Labwork 2: Logging, Attributes and Tracing

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1 Logging

We enable logging by adding the following line to the file:

```
LogComponentEnable("UdpEchoClientApplication", LOG_LEVEL_FUNCTION);
LogComponentEnable("UdpEchoServerApplication", LOG_LEVEL_FUNCTION);
```

```
❯ ./ns3 run examples/tutorial/first.cc
[0/2] Re-checking globbed directories...
ninja: no work to do.
UdpEchoServerApplication:UdpEchoServer(0x59c54355e450)
UdpEchoClientApplication:UdpEchoClient(0x59c5435a8570)
UdpEchoClientApplication:SetDataSize(0x59c5435a8570, 1024)
UdpEchoServerApplication:StartApplication(0x59c54355e450)
UdpEchoClientApplication:StartApplication(0x59c5435a8570)
UdpEchoClientApplication:ScheduleTransmit(0x59c5435a8570, +0ns)
UdpEchoClientApplication:Send(0x59c5435a8570)
At time +2s client sent 1024 bytes to 10.1.1.2 port 9
UdpEchoServerApplication:HandleRead(0x59c54355e450, 0x59c54358c170)
At time +2.00184s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00184s server sent 1024 bytes to 10.1.1.1 port 49153
UdpEchoClientApplication:HandleRead(0x59c5435a8570, 0x59c543599870)
At time +2.00369s client received 1024 bytes from 10.1.1.2 port 9
UdpEchoClientApplication:StopApplication(0x59c5435a8570)
UdpEchoServerApplication:StopApplication(0x59c54355e450)
UdpEchoClientApplication:DoDispose(0x59c5435a8570)
UdpEchoServerApplication:DoDispose(0x59c54355e450)
UdpEchoClientApplication:~UdpEchoClient(0x59c5435a8570)
UdpEchoServerApplication:~UdpEchoServer(0x59c54355e450)
```

Figure 1: Logging output with DataRate = 10Mbps and Delay = 1ms

2 Edditing Attributes

The average delay of received packets can be calculated as:

$$\text{Average Delay} = \frac{\text{Total Delay}}{\text{Total Packets}}$$

$$\text{Total Delay} = \text{Receieved Time} - \text{Start of Transmission}$$

In the Figure 1, with the DataRate = 10Mbps and Delay = 1ms. The server received the packet at approximately 2.00184 seconds, which was sent by the client at 2 seconds. So, the average received delay of received packets at the server is approximately $0.00184 - 2 = 0.00184$ seconds.

The client received the packet at approximately 2.00369 seconds, which was sent by the server at 2.00184 seconds. So, the average received delay of received packets at the client is approximately $2.00369 - 2.00184 = 0.00185$ seconds. The overall average received delay of received packets is the average of the above two delays, which is approximately $(0.00184 + 0.00185)/2 = 0.001845$ seconds.

In the figure 2, if we were to change the attributes to DataRate = 5Mbps and Delay = 1ms. The server received the packet at approximately 2.00269 seconds, which was sent by the client at 2 seconds. So, the average received delay of received packets at the server is approximately $0.00269 - 2 = 0.00269$ seconds. The client received the packet at approximately 2.00537 seconds, which was sent by the server at 2.00269 seconds. So, the average received delay of received packets at the client is approximately $2.00537 - 2.00269 = 0.00268$ seconds. The overall average received delay of received packets is the average of the above two delays, which is approximately $(0.00269 + 0.00268)/2 = 0.002685$ seconds.

```
❯ ./ns3 run examples/tutorial/first.cc
[0/2] Re-checking globbed directories ...
[2/2] Linking CXX executable /home/vivarium/ ... uild/examples/tutorial/ns3-dev-first-defaul
UdpEchoServerApplication:UdpEchoServer(0x5cfc63c08450)
UdpEchoClientApplication:UdpEchoClient(0x5cfc63c3fbc0)
UdpEchoClientApplication:SetDataSize(0x5cfc63c3fbc0, 1024)
UdpEchoServerApplication:StartApplication(0x5cfc63c08450)
UdpEchoClientApplication:StartApplication(0x5cfc63c3fbc0)
UdpEchoClientApplication:ScheduleTransmit(0x5cfc63c3fbc0, +0ns)
UdpEchoClientApplication:Send(0x5cfc63c3fbc0)
At time +2s client sent 1024 bytes to 10.1.1.2 port 9
UdpEchoServerApplication:HandleRead(0x5cfc63c08450, 0x5cfc63c40440)
At time +2.00184s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00184s server sent 1024 bytes to 10.1.1.1 port 49153
UdpEchoClientApplication:HandleRead(0x5cfc63c3fbc0, 0x5cfc63c32400)
At time +2.00369s client received 1024 bytes from 10.1.1.2 port 9
UdpEchoClientApplication:StopApplication(0x5cfc63c3fbc0)
UdpEchoServerApplication:StopApplication(0x5cfc63c08450)
UdpEchoClientApplication:DoDispose(0x5cfc63c3fbc0)
UdpEchoServerApplication:DoDispose(0x5cfc63c08450)
UdpEchoClientApplication:~UdpEchoClient(0x5cfc63c3fbc0)
UdpEchoServerApplication:~UdpEchoServer(0x5cfc63c08450)
```

Figure 2: Logging output with DataRate = 5Mbps and Delay = 1ms

3 Capture Packet Traces

3.1 Average delay of received packets at client and server

From the trace we obtain similar results as the logging output. So we can conclude that the logging output is correct, and the calculatio will be the same.

3.2 Packet Delivery Ratio

The Packet Delivery Ratio (PDR) is the ratio of the number of packets received by the destination to the number of packets sent by the source.

$$\text{PDF} = \frac{\text{Number of packet received by the server}}{\text{Number of packet sent by the client}}$$

From the trace, only one packet is sent and received from the client and server, so the PDF = 1.0