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THE NATIONAL UNIVERSITY OF IRELAND, CORK

COLAISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

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Semester 2 - Summer 2017

CS2505 – Network Computing

Dr. H. Purchase
Professor C. J. Sreenan

Answer all Questions.
Total Marks 80

1.5 hours

The use of electronic calculators is permitted.
Please clearly label your answer to each question and sub-question.

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ENSURE THAT YOU HAVE THE CORRECT EXAM PAPER

Question 1: General Networking Concepts [20 marks]

a) Each sub-question below is worth 2 marks. Answer either *True* or *False* in each case. *[10 marks]*

i) Streaming video is mostly delivered using HTTP.

ii) Layer 3 in the Internet architecture is the Link layer.

iii) Transport-layer demultiplexing in the Internet is based on the use of port numbers.

iv) Congestion is said to occur when queues in routers overflow.

v) The UDP header includes a sequence number.

b) In regard to the composition of the *edge* and the *core* of the Internet, for each (i) name two common physical (hardware) elements, and (ii) state which layers of the IP protocol stack are used. *[10 marks]*

Question 2: Networking Fundamentals [20 marks]

a) In regard to encapsulation:
   i) Why is it considered good practice to minimise the size of packet headers? *[2 marks]*
   ii) Draw a diagram showing the encapsulation of a HTTP message as it passes through a network link. *[4 marks]*

b) Give an equation to express how long it takes for a packet of size *B* bytes to be delivered over a link of length *L* kilometres, with data rate *R* bits/sec, and propagation speed *S* metres/sec. *[6 marks]*

c) Imagine a 4 Mb/s network link that uses time division multiplexing (TDM), with 20 sending computers, each allocated one slot per second.
   i) If just one computer is actively sending, what is the maximum data rate it can achieve? *[4 marks]*
   ii) If instead of using TDM we used statistical multiplexing, what would be the maximum data rate the sending computer could achieve over the link? *[4 marks]*

Question 3: Application Layer [20 marks]

a) A web browser is being used to access a remote web server. It requests a specific web page identified by a URL, and the web page contains links to *two* images. Using a *time-sequence diagram* show the series of application-layer protocol messages that are exchanged between the browser and the server. Also indicate at what points in the exchange an underlying transport layer connection is opened or closed. Be sure to name the application-layer and transport-layer protocols that are used. Assume that the application-layer protocol uses persistent connections *and* pipelining. *[8 marks]*

b) In the context of peer-to-peer file sharing protocols, briefly explain the purpose of a DHT. *[4 marks]*

In regard to BitTorrent, briefly answer the following questions:

i) How does a client find which peers are participating in distributing the file it needs? Mention a possible drawback to this technique. *[4 marks]*

ii) How does a client select the order in which it should request file pieces from among its selected set of peers? Briefly explain why. *[4 marks]*

Question 4: Transport Layer [20 marks]

a) TCP uses a sliding-window protocol. Consider two hosts, A and B, with an open TCP session. A sends a segment with sequence number 5400 and after some time receives a segment from B with sequence number 6100 and acknowledgment number 6600 and Receive/Advertised Window set to 10000.

i) How many bytes were received and confirmed by host B? *[4 marks]*

ii) Is there a relationship between the values of the two sequence numbers? Explain your answer. *[4 marks]*

iii) How will host A interpret the value of the Receive/Advertised Window field?*[2 marks]*

b) Study the diagram below, taken from the lecture notes, showing the finite state machine for the sender in a unidirectional stop-and-wait reliable protocol.

i) Explain what errors this protocol can detect. *[4 marks]*

ii) Why is a 1-bit sequence number sufficient for the correct operation of this protocol? *[2 marks]*

iii) Is it possible for a duplicate packet to arrive at the receiver? If so how would the receiver detect the duplicate*? [4 marks]*