

## COMMUNICATIONS NETWORKS (14ELP009)

January 2015

2 Hours

Answer Question 1, and 2 questions out of Question 2, 3 and 4.

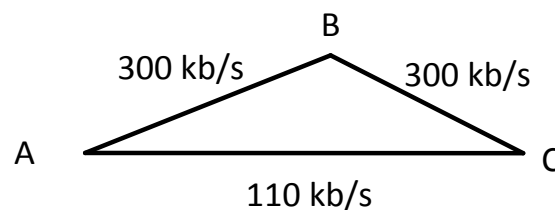
Each question carries 20 marks.

Any University approved calculator is permitted.

1. A communication network with line capacities shown in Figure 1 may be considered to consist of a series of M/M/1 queues. Table 1 shows the average traffic (in packets/second) which passes between each node pair. The mean packet size for the network is 1000 bits/packet.

Select the routing paths between nodes so that the mean packet delay over the network is minimized. Calculate the mean packet delay over the network for the selected routing paths. (Hint: the mean delay for a link is  $1/(\mu c_i - \lambda_i)$ ).

[20 mark]



**Figure 1:** Network with full duplex line capacities in kb/second

		Destination		
		A	B	C
Source	A		100	100
	B	100		100
	C	100	100	

**Table 1:** Traffic between nodes (in packets/second).

2. This question contains 2 parts.

a) The routing table of the router "A" is shown as following.

Destination network	Distance to destination	Next hop
$N_1$	4	B
$N_2$	2	C
$N_3$	1	F
$N_4$	5	G

Suppose A receives the updating from another router "C" as

Destination network	Distance to destination
$N_1$	2
$N_2$	1
$N_3$	3
$N_5$	7

Find the new routing table of "A", and explain the reasons for every item in the new routing table.

[10 marks]

b) A TCP transmission is based on a 1G bps link ( $G = 10^9$ ), and the transmission window size is 65535 bytes. Suppose the confirmation is sent only after all data in a transmission window have been received.

Obtain the throughput of this TCP link (or the amount of data delivered per second).

[10 marks]

3. This question contains 3 parts.

a) Describe the 5-layer structure, and determine whether the reliable transmission can be achieved in each of the layers or not.

[10 marks]

b) At a transmission rate of  $10 \text{ Mbs}^{-1}$  ( $M = 10^6$  here) and a propagation speed of 200 meters/ $\mu\text{s}$ , how many metres of cable is the 1 bit delay equivalent to?

[6 marks]

c) What are the main protocols in the transport layer? What is the main difference of these protocols?

[4 marks]

4. This question contains 2 parts.

- a) In a TCP link, the transmission window size is 3, the receiving window size is 1, and the byte sequence numbers are within the range of [0,15].

Suppose at one time, the receiving window is at byte "5".

List all possible transmission windows at this time.

[10 marks]

- b) The routing table of a router is shown as following

Destination network	Subnet mask	Next hop
128.96.39.0	255.255.255.128	Port $m_0$
128.96.39.128	255.255.255.128	Port $m_1$
128.96.40.0	255.255.255.128	$R_2$
192.4.153.0	255.255.255.192	$R_4$

The router receives a packet, and the destination IP address of the received packet is "128.96.40.12". Determine the next hop for this packet.

[10 marks]

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