

ECE 636
COMPUTER NETWORKING LABORATORY

Ayush Kale
Sree Kiran Atluru
ak2739@njit.edu
sa2598@njit.edu

Lab 9
ns-3 experiments

9.2 Lab Description

9.2.3 Building a Bus Network Topology

Set the value of the “DataRate” for the point-to-point device as 3Mbps.

```
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("3Mbps"));  
pointToPoint.SetChannelAttribute ("Delay", StringValue ("1ms"));
```

Set the value of the transmission delay of the point-to-point channel as 1ms.

```
PointToPointHelper pointToPoint;  
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("3Mbps"));  
pointToPoint.SetChannelAttribute ("Delay", StringValue ("1ms"));
```

Associate the devices on your point-to-point nodes with IP addresses 10.1.7.1 and 10.1.7.2.

```
address.SetBase ("10.1.7.0", "255.255.255.0");  
Ipv4InterfaceContainer p2pInterfaces;  
p2pInterfaces = address.Assign (p2pDevices);
```

Associate the CSMA devices with IP addresses from network number 10.1.2.0.

```
address.SetBase ("10.1.2.0", "255.255.255.0");  
Ipv4InterfaceContainer csmaInterfaces;  
csmaInterfaces = address.Assign (csmaDevices);
```

Schedule start events for the server and the client at 1.0 seconds, 2.0 seconds and the Stop events for the server and the client both at 15.0 seconds.

```
ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));  
serverApps.Start (Seconds (1.0));  
serverApps.Stop (Seconds (15.0));
```

```
ApplicationContainer clientApps =  
    echoClient.Install (wifiStaNodes.Get (nWifi - 1));  
clientApps.Start (Seconds (2.0));  
clientApps.Stop (Seconds (15.0));
```

1. Running the script with nCSma = 3

```
t3net04-66 ns-3.25 >: gedit scratch/ak2739second.cc
t3net04-67 ns-3.25 >: ./waf --run scratch/ak2739second
Waf: Entering directory `/afs/cad.njit.edu/courses/ece/f22/ece/636/101/ak2739/ns-allinone-3.25/ns-3.25/build'
[ 888/2289] Compiling scratch/ak2739second.cc
[2261/2289] Linking build/scratch/ak2739second
Waf: Leaving directory `/afs/cad.njit.edu/courses/ece/f22/ece/636/101/ak2739/ns-allinone-3.25/ns-3.25/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (2.048s)
At time 2s client sent 1024 bytes to 10.1.2.4 port 9
At time 2.00797s server received 1024 bytes from 10.1.7.1 port 49153
At time 2.00797s server sent 1024 bytes to 10.1.7.1 port 49153
At time 2.01794s client received 1024 bytes from 10.1.2.4 port 9
t3net04-68 ns-3.25 >: □
```

2. Tcpcdump of the trace file for the leftmost point-to-point node.

```
t3net04-43 ns-3.25 >: tcpdump -nn -tt -r second-0-0.pcap
reading from file second-0-0.pcap, link-type PPP (PPP)
2.000000 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.017938 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
t3net04-44 ns-3.25 >: tcpdump -nn -tt -r second-0-0.pcap
reading from file second-0-0.pcap, link-type PPP (PPP)
2.000000 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.017938 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
t3net04-44 ns-3.25 >: tcpdump -nn -tt -r second-0-0.pcap
reading from file second-0-0.pcap, link-type PPP (PPP)
2.000000 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.017938 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
```

3. Tcpcdump of the trace file for the other side of the point-to-point node, that is node 1.

```
t3net04-44 ns-3.25 >: tcpdump -nn -tt -r second-1-0.pcap
reading from file second-1-0.pcap, link-type PPP (PPP)
2.003810 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.014127 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
t3net04-45 ns-3.25 >: tcpdump -nn -tt -r second-1-0.pcap
reading from file second-1-0.pcap, link-type PPP (PPP)
2.003810 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.014127 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
```

4. tcpdump of the trace file for node 2 as the promiscuous sniffer node for the CSMA network

```
t3net04-45 ns-3.25 >: tcpdump -nn -tt -r second-2-0.pcap
reading from file second-2-0.pcap, link-type EN10MB (Ethernet)
2.007824 ARP, Request who-has 10.1.2.4 (ff:ff:ff:ff:ff:ff) tell 10.1.2.1, length 50
2.007839 ARP, Reply 10.1.2.4 is-at 00:00:00:00:00:06, length 50
2.007969 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.013983 ARP, Request who-has 10.1.2.1 (ff:ff:ff:ff:ff:ff) tell 10.1.2.4, length 50
2.013998 ARP, Reply 10.1.2.1 is-at 00:00:00:00:00:03, length 50
2.014127 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
t3net04-46 ns-3.25 >: tcpdump -nn -tt -r second-2-0.pcap
reading from file second-2-0.pcap, link-type EN10MB (Ethernet)
2.007824 ARP, Request who-has 10.1.2.4 (ff:ff:ff:ff:ff:ff) tell 10.1.2.1, length 50
2.007839 ARP, Reply 10.1.2.4 is-at 00:00:00:00:00:06, length 50
2.007969 IP 10.1.7.1.49153 > 10.1.2.4.9: UDP, length 1024
2.013983 ARP, Request who-has 10.1.2.1 (ff:ff:ff:ff:ff:ff) tell 10.1.2.4, length 50
2.013998 ARP, Reply 10.1.2.1 is-at 00:00:00:00:00:03, length 50
2.014127 IP 10.1.2.4.9 > 10.1.7.1.49153: UDP, length 1024
t3net04-46 ns-3.25 >: □
```

5. Replacing the EnablePcap calls with the following calls

```
pointToPoint.EnablePcap ("second", p2pNodes.Get (0)->GetId (), 0);
csma.EnablePcap ("second", csmaNodes.Get (nCsma)->GetId (), 0, false);
csma.EnablePcap ("second", csmaNodes.Get (nCsma-1)->GetId (), 0, false);
```

```
t3net04-72 ns-3.25 >: r, *.pcap
t3net04-75 ns-3.25 >: rm *.tr
```

6. Building the new script and run the simulation setting nCsma to 170

```
t3net04-78 ns-3.25 >: ./waf --run "scratch/ak2739second --nCsma=170"
Waf: Entering directory `/afs/cad.njit.edu/courses/ece/f22/ece/636/101/ak2739/ns-allinone-3.25/ns-3.25/build'
Waf: Leaving directory `/afs/cad.njit.edu/courses/ece/f22/ece/636/101/ak2739/ns-allinone-3.25/ns-3.25/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (1.272s)
At time 2s client sent 1024 bytes to 10.1.2.171 port 9
At time 2.00397s server received 1024 bytes from 10.1.7.1 port 49153
At time 2.00397s server sent 1024 bytes to 10.1.7.1 port 49153
At time 2.01494s client received 1024 bytes from 10.1.2.171 port 9
t3net04-79 ns-3.25 >: □
```

7. Tcpdump of the trace file for of the next-to-last node 170

```
t3net04-48 ns-3.25 >: tcpdump -nn -tt -r second-170-0.pcap
reading from file second-170-0.pcap, link-type EN10MB (Ethernet)
2.003824 ARP, Request who-has 10.1.2.171 (ff:ff:ff:ff:ff:ff) tell 10.1.2.1, length 50
2.010983 ARP, Request who-has 10.1.2.1 (ff:ff:ff:ff:ff:ff) tell 10.1.2.171, length 50
t3net04-49 ns-3.25 >: □
```

8. Tcpdump of the trace file for node 171

```
t3net04-49 ns-3.25 >: tcpdump -nn -tt -r second-171-0.pcap
reading from file second-171-0.pcap, link-type EN10MB (Ethernet)
2.003824 ARP, Request who-has 10.1.2.171 (ff:ff:ff:ff:ff:ff) tell 10.1.2.1, length 50
2.003824 ARP, Reply 10.1.2.171 is-at 00:00:00:00:00:ad, length 50
2.003969 IP 10.1.7.1.49153 > 10.1.2.171.9: UDP, length 1024
2.010969 ARP, Request who-has 10.1.2.1 (ff:ff:ff:ff:ff:ff) tell 10.1.2.171, length 50
2.010998 ARP, Reply 10.1.2.1 is-at 00:00:00:00:00:03, length 50
2.010998 IP 10.1.2.171.9 > 10.1.7.1.49153: UDP, length 1024
t3net04-50 ns-3.25 >: □
```

9.3 Building a Wireless Network Topology

(1) Running the script with nCsma and nWifi both equal to 3

```
int
main (int argc, char *argv[])
{
    bool verbose = true;
    uint32_t nCsma = 3;
    uint32_t nWifi = 3;
    bool tracing = true;

    PointToPointHelper pointToPoint;
    pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("3Mbps"));
    pointToPoint.SetChannelAttribute ("Delay", StringValue ("1ms"));

    Ipv4AddressHelper address;

    address.SetBase ("10.1.7.0", "255.255.255.0");
    Ipv4InterfaceContainer p2pInterfaces;
    p2pInterfaces = address.Assign (p2pDevices);

    address.SetBase ("10.1.2.0", "255.255.255.0");
    Ipv4InterfaceContainer csmaInterfaces;
    csmaInterfaces = address.Assign (csmaDevices);

    address.SetBase ("10.1.3.0", "255.255.255.0");
    address.Assign (staDevices);
    address.Assign (apDevices);

    ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));
    serverApps.Start (Seconds (1.0));
    serverApps.Stop (Seconds (15.0));

    ApplicationContainer clientApps =
        echoClient.Install (wifiStaNodes.Get (nWifi - 1));
    clientApps.Start (Seconds (2.0));
    clientApps.Stop (Seconds (15.0));
```

(2) Snapshot from node one

```
t3net04-60 ns-3.25 >: tcpdump -nn -tt -r third-0-0.pcap
reading from file third-0-0.pcap, link-type PPP (PPP)
2.008151 IP 10.1.3.3.49153 > 10.1.2.4.9: UDP, length 1024
2.027089 IP 10.1.2.4.9 > 10.1.3.3.49153: UDP, length 1024
t3net04-61 ns-3.25 >: tcpdump -nn -tt -r third-1-0.pcap
reading from file third-1-0.pcap, link-type PPP (PPP)
2.011961 IP 10.1.3.3.49153 > 10.1.2.4.9: UDP, length 1024
2.023278 IP 10.1.2.4.9 > 10.1.3.3.49153: UDP, length 1024
t3net04-62 ns-3.25 >: tcpdump -nn -tt -r third-2-0.pcap
tcpdump: third-2-0.pcap: No such file or directory
t3net04-63 ns-3.25 >: tcpdump -nn -tt -r third-3-0.pcap
tcpdump: third-3-0.pcap: No such file or directory
t3net04-64 ns-3.25 >: □
```

(3) Snapshots from from node zero

```
t3net04-65 ns-3.25 >: tcpdump -nn -tt -r third-0-1.pcap
reading from file third-0-1.pcap, link-type IEEE802.11 (802.11)
0.000025 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.000308 Assoc Request (ns-3-ssid) [6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0 Mbit]
0.000324 Acknowledgment RA:00:00:00:00:00:08
0.000402 Assoc Response AID(0) :: Successful
0.000546 Acknowledgment RA:00:00:00:00:00:0a
0.000721 Assoc Request (ns-3-ssid) [6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0 Mbit]
0.000737 Acknowledgment RA:00:00:00:00:00:07
0.000824 Assoc Response AID(0) :: Successful
0.000968 Acknowledgment RA:00:00:00:00:00:0a
0.001134 Assoc Request (ns-3-ssid) [6.0 9.0 12.0 18.0 24.0 36.0 48.0 54.0 Mbit]
0.001150 Acknowledgment RA:00:00:00:00:00:09
0.001273 Assoc Response AID(0) :: Successful
0.001417 Acknowledgment RA:00:00:00:00:00:0a
0.102400 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.204800 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.307200 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.409600 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.512000 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.614400 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.716800 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.819200 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
0.921600 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.024000 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.126400 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.228800 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.331200 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.433600 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.536000 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.638400 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.740800 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.843200 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
1.945600 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
2.006112 ARP, Request who-has 10.1.3.4 (ff:ff:ff:ff:ff:ff) tell 10.1.3.3, length 32
2.006128 Acknowledgment RA:00:00:00:00:00:09
2.006206 ARP, Request who-has 10.1.3.4 (ff:ff:ff:ff:ff:ff) tell 10.1.3.3, length 32
2.006352 ARP, Reply 10.1.3.4 is-at 00:00:00:00:00:0a, length 32
2.006524 Acknowledgment RA:00:00:00:00:00:0a
2.008151 IP 10.1.3.3.49153 > 10.1.2.4.9: UDP, length 1024
2.008167 Acknowledgment RA:00:00:00:00:00:09
2.032089 ARP, Request who-has 10.1.3.3 (ff:ff:ff:ff:ff:ff) tell 10.1.3.4, length 32
2.032347 ARP, Reply 10.1.3.3 is-at 00:00:00:00:00:09, length 32
2.032363 Acknowledgment RA:00:00:00:00:00:09
2.032495 IP 10.1.2.4.9 > 10.1.3.3.49153: UDP, length 1024
2.034031 Acknowledgment RA:00:00:00:00:00:0a
2.048000 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
2.150400 Beacon (ns-3-ssid) [6.0* 9.0 12.0* 18.0 24.0* 36.0 48.0 54.0 Mbit] IBSS
```


When the tcpdump is for node-1, the communication is displayed in packets exchanged using Ip and UDP with no acknowledgments. Whereas for the node-1,0 the communication is using Acknowledgments, Assoc Requests and ARP requests for the transmission.

Running the Script with nCSMA and nWifi both equal to 3.

```
t3net04-86 ns-3.25 >: ./waf --run ak2739third
Waf: Entering directory `/afs/cad.njit.edu/courses/ece/f22/ece/636/101/ak2739/ns-allinone-3.25/ns-3.25/build'
[1948/2291] Compiling scratch/ak2739third.cc
[2254/2291] Linking build/scratch/ak2739third
Waf: Leaving directory `/afs/cad.njit.edu/courses/ece/f22/ece/636/101/ak2739/ns-allinone-3.25/ns-3.25/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (2.646s)
At time 2s client sent 1024 bytes to 10.1.2.4 port 9
At time 2.01812s server received 1024 bytes from 10.1.3.3 port 49153
At time 2.01812s server sent 1024 bytes to 10.1.3.3 port 49153
At time 2.03397s client received 1024 bytes from 10.1.2.4 port 9
t3net04-87 ns-3.25 >: □
```