

SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2018
ENSC 427: COMMUNICATION NETWORKS

Midterm No. 1
Monday, February 19, 2018

Duration: 110 minutes. Attempt all problems. Questions are not equally weighted. Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted. Please provide brief and concise answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Please write legibly. Illegible text will not be graded. Please use a pen (no pencils, please).

1. Computer Networks and the Internet (10 points):

- (a) Name two reference models for communication networks and list their layers.
- (b) Provide examples of protocols used in each layer.
- (c) List names of data units in each layer.
- (d) List layers present in: server, client, router, and bridge.

2. Application Layer (15 points):

- (a) What is the role of the application layer?
- (b) Provide examples of Internet applications using TCP and applications using UDP. Explain why these applications employ the specified protocol.
- (c) Describe two types of the HTTP protocol.

3. Transport Layer (35 points):

- (a) List main phases of the TCP congestion control algorithm. Indicate each phase on a plot of TCP window size vs. time.
- (b) Describe the TCP feedback mechanism in case of packet loss. How is the packet loss detected by TCP? How does TCP react to each type of packet loss?
- (c) What is Round-Trip Time and how is it estimated?
- (d) What is Timeout? How is its value set in TCP?

4. **Case Study: Distributed Denial of Service Attacks (15 points):**

- (a) What are distributed denial of service attacks?
- (b) Describe the goal of the study and simulation scenarios.
- (c) Summarize main simulation results.

5. **ns-3 Tutorial (25 points):**

Define a topology with two nodes that are connected by a link and consider the listed ns-3 code (page 4):

- (a) Create two nodes and connect these two nodes with a link having bandwidth of 5 Megabits per second as the data rate and a delay of 5 milliseconds. Insert your code in lines 20, 23, and 24.
- (b) Under the *UdpEchoClientHelper* subject, create a traffic source. The packet size is set to 1,024 bytes and the packet will be sent every 1 second. The maximum number of packets that a client is allowed to send during the simulation is set to 5. Insert your code in lines 44–46.
- (c) Schedule the events client application to start at 2 seconds and end at 15 seconds. Insert your code in lines 49–50.
- (d) Describe the difference between the methods used in lines 40–41 and lines 49–50.
- (e) List the command to run *ns-3* scripts. List and describe two functions used to collect and to read simulation results.

```

1 #include "ns3/core-module.h"
2 #include "ns3/network-module.h"
3 #include "ns3/internet-module.h"
4 #include "ns3/point-to-point-module.h"
5 #include "ns3/applications-module.h"
6
7 using namespace ns3;
8 NS_LOG_COMPONENT_DEFINE ("midterm_exam2018");
9 int
10 main (int argc, char *argv [])
11 {
12     CommandLine cmd;
13     cmd.Parse (argc, argv);
14
15     Time::SetResolution (Time::NS);
16     LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
17     LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);
18
19     NodeContainer nodes;
20                                     #fill in here for part (a)
21
22     PointToPointHelper pointToPoint;
23                                     #fill in here for part (a)
24                                     #fill in here for part (a)
25
26     NetDeviceContainer devices;
27     devices = pointToPoint.Install (nodes);
28
29     InternetStackHelper stack;
30     stack.Install (nodes);
31
32     Ipv4AddressHelper address;
33     address.SetBase ("10.1.1.0", "255.255.255.0");
34
35     Ipv4InterfaceContainer interfaces = address.Assign (devices);
36
37     UdpEchoServerHelper echoServer (9);
38
39     ApplicationContainer serverApps = echoServer.Install (nodes.Get (1));
40     serverApps.Start (Seconds (1.0));
41     serverApps.Stop (Seconds (20.0));
42
43     UdpEchoClientHelper echoClient (interfaces.GetAddress (1), 9);
44                                     #fill in here for part (b)
45                                     #fill in here for part (b)
46                                     #fill in here for part (b)
47
48     ApplicationContainer clientApps = echoClient.Install (nodes.Get (0));
49                                     #fill in here for part (c)
50                                     #fill in here for part (c)
51
52     Simulator::Run ();
53     return 0;
54 }

```