LAN is connected to rest of the network using node 3, node 3 is act as gateway between LAN and rest of the network (node 0-2). The LAN have capacity of 0.5Mb with 40ms propagation delay.

Link in between LAN and rest of network have capacity of 0.3Mb with 100ms propagation delay, and all other links have capacity of 2Mb with 10ms propagation delay.

The gateway link have queue limit of 10 packets.

Node 0 in the network acts as TCP source (packet size = 552 bytes) and node 4 in LAN act as a TCP destination.

Also node 1 in the network acts as UDP source (packet size = 1000 bytes) and node 5 as a UDP destination.

The simulation lasts for 125 seconds, where CBR traffic will start at 0.1s and stop at 124.5s, and FTP traffic will start at 1.0s and stop at 124s.

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

#set color
$ns color 1 blue
$ns color 2 red

#set output files
set file1 [open out.tr w]
$ns trace-all $file1
set file2 [open out.nam w]
$ns namtrace-all $file2

#create 6 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]

#shape and color of animation of each node
#circle by default
$n1 color red
$n1 shape box
$n0 color blue
$n0 shape box

#create links
#0,1,2 rest of the network
#3,4,5 LAN
#n2 connected to LAN via n3
```

```
$ns duplex-link $n0 $n2 2Mb 10ms DropTail
$ns duplex-link $n1 $n2 2Mb 10ms DropTail
$ns duplex-link $n2 $n3 0.3Mb 100ms DropTail

#Local Area Network needs a CENTRAL CONTROLLER
#device like a switch
#if any node on the LAN wants to communicate, it must contact the central
controller
set lan [$ns newLan "$n3 $n4 $n5" 0.5Mb 40ms LL Queue/DropTail MAC/Csma/Cd Channe
l]
#lan acts as a switch
#newLan creates LAN + central controller
#n3, n4 and n5 are connected to the LAN
#Capacity 0.5Mb
#Data Link = Link layer and Medium access control layer [LL: error correction and
detection features
#Queue/DropTail
#MAC feature: Csma/Cd
#

#queue limit
$ns queue-limit $n2 $n3 10

#tcp connection
set tcp [new Agent/TCP]
$ns attach-agent $n0 $tcp
set sink [new Agent/TCPSink]
$ns attach-agent $n4 $sink
$ns connect $tcp $sink
$tcp set fid_ 1
$tcp set packetSize_ 552
set ftp [new Application/FTP]
$ftp attach-agent $tcp

#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
set cbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set packet_size_ 1000

#schedule
$ns at 0.1 "$cbr start"
$ns at 1.0 "$ftp start"
$ns at 124.0 "$ftp stop"
$ns at 124.5 "$cbr stop"
$ns at 125.0 "finish"

#procedure
proc finish {} {
    global ns file1 file2
    $ns flush-trace
    close $file1
```

```
    close $file2
    exit 0
}
$ns run
```

📖 <mark>Trace files</mark>
Outcome of the animation in text form

How to read a trace file:
  - Each row consists of space separateed 12 columns

Colum 1:

Event	
r	Receive
+	Send/enqueue
-	Dequeue
d	Drop
h	Hop

Column 2: time at which event happened
Column 3: source node for the event
Column 4:destination node for the event
Column 5:packet type (cbr/ftp). If ftp, ack is acknowledge
Column 6: packet size
Column 7: future scope for flags
Column 8: Flow ID
Column 9: Source address
Column 10: Destination address
Column 11: Sequence number [every segment has a sequence number]
Column 12: packet ID

5 is the source for udp traffic
Sends from 1-2-3-6-5
3 is part of the LAN
From 3 to 6 because 6 is the **central controller/switch: hop**
4 to 6 is dropped, 6 to 5 is received
Time first packet sent: 0.1
Time the first packet received at 5: 0.3
Can calculate delay
Trace file can give statistics of the network (throughput, delay etc)

+ 0.1 1 2 cbr 1000 ------- 2 1.0 5.0 0 0

```
- 0.1 1 2 cbr 1000 ------- 2 1.0 5.0 0 0
r 0.114 1 2 cbr 1000 ------- 2 1.0 5.0 0 0
+ 0.114 2 3 cbr 1000 ------- 2 1.0 5.0 0 0
- 0.114 2 3 cbr 1000 ------- 2 1.0 5.0 0 0
+ 0.117857 1 2 cbr 1000 ------- 2 1.0 5.0 1 1
- 0.117857 1 2 cbr 1000 ------- 2 1.0 5.0 1 1
r 0.131857 1 2 cbr 1000 ------- 2 1.0 5.0 1 1
+ 0.131857 2 3 cbr 1000 ------- 2 1.0 5.0 1 1
+ 0.135714 1 2 cbr 1000 ------- 2 1.0 5.0 2 2
- 0.135714 1 2 cbr 1000 ------- 2 1.0 5.0 2 2
- 0.140667 2 3 cbr 1000 ------- 2 1.0 5.0 1 1
r 0.149714 1 2 cbr 1000 ------- 2 1.0 5.0 2 2
+ 0.149714 2 3 cbr 1000 ------- 2 1.0 5.0 2 2
+ 0.153571 1 2 cbr 1000 ------- 2 1.0 5.0 3 3
- 0.153571 1 2 cbr 1000 ------- 2 1.0 5.0 3 3
- 0.167333 2 3 cbr 1000 ------- 2 1.0 5.0 2 2
r 0.167571 1 2 cbr 1000 ------- 2 1.0 5.0 3 3
+ 0.167571 2 3 cbr 1000 ------- 2 1.0 5.0 3 3
+ 0.171429 1 2 cbr 1000 ------- 2 1.0 5.0 4 4
- 0.171429 1 2 cbr 1000 ------- 2 1.0 5.0 4 4
r 0.185429 1 2 cbr 1000 ------- 2 1.0 5.0 4 4
+ 0.185429 2 3 cbr 1000 ------- 2 1.0 5.0 4 4
+ 0.189286 1 2 cbr 1000 ------- 2 1.0 5.0 5 5
- 0.189286 1 2 cbr 1000 ------- 2 1.0 5.0 5 5
- 0.194 2 3 cbr 1000 ------- 2 1.0 5.0 3 3
r 0.203286 1 2 cbr 1000 ------- 2 1.0 5.0 5 5
+ 0.203286 2 3 cbr 1000 ------- 2 1.0 5.0 5 5
+ 0.207143 1 2 cbr 1000 ------- 2 1.0 5.0 6 6
- 0.207143 1 2 cbr 1000 ------- 2 1.0 5.0 6 6
- 0.220667 2 3 cbr 1000 ------- 2 1.0 5.0 4 4
r 0.221143 1 2 cbr 1000 ------- 2 1.0 5.0 6 6
+ 0.221143 2 3 cbr 1000 ------- 2 1.0 5.0 6 6
+ 0.225 1 2 cbr 1000 ------- 2 1.0 5.0 7 7
- 0.225 1 2 cbr 1000 ------- 2 1.0 5.0 7 7
r 0.239 1 2 cbr 1000 ------- 2 1.0 5.0 7 7
+ 0.239 2 3 cbr 1000 ------- 2 1.0 5.0 7 7
r 0.240667 2 3 cbr 1000 ------- 2 1.0 5.0 0 0
h 0.240667 3 6 cbr 1000 ------- 2 1.0 5.0 0 0
+ 0.242857 1 2 cbr 1000 ------- 2 1.0 5.0 8 8
- 0.242857 1 2 cbr 1000 ------- 2 1.0 5.0 8 8
- 0.247333 2 3 cbr 1000 ------- 2 1.0 5.0 5 5
r 0.256857 1 2 cbr 1000 ------- 2 1.0 5.0 8 8
+ 0.256857 2 3 cbr 1000 ------- 2 1.0 5.0 8 8
+ 0.260714 1 2 cbr 1000 ------- 2 1.0 5.0 9 9
- 0.260714 1 2 cbr 1000 ------- 2 1.0 5.0 9 9
r 0.267333 2 3 cbr 1000 ------- 2 1.0 5.0 1 1
h 0.267333 3 6 cbr 1000 ------- 2 1.0 5.0 1 1
- 0.274 2 3 cbr 1000 ------- 2 1.0 5.0 6 6
r 0.274714 1 2 cbr 1000 ------- 2 1.0 5.0 9 9
```