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| *This question paper consists of 3*  *printed pages, each of which*  *identified by ELEC5471M* | *Drawing instruments and electronic*  *Calculators may be used.*  *Approved dictionaries may be used.* |

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**Examination for the Degree of BEng or MEng**

**(January 2016)**

**School of Electronic and Electrical Engineering**

**ELEC5471M: Data Communications and Network Security**

**Time allowed: 3 hours**

*Attempt any* **three** *questions*

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| **Do not write or draw with red ink or red pencil** |

* *To obtain full marks candidates must show how answers are derived*
* *All symbols not specifically defined have their normally accepted meanings*

**Question 1**

1. TCP is considered to provide “reliable data transfer”. What does this mean?

*[4 marks]*

1. TCP is connection-oriented protocol and thus it will establish the connection through three handshake step first, after that it can communicate. It can ensure the communication can establish.
2. TCP has retransmission algorithm which can make it retransmit the loss data again according to the ACK, the timer and Sequence number.
3. TCP has the mechanism to detect the error in data such as CRC and checksum, which can ensure the correct of the data.
4. TCP has the flow control which makes the sender will control the speed of the data send ensure the data receiver received cannot over the capacity of the buffer.
5. TCP has the network congestion control which can change the route automatically when occur the congestion at network.
6. Describe how TCP provides reliable data transfer when using an unreliable service provided by the layer beneath the transport layer?

*[4 marks]*

1. TCP using the flow control to manage the speed of the data send between the receiver and the sender to prevent the data sender send don’t overwhelm the buffer of the receiver.
2. TCP using the congestion control to change the route when congestion occurred in the network, which prevent the loss of the data due to the congestion.
3. TCP has the ACK and Sequence number to ensure the data were sent in order. And it will retransmit when the data is loss or incorrect through the timer and the CRC or checksum algorithm.
4. TCP will use the three steps handshake process to establish the connection between the sender and the receiver, which ensure the communication reliable.
5. Since the development of TCP, wireless communications have become far more common. Consequently the Internet is migrating from a predominantly wired network to one including many wireless links, especially at the periphery. How does this impact the performance of TCP?

*[6 marks]*

1. The wireless communication has close connection with the distance, which is shorter than wired networks. 无线设备通常是移动的，在不同的接入点或网络之间移动。 设备从一个接入点切换到另一个接入点的切换过程给 TCP 带来了挑战。 切换期间的短暂中断可能会导致连接中断，需要 TCP 进行调整并可能触发重传。
2. The use of wireless in network will makes the scenario more complex. Because the transmission is through the air, which makes there are a lot of disturbances on air slow down the speed of the transmit data.
3. The increase of disturbance on air will improve the possibility of change the bit of the data, which increase the times of the retransmission and thus slow down the speed.
4. Because the spread of the wireless signal is through air. The sender will broadcast the wireless signal to each on in the wireless network, which will increase the calculation of other device and decrease the efficiency of transmitting data. 无线网络容易受到各种来源的信号干扰，例如其他电子设备或物理障碍物。 信号强度的波动可能会导致数据包丢失或数据传输延迟，从而影响 TCP 的整体性能。
5. 与有线网络相比，无线网络的带宽通常有限。
6. 无线设备通常依靠电池供电，高效的功耗至关重要。
7. 确保无线连接的一致且可靠的 QoS 可能具有挑战性。
8. The mechanism of ‘Fast Retransmit’ is to avoid some of the problems caused by the TCP flow control mechanism. Explain the problem which Fast Retransmit is designed to alleviate, and its operation.

*[6 marks]*

1. 问题：传统的 TCP 流量控制机制依赖于接收数据的确认来确定传输是否成功。 当数据包丢失时，TCP 会等待超时，然后重新传输丢失的数据包。 此超时可能会导致数据传输效率低下，尤其是在暂时丢失的情况下。
   1. 操作：快速重传旨在加快丢失数据包的重传，而无需等待常规超时。 它依赖于对来自接收器的重复确认 (ACK) 的检测。
2. 检测：当数据包丢失时，接收方可能会在丢失的数据包之后收到乱序数据包。 当接收器确认收到的最高顺序数据包时，这些无序数据包会触发重复 ACK 的生成。 TCP 将收到多个重复 ACK 解释为数据包在传输过程中丢失的指示。
   1. 触发：当检测到一定数量的重复 ACK（通常为 3 个）时，发送方认为相应的数据包已丢失。 发送方不会等待常规超时，而是启动丢失数据包的快速重传。

**Question 2**

1. An update to the Internet Protocol (IP) from v4 to v6 is gradually being implemented in the Internet. What is the main motivation for this transition (use quantitative arguments) and describe the range of service changes being made?

*[4 marks]*

1. What addressing scheme is proposed for use in WSNs and why?  *[2 marks]*
2. What is network address translation (NAT), and what problems does it aim to overcome?

*[4 marks]*

1. What is the difference between flow control and congestion control? Describe the objective of each.

*[4 marks]*

1. The majority of Internet traffic uses TCP. Explain why this is the case. Describe what traffic flows use UDP and why. Discuss the impact for varying load conditions on Internet performance if TCP or UDP would be dominant, i.e. carrying the majority of traffic.

*[6 marks]*

**Question 3**

The ISO developed the Open Systems Interconnection layered architectural model to describe communications systems.

1. What is the purpose of having such a layered model?

*[4 marks]*

1. Describe in order, the layers of the ISO open systems interconnection model, and provide an example of a function performed at each layer.

*[8 marks]*

1. Describe potential disadvantages of using a layered architecture.

*[3 marks]*

1. Describe the TCP/IP architecture including in your description the layers and example functions at each layer.

*[5 marks]*

**Question 4**

The study of medium access control (MAC) has taken place over many years as technology has developed.

1. In the context of medium access control (MAC) describe methods of fixed resource allocation.

*[2 marks]*

1. The original Ethernet definition used a Slotted ALOHA based MAC technique. Describe slotted ALOHA in terms of its suitability for computer networks, list the pros and cons of slotted protocols, and explain the resolution of collisions. *[8 marks]*
2. Slotted ALOHA is a standard technique to which other MAC solutions are compared. Show that the throughput of slotted ALOHA can be expressed as S = G.e-G , for offered load G, given that the probability that *k* frames are generated in a given frame interval is given by the Poisson distribution Pr[*k*] = G*k*.e-G / *k*! *[4 marks]*
3. Describe methods of limited contention based MAC techniques, giving the pros and cons of each and their implementation details. *[6 marks]*

**The End**