**Question 1**

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

*[4 marks]*

1. Describe how TCP provides reliable data transfer when using an unreliable service provided by the layer beneath the transport layer?

*[4 marks]*

1. The mechanisms of TCP were developed for a Wired network. How does this affect the operation of TCP over a network including wireless links?

*[6 marks]*

1. 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]*

**Question 1.**

1. Reliable data transfer means *in-order delivery* of *all data*, Explanation of what this means.
2. Explanation of the mechanisms employed to enhance the service for TCP.
3. Comparison of the error rates for wired and wireless services and how these impact TCP performance.
4. Description of fast retransmit in terms of the selective repeat and go-back-n repeat mechanisms and what triggers this and how it is implemented.

**Question 2**

1. An update to the Internet Protocol (IP) from v4 to v6 is being implemented in the Internet. What is the main motivation for this transition (be quantitative) and describe the range of service changes which are being made?  *[4 marks]*
2. What addressing scheme is typically proposed for use in WSNs and why?  *[2 marks]*
3. What is network address translation (NAT), and what does it aim to achieve?

*[4 marks]*

1. What is the difference between flow control and congestion control and the objective of each? *[4 marks]*
2. The majority of Internet traffic uses TCP. Explain why this is the case, what traffic flows use UDP and why, and discuss the impact for varying load conditions on Internet performance if TCP or UDP are dominant, i.e. are carrying the majority of traffic. *[6 marks]*

**Question 2.**

1. Description of the motivations for moving from IPv4 to IPv6.

(b) Normally 2 layer i.e. a network wide address and Internet world-wide address. This is to allow worldwide addressing if required but to reduce the address field for intra-network addressing.

(c)Explanation of what NAT aims to achieve and how.

(d) Description of what Flow control and congestion control aim to achieve.

(e) Explanation that because TCP provides reliable in order delivery of packets and UDP is useful for Time sensitive traffic which is not concerned about some data errors. For lightly loaded network there will be Little impact if UDP becomes the common protocol instead of TCP though some undetected packet loss (low delay, some undetected packet loss, good througput).

For a heavily loaded network using predominantly UDP there will be Severe packet loss and some unordered packets (causing real problems at the application). Occasional bursts where very rapid successful transfer occurs. (highly variable delay, very high packet loss and poor throughput).

For the overall aggregate traffic in the network for lightly loaded networks using mainly UDP there would be considerable sporadic packet loss. Generally the delay would be low since there would be few acknowledgements and so few retransmissions and all data would be sent at maximum possible rate. (individual packets would suffer little delay when successful, there would be high packet loss when buffer overflow occurred resulting in many lost packets but this would not be a common occurrence). The effect on the aggregate traffic for heavily loaded networks where UDP is predominant will be many UDP flows would cause significant buffer overflow at all routers and so there would be large queuing delays but the overall delay for the successful packets would still be quite low. However there would be very large packets loss and the throughput would be reasonable but any particular flow would be very incomplete suffering many lost packets.

**Question 3**

The ISO developed a layered architectural model to describe communications systems.

1. What is the purpose of having such a layered model?  *[4 marks]*
2. Describe in order, the layers of the ISO open systems interconnect model, and provide an example of a function performed at each layer.  *[8 marks]*
3. Describe potential disadvantages of using a layered architecture. *[3 marks]*
4. Describe the TCP/IP architectural model including in your description the layers and example functions at each layer.  *[5 marks]*

*Question3.*

*(a)* Explanation of rationale for layered modelling (4 reasons).

*(b)*7-Layers with example function.

*(c)*Layering can cause inefficiency though development of cross layer solutions can combat this whilst compromising the principle of layering. Constraining functions to particular layers may inappropriately constrict solutions for some applications.

*(d)*List the layers of the TCP/IP architecture with examples.

**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) what are the methods of fixed resource allocation?  *[2 marks]*
2. The original Ethernet definition used a Slotted ALOHA based MAC technique. Describe slotted ALOHA in terms of its suitability for computer networks, pros and cons of slotted protocols and the resolution of collisions. *[8 marks]*
3. 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 presented 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]*
4. Describe methods of limited contention based MAC techniques giving the pros and cons of each and their implementation details. *[6 marks]*

***Question 4.***

*Frequency, Time, (possible Space or Code)*

1. *Explanation of ALOHA and it’s suitability for computer networks. Extension of this to slotted ALOHA with improvement in efficiency through reduction in vulnerable period. Disadvantage in terms of delay and/or throughput, description of backoff mechanism.*
2. *Simply show derivation of expression.*

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| --- | --- | --- | --- |
| *Protocol* | *Advantage* | *Disadvantage* | *Implementation* |
| *Binary countdown* | *Allows priority assignment* | *Can be slow detemining who will get access to the channel* | *Control Area Network (CAN)* |
| *Basic bitmap* | *Simple & versatile* | *Adds delay and uses resources in determining who will transmit* | *802.15.4 MAC* |

**The End**