The University of Nottingham

SCHOOL OF COMPUTER SCIENCE

A LEVEL 4 MODULE, AUTUMN SEMESTER 2010-2011

Advanced Computer Communications

Time allowed TWO hours

Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced

Answer FOUR questions only

Only silent, self contained calculators with a Single-Line Display or Dual-Line Display are permitted in this examination.

Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.

DO NOT turn your examination paper over until instructed to do so

1. This question concerns multiplexing.

   (a) Define the acronyms STM, PTM and ATM and describe how they operate with reference to some particular implementations. [10 marks]
   (b) Describe the key advantage of PTM and ATM over STM. [5 marks]
   (c) Describe Direct Sequence CDMA and illustrate your answer with a particular chip sequence. Give examples of its use in modern communications systems and describe some of its key advantages. [10 marks]

2. This question concerns the datalink layer.

   (a) Describe Slotted Aloha and provide a formula for the probability of a successful packet transmission based on the number of stations and the transmission probability. [10 marks]
   (b) Show how this can be used to model Ethernet CSMA/CD and derive an equation to show the network efficiency based on the collision window and average packet size. [10 marks]
   (c) Using this equation, describe how efficiency can be maintained as the network speed is increased. [5 marks]

3. This question concerns switching.

   (a) Describe input and output buffered switches and discuss their relative performance and the cost of implementation. [10 marks]
   (b) Describe the crossbar switch fabric and illustrate how a crossbar switch can be used to build larger multi-stage networks. [10 marks]
   (c) Illustrate internal blocking in such a multi-stage switch fabric with an example. [5 marks]

4. TCP is a transport protocol providing a connection-oriented reliable bytestream over an unreliable asynchronous IP network. Reliability is provided by retransmitting lost data based on a retransmission timer. The appropriate transmission rate is determined by adjusting a sliding window.

   (a) Explain the distinction between *unreliable* and *asynchronous* in this context. [2 marks]
   (b) Explain the operation of the 3-way handshake that TCP uses to setup a connection. [2 marks]
   (c) Explain the distinction between flow control and congestion control. [2 marks]
   (d) Explain how TCP provides flow control. [1 mark]
   (e) Explain the basis for, and mechanisms involved in, computing the retransmission timeout. [9 marks]
   (f) Explain the procedures TCP uses to adjust its sliding window. [9 marks]

5.   Consider an IP network that uses Ethernet as the underlying transmission technology. Data originates from a specified IP address, and is forwarded by one or more IP and/or Ethernet devices to a destination IP address.

   (a)   Describe the configuration information which a host with a single Ethernet interface requires to transmit and receive IP packets.   [2 marks]
   (b)   Assuming that the destination is a host that is neither on the same Ethernet nor on the same IP subnet, what else must the source host do before it can send data to the destination, why, and how?   [3 marks]
   (c)   Discuss the potential impact of a change in routing on the UDP and TCP transport protocols.   [3 marks]
   (d)   Illustrate, using one or more simple topologies, the operation of both distance vector and link state routing protocols. Include a brief discussion of the impact of a single link failure.   [12 marks]
   (e)   Briefly compare the scalability of link state and distance vector routing protocols.
                                                                        [5 marks]

6.   Based on the underlying protocol selected, the Berkeley Sockets API presents either a file-like or a packet-like interface.

   (a)   State which transport protocol is used by the two interfaces the Sockets API supports, and describe three key differences between the two interfaces when sending and receiving data.   [4 marks]
   (b)   Define big-, little- and network-endianness and, using examples, demonstrate the problem caused by the distinction.   [3 marks]
   (c)   In the context of network security, briefly define the following four terms: identification; authentication; integrity; confidentiality.   [4 marks]
   (d)   What capabilities are provided by OpenID and OAuth?   [2 marks]
   (e)   Describe and illustrate the capability provided by OpenID operating in dumb mode.
                                                                        [10 marks]
   (f)   Describe how OpenID smart mode provides a performance enhancement over dumb mode?   [2 marks]