**This question paper consists *Drawing instruments and electronic calculators may***

**of 5 printed pages, each  *be used.***

**of which is identified by the Code**

**Number** ELEC5471M01

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School of Electronic and Electrical Engineering

**January 2018**

**ELEC5471M01**

Communications Networks and Network Security

Time allowed: 3 hours

**Attempt any THREE questions.**

**Each question carries the same number of marks.**

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**NOTES TO INVIGILATOR AND STUDENT**

To obtain full marks candidates must show how answers are derived

All symbols not specifically defined have their normally accepted meanings

Do not write or draw with red ink or red pencil

**Question 1**

TCP provides Congestion Control and Flow Control.

1. Describe the parameters monitored to provide Congestion Control and to provide Flow Control and how are they used? *[10 marks]*
2. Congestion Control
   1. Round-Trip Time
      1. It is used to calculate the time which the data travel from the sender to receiver and back.
      2. RTT is used to calculate the Round-Trip Timeout and thus can infer from whether the network congested.
   2. Packet Loss
      1. TCP through detecting the duplicated ACK package to know whether the packet was loss.
      2. When the loss of packet occurred, the TCP will reduce the transmission of the data to release the congestion.
   3. Window Size
      1. TCP automatically change the size of the Window according to the network situation detected.
      2. The smaller size of the window the smaller speed of the packet to transmit to receiver. And a big Window Size will increase the bandwidth of the network.
3. Flow Control
   1. Receiver’s Window Size
      1. Receiver uses this argument to inform the sender how much the receiver’s buffer left.
      2. Sender adjust the speed of transmission automatically to avoid overwhelming the receiver’s buffer.
   2. Buffer Occupancy at Receiver
      1. TCP track the buffer’s occupancy of the receiver.
      2. If the Buffer Occupancy is close to full, and the TCP will reduce the speed of the transmission to avoid congestion on receiver.
   3. TCP receiver window
      1. It is an argument of the receiver, which point out a number which can be transmitted without acknowledgement.
      2. TCP uses this argument to control the data sender send do not overwhelm the buffer of the receiver.
4. Frames of length 1,000 bits are to be transmitted over the following links using the ‘stop and wait’ Flow Control mechanism. The velocity of propagation across these links is 2.5 108 m.s-1. For each link determine the link efficiency.
5. A 1,250 km link with a data transmission rate of 10 Gbps.

*[2 marks]*

Tpropagation=1250\*10^3/(2.5\*10^8)= 5 \* 10^ (-3) (s)

Ttransmission= 1000/10^9=10^ (-7) (times)

Link efficiency = Ttransmission/( Ttransmission+2\* Tpropagation )=10^ (-7)/(10^ (-7) + 2 \* 5 \* 10 ^ (-3))

1. A 12.5 m link with a transmission rate of 1 Mbps.

*[2 marks]*

Tpropagation=12.5/(2.5\*10^8)= 5 \* 10^ (-8) (s)

Ttransmission= 1000/10^6=10^ (-3) (times)

Link efficiency = Ttransmission/( Ttransmission+2\* Tpropagation )=10^ (-3)/(10^ (-3) + 2 \* 5 \* 10 ^ (-8))

1. Propose a particular application for which the stop and wait flow control mechanism is suitable. Explain what advantages stop and wait has and suggest alternatives where stop and wait is not suitable.

*[6 marks]*

Application: Point-to-point file transfer

Explain: Point-to-point file transfer needs to be get the acknowledgement before the sender send the next data packet.

Advantage:

* + - 1. Simplicity: Stop and Wait flow control is easy to implement.
      2. Reliability: This mechanism ensure the data packet current received successfully otherwise it will wait the retransmission.
      3. Easy to handle error: The error occurred must be last one packet the sender send, thus it is easy for sender to resend the lost packet or incorrect packet.
      4. Low bandwidth requirements: Because it cannot reach a very high bandwidth, thus it is suitable for some scenarios which doesn’t need high bandwidth.

Disadvantages:

1. High bandwidth requirements: Because it cannot reach a very high bandwidth, thus it is not suitable for some scenarios which need high bandwidth.
2. Long transmission delays: The sender always stop and wait the acknowledgement packet, which would cause the long transmission delays.
3. Parallel Data Streams: The efficient will be pretty low when the stop and wait flow control encounters the parallel data streams.
4. Interactive communication: This mechanism is not suitable for Interactive communication.
5. Large File transfers: Due to the mechanism’s serials nature, it is not suitable for large file transfers.

**Question 2**

A key aspect of TCP is provision of a reliable data transfer (RDT) service. A ‘timeout interval’ is used in this provision.

1. Explain what part the ‘timeout interval’ plays in providing RDT. *[4 marks]*
2. The round trip time (RTT) is measured and used in the calculation of the timeout interval. Explain what the RTT is, and how it is calculated. *[7 marks]*
3. Explain how the duration of the timeout interval is determined with reference to the RTT and any other parameters (especially with reference to TCP). *[9 marks]*

**Question 3**

The Open Systems Interconnection (OSI) layered architectural model was developed by the International Standards Organisation (ISO) to describe communication systems.

1. What is the purpose of having such a layered model? *[4 marks]*
2. Specify, in the correct order, the layers of the ISO open systems interconnect model, with example functions performed at each layer. *[8 marks]*
3. Are there disadvantages of using a layered architecture? *[3 marks]*
4. In contrast to the OSI model describe the TCP/IP architectural model. *[5 marks]*

**Question 4**

The Internet is in a state of transition as it changes from using IPv4 to using IPv6.

1. What is the binary equivalent of IPv4 address: ‘64.54.34.1’ *[1 mark]*
2. Compress the following IPv6 address (into the more compact form defined for IPv6 addresses): 47CD:0000:0000:0000:0000:0000:A456:0124 *[1 mark]*
3. Explain the reasons for this transition, the advantages it provides and how the transition is being implemented. *[10 marks]*
4. Detail the different IP exchanges necessary to allow the transition to take place.

*[8 marks]*