**SECOND PROGRAM**

* Save srcond12.cc in directory **ns-allinone-3.37/ns-3.37/examples/tutorial/**
* The following commands has to be run to setup ns3 in order to run .cc files after changing the directory.

1. ./ns3 clean : to delete any existing ns3 build
2. ./ns3 configure --build-profile –enable-examples –enable-tests : to configure network simulation
3. ./ns3 build : to build network simulation

**Program Modification *( all the lines modified from second.cc are commented*)**

1. Line 40 : Modified nCsma to value to 5 from 3 , to have 6 nodes on LAN 192.168.2.0
2. Line 64: Modified data rate as 10 Mbps
3. Line 65: Modified delay as 2ms
4. Line 72: Modified csma channel delay rate as 10 microseconds = 10,000 nano seconds
5. Line 82: Modified IP address as 192.168.1.0/24 for p2pDevices
6. Line 86: Modified IP address as 192.168.2.0/24 for csmaDevices
7. Line 90: Modified port number for UDP server as 64
8. Line 96: Modified port number as 64
9. Line 97-103: Added code to send 3 UDP packets at 2s, 4s, 6s from **Node1** (192.168.2.1) to Server **Node6** (192.168.2.6 ;port 64)
10. Line 105-112: Added code to send 2 UDP packets at 2s, 5s from **Node0** (192.168.1.1) to Server **Node6** (192.168.2.6 ;port 64)

* Line 117 is present to give 3 .pcap file. Name given to pcap file is mysecond. So the output .pcap file after running second12.cc will be **mysecond-0-0.pcap, mysecond-1-0.pcap** and , **mysecond-2-0.pcap**
* Once Build is successful; to Runsecond12.cc; execute the command **cp examples/tutorial/second12.cc scratch/mysecond12.cc**

This will create an executable version of second12.cc in scratch folder with name mysecond12.cc.

* Now to run ; execute command **./ns3 run scratch/mysecond12.cc.** The output obtained is as shown below.

Text

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**Explanation/Conclusion:**

* The network build in second12.cc consists of total of 7 nodes; where N0 and N1 are p2p nodes and N1 to N6 are Csma nodes. Here we make N0 and N1 send packet to server node N6 alternately, So N0 and N1 are our client node and N6 is server node.
* Ip addresses assigned: N0 (Client) 🡪 192.168.1.1 N1(Client) 🡪 192.168.2.1 N6(server) 🡪192.168.2.6 ; port 64
* On line 93 ; we set the server start time which is 1s and end time which is 10s
* **Line 97-103 code output**: As we set **max packets size 3**, and time interval 2s with start time of **N1**, as 2s, end time 7s; the client **N1** will send first packet of size 1024 to server at 2s. This will be received by server node **N6** at 2.00413s, and then the server node **N6** will immediately send back packet to client. The client will receive the packets at 2.00926s.

Similarly, the client Node1 will send next 2 packets at 4s, and 6s to Server **N6** ;port 64 which is received at time 4.0001s, 6.0001s respectively as the propagation delay is 10000ns for Csma channel. Server replies to client node with packet size 1024, which will be received by client at 4.00019s, 6.00019s respectively.

* **Line 105-112 code output**: As we set **max packets size 2**, and time interval 2s with start time of **N0** as 3s, end time 6s; the client **N0** will send first packet of size 1024 to server at 3s. This will be received by server node **N6** at 3.00194s, and then the server node **N6** will immediately send back packet to client. The client will receive the packets at 3.00388s.

Similarly, the client **N0** will send next packet at 5s to Server **N6**; port 64 which is received at time 5.00194s as the propagation delay is 10000ns (0.01ms) for Csma channel + 1ms for p2p channel. Server replies to client node with packet size 1024, which will be received by client at 5.00388s.

Packet Tracing using wireshark:

Table

Description automatically generated with medium confidence

Graphical user interface, text, application, table

Description automatically generated

As you can see, the link type is now “Ethernet”. Something new has appeared, though. The bus network needs ARP, the Address Resolution Protocol. Node one knows it needs to send the packet to IP address 192.198.2.6, but it doesn’t know the MAC address of the corresponding node. It broadcasts on the CSMA network (ff:ff:ff:ff:ff:ff) asking for the device that has IP address 192.198.2.6. In this case, the rightmost node replies saying it is at MAC address 00:00:00:00:00:03. Note that node two is not directly involved in this exchange, but is sniffing the network and reporting all of the traffic it sees.This exchange is seen in the first 5 lines.

The naming convention of .pcap files have, <name>-<node>-<device>.pcap. For example, the first file in the listing is **mysecond-0-0.pcap** which is the pcap trace from node zero, device zero. This is the point-to-point net device on node zero. The file **mysecond-1-0.pcap** is the pcap trace for device zero on node one, also a point-to-point net device; and the file **mysecond-2-0.pcap** is the pcap trace for device zero on node two.

Packet tracing using **tcpdump -nn -tt -r** command.

Text

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Text

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