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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. The mainly reason is that the number of the address in ipv4 has already run out in 2009, we have to raise a new protocol to ensure the uniqueness of the IP address.
      2. The IPv6 has lots of the arguments bit to implements such as QOS service while the IPV4 doesn’t has.
      3. The IPV6 also has the arguments to implement the safety protocol such as tunnel.
      4. The IPV6 has more than 128 bits and thus can contain more information compared to 32 bits in IPV4.

1. What addressing scheme is proposed for use in WSNs and why?  *[2 marks]*
   * + 1. It proposed the MAC protocol to address since it is easily occur collision and waste lots of energy during the transmission in the wireless network.
2. What is network address translation (NAT), and what problems does it aim to overcome?

*[4 marks]*

* + - 1. NAT is aimed at solve the problem that the IPV4 address has been run out and improve the safety in the LAN network.
      2. The NAT is a protocol which is used in the LAN network, it uses the port of the server to generate the ip address in the lan.
      3. The NAT protocol let the ip address doesn’t unique.
      4. If the other part of the network device want to communicate with the subnet device which uses the NAT, they must use the DNAT to translate the destination ip address to the server ip address plus the port of the subnet service.
      5. If the subnet service want to communicate with the service outside, they must use the DNAT to switch its ip address to the service to communicate with the service outside.

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

*[4 marks]*

The difference between flow control and congestion control:

* + - 1. The flow control is mainly about source network device and the destination device, while the congestion control is mainly about the route of the network.
      2. The flow control is aimed at controlling the rate of the sender send segment, while the congestion control is aimed at controlling the congestion of the network.

The objective of the flow control and the congestion control:

1. The objective of the flow control is to control the rate of the sender send segment to ensure the data sender send would not overwhelm the buffer of the receiver.

2. The objective of the congestion control is that controlling the congestion of the network to prevent the congestion when transmission.

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]*

The reason of the majority of Internet traffic uses TCP:

1. The majority of the internet applications need the responsible transmission of the data.
2. The majority of the internet applications do not has such high requirements about the bandwidth.
3. The majority of the internet applications need the data send in turn.

What traffic flows use UDP:

1. The live application, game application and other application, which is not so concerned about the error rate, since it has high requirements of the bandwidth and does not so concern about the rate of error.

The impact for varying load conditions on internet performance:

1. Low load conditions:
   1. If the TCP is dominant, the Internet would have high bandwidth and responsible transmission since the TCP is responsible, but compared with the UDP the bandwidth is not so fast.
   2. If the UDP is dominant, the Internet would have the highest bandwidth while it may have the problem of the error and the data were sent not in turn.
2. High load conditions
   1. If the TCP is dominant, the Internet may not occur the congestion since the TCP has the congestion control, which can make the router choose another route to transmission. And if the rate of the sender is too fast, the TCP also would use flow control to control the rate ensuring the data not overwhelming the buffer.
   2. If the UDP is dominant, the internet will occur congestion, and the data sender send may overwhelm the buffer of receiver, moreover, the rate of the error will increase a lot also.

**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. It can sub-divided the complex problem to many parts, which can make us easier to solve the problem.
2. It can make the process modulization and thus can spare more time on the part other people have not addressed.
3. It will have bigger market in the world since it broadens many aspects about the network.
4. It can make the manufacturers pay more attention on their direction.
5. 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. Application layer
   1. Function: Provide the service to the user directly such as FTP service and other file transfer services.
2. Presentation layer
   1. Function: Transfer the language or message to readable, such as the decoding and assemble.
3. Session layer
   1. Function: Ensure the session going successfully such as establishing the session, recognizing the session and maintaining the session.
4. Transport layer
   1. Function: Providing the service of the error detection for segment and flow control and congestion control, such as TCP.
5. Network layer
   1. Function: Ensure the route can deliver the package reliable and divide every network device unique ip address, such as IP protocol.
6. Link data layer
   1. Function: Ensure the bit transfer reliable, providing the error check mechanism to upper layer such as MAC protocol
7. Physical layer
   1. Function: Make sure the bit transfer through wire or wireless such as the bronze wire.
8. Describe potential disadvantages of using a layered architecture.

*[3 marks]*

1. It is not so popular in the practical applications, since it has no bios to the any business architecture.
2. The define of the layer is too strict, while some protocol cross several layers to run, which disobey the layered architecture.
3. The layered architecture shadow the process the data transmit to upper layer and under layer.
4. Describe the TCP/IP architecture including in your description the layers and example functions at each layer.

*[5 marks]*

1. Application layer
   1. Providing the service to the user such as FTP
2. Transport layer
   1. Providing the error check mechanism and flow control and congestion control such as TCP
3. Network layer
   1. Providing the unique IP address to identify every device such as IP protocol.
4. Data link layer
   1. Providing the error control to avoid the collision in the transform such as MAC protocol.
5. Physical layer
   1. Providing the connection with the network device through wire and wireless.

**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**