University at Buffalo
The State University of New York

EE450/550: Principles of Networking
Laboratory Project: Assignment 1

Given: February 13, 2017
Due: March 5, 2017 (11:59 PM)

Submission Instructions:

Submit your assignment in electronic format (such as a *doc* or *pdf*) **directly on UB Learns**

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The objective of this first assignment is to become familiar with the ns-3 working environment and the presented simulation workflow. To complete this assignment, you need a working environment with ns-3 and Wireshark properly set up. Please follow the instructions in the Laboratory Tutorial slides in UB Learns and the additional information provided in class. If you still have problems setting up the environment, please contact the TA or the instructor for this course.

Task 1:

Modify the example seen in class, *first.cc*, to simulate the following network:

- 2 nodes
  - 1 network interface at each node
- Point-to-point link:
  - Data Rate: 20 Mbps
  - Delay: 2 ms
- IP address assignment:
  - 192.120.2.0/24
- Application:
  - UDP Echo Server on port 63
  - Packet size: 512 bytes
- Use the same values as in the example for the rest of the parameters

Compile and run the simulation. Visualize the packet trace file with Wireshark.

Task 2:

Simulate the following network architecture:

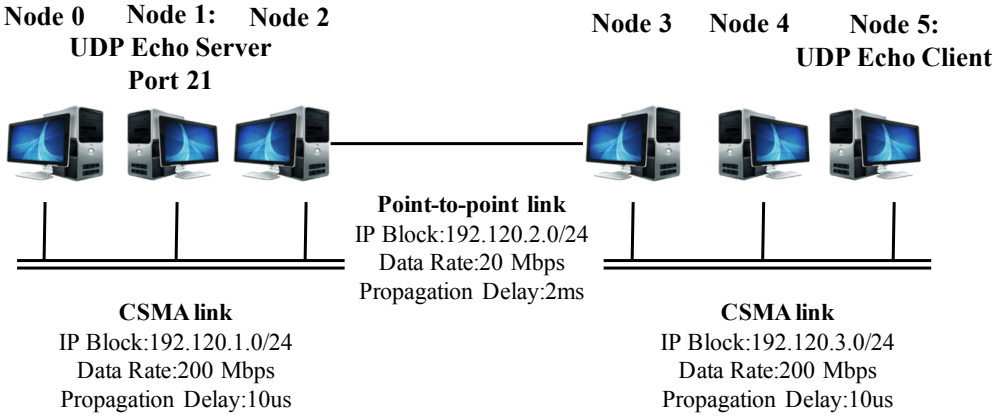

Figure 1: Network architecture

Additional information:

- The network contains:
  - 3 nodes in the first shared bus operating under CSMA +
    3 nodes in the second shared bus operating under CSMA
    - Look at the `CSMA Helper` class
  - 2 nodes in the point-to-point link
  - Note that Node 2 and 3 in Figure 1 have two network interfaces, one for each link to which they are connected
- The applications running in the network are:
  - `UDP Echo Server` at Node 1:
    - Listening on port 21
  - `UDP Echo Client` at Node 5:
    - Sends 2 UDP Echo packets to the server at times 4s and 7s

Verify that the network behavior is as expected, by capturing the packet traces and utilizing Wireshark to analyze them.
Tip: Take a look at *second.cc* in the tutorials folder of the ns-3 installation.

Submission materials:

- Task 1:
  - Simulation source code (.cc) and packet trace (.pcap) file
- Task 2:
  - Simulation source code (.cc)
  - Packet trace (.pcap) files for the client, server and the point-to-point nodes ONLY. Please name them accordingly.
  - A non-promiscuous mode packet trace for node 4. A packet trace is collected in non-promiscuous mode when the third parameter in the next statement is set 'false':

```
csma.EnablePcap ("second", csmaDevices.Get (1), true);
```

- For both tasks: A brief report briefly explaining the experimental setup (which part of the code have you modified), the results (comment and include a screen shot of the packet traces in Wireshark) and the conclusions (what did you learn).
  - In the report, make sure you answer the following questions:
    - Q1: Why do Node 2 and Node 3 require two network adapters?
    - Q2: How many networks are illustrated in Fig. 1?
    - Q3: What does "promiscuous" mode mean in the context of packet tracing?