

**SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE**

**Spring 2020
ENSC 427: COMMUNICATION NETWORKS**

**Final Examination
Thursday, April 23, 2020**

Duration: 180 minutes. Attempt all problems. Questions are not equally weighted. Please provide detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted. Please write legibly or type your answers (preferred). Please use a pen (no pencils, please). Illegible text will not be graded.

Please sign your solution sheets before uploading the PDF file to Canvas. By signing and uploading your solutions, you agree to recognize your professional responsibility for ethical behavior in this course.

1. Transport Layer (30 points):

- (a) List the mechanisms employed by reliable data transfer (rdt) to deal with:
 - i. Channel with bit errors. How to recover from errors?
 - ii. Duplicate packets. How to handle duplicates?
 - iii. Channel with errors and loss. What is the sender's approach?
- (b) Show the states and main specifications of the finite state machine (FSM) for the rdt3.0 protocol.

2. The Network Layer: Data Plane (25 points):

- (a) List and briefly describe three types of switching fabric. Which, if any, can send multiple packets across the fabric in parallel?
- (b) What is HOL blocking? Does it occur in input ports or output ports?
- (c) What field in the IP header can be used to ensure that a packet is forwarded through no more than N routers?
- (d) Do routers have IP addresses? If so, how many?

3. Wireless and Mobile Networks (25 points):

- (a) What are important differences between 2G, 3G, and 4G-LTE cellular architectures?
- (b) Show elements of a mobile network architecture.
- (c) What is the difference between a permanent address and a care-of address? Who assigns a care-of address?
- (d) What are the purposes of HLR and VLR in GSM networks?

4. Case Study: WiMAX Broadband Access (20 points):

- (a) What is WiMAX?
- (b) List the main elements of the WiMAX broadband architecture.
- (c) Describe the goals of the case study and the simulation scenario.
- (d) Describe the traffic used to evaluate WiMAX performance?
- (e) State the conclusion of the study.