

INTERNET AND COMMUNICATION NETWORKS (15LLP101)

JANUARY 2016

2 HOURS

Answer **THREE** questions out of five.

All questions carry **20 marks**

Any university approved calculators are permitted.

Question 1

A communication network has the topology shown below. The communication channels all have data rates of 1Mbits/sec. The routing matrix for the network is shown. The number of frames per second between each node pair is also shown. Assume that the average frame size is 1Kbit/packet.

- i) Calculate the average delay for this network.

[10 marks]

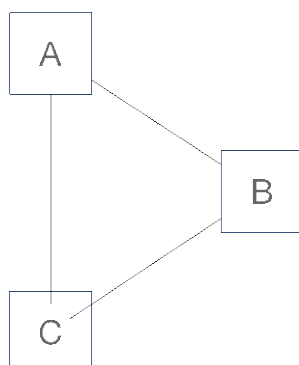
A fourth node (Node D) is added to the network, connected to node A only via an additional communication channel of capacity 1 Mbit/sec. Additional traffic of 100 frames per second in each direction will pass between node D and each other node. Traffic between nodes B and D will follow the route BAD, traffic between nodes C and D will follow the route CAD and traffic between nodes A and D will follow the route AD.

- ii) Adjust the routing and traffic matrix to accommodate the above change in the network.

[3 marks]

- iii) Calculate the new average delay per frame and comment on your results.

[7 marks]



	A	B	C
A	X	300 AB	400 AC
B	300 BA	X	500 BC
C	400 CA	500 CB	X

Question 2

- i) Explain the concept of piggybacking, its advantage(s) and disadvantage(s) when applied to a communication network protocol. **[3 marks]**
- ii) Explain the concepts and operation of a sliding window protocol by means of a diagram (explain the diagram and also what the windows represent). **[8 marks]**
- iii) Suggest a higher layer, which uses windowing techniques. **[1 mark]**
- iv) Explain briefly the concept of a Stop-And-Wait protocol. How does its throughput compare against protocols using Sliding Window and piggybacking? **[2 marks]**
- v) Suggest and briefly describe routing protocols, which would be appropriate for the following case scenarios:
 - a. A military network where reliability is required in a battlefield **[3 marks]**
 - b. A very large network where topology changes occur, but slowly. **[3 marks]**

Question 3

A communications channel is to be built with a bit error rate $P=10^{-5}$. The channel efficiency, without

assuming that P is very small, is given by the following expression:
$$E = \frac{D(1-P)^{H+T+D}}{H+T+D}$$

- i) Taking into account the overhead from Header and Trailer, retransmissions, the bit error probability of the channel P and assuming that acknowledgements are piggybacked, explain all notation used and derive expressions that describe:
 - a. The probability of correct frame reception **[1 mark]**
 - b. The probability of correct frame reception on the n^{th} transmission **[1 mark]**
 - c. The expected number of transmissions using the series
$$[1+2x+3x^2+4x^3 \dots] = \frac{1}{(1-x)^2}$$
 [2 marks]
 - d. The average number of bits required to convey one frame **[1 mark]**
 - e. The efficiency of this channel when the bit error probability is very small. **[2 marks]**
 - f. The optimum frame size for maximum efficiency. **[5 marks]**
- ii) The header and trailer size for the frames sent over the channel is 48 bytes in total. Use the appropriate expressions to
 - a. Calculate the optimum frame size for the network. **[2 marks]**
 - b. Calculate the efficiency if the frame size is equal to the optimum **[2 marks]**
 - c. Calculate the efficiency if the frame size is ten times the optimum **[2 marks]**
 - d. Explain why the efficiency is less than the optimum when not using the optimum size **[2 marks]**

Question 4

- i) For each of the following statements, indicate if the statement is true or false. You do not need to justify your answer. 1 mark for each correct answer **[13 marks]**
- a. In the Internet, the IP Protocol Header is always of fixed size.
 - b. The subnet MASK FF.FF.80.00 could be used on a Class B or Class A network, but not a Class C network.
 - c. The Network Layer of a Communication Network never provides Virtual Circuit operation.
 - d. If an Ethernet Switch is replaced by an Ethernet Hub the number of collisions will increase.
 - e. In the Internet, unique addresses are only required at the Network Layer
 - f. The delay in a communication network reduces to 0 as the traffic load decreases
 - g. The Static Routing algorithm will always provide a more optimum routing decision than the Hot Potato algorithm
 - h. A Router is aware of more network layers than a switch
 - i. The TCP 3-way handshake can not be used as a delay estimation mechanism
 - j. In most network data link protocols, the CRC or Framecheck value allows errors in the transmission of a frame to be corrected
 - k. The IP protocol set does not define the Physical Layer
 - l. The Internet does not use a Physical Layer
 - m. The Network Layer of the IP protocol set provides a Datagram service
- ii) Describe the operation (including a diagram) of Carrier Sense Multiple Access Collision Detection in an Ethernet LAN **[7 marks]**

Question 5

An Ethernet based network has a total cable length of 0.5 Km with a propagation speed of 200 m/ μ sec. Frames are of size 1540 bytes, where 40 bytes in total are used for the Header and Trailer information (overhead). The bit rate of the network is 10 Mbit/sec. Acknowledgements are ignored.

Calculate the effective data transfer rate, assuming that the probability that a station transmits during a contention interval is maximised, for the following situations, in all cases explaining all formulae used:

- i) One station only with many frames to send **[5 marks]**
- ii) Many stations with many frames to send **[15 marks]**