

# The University of Nottingham

SCHOOL OF COMPUTER SCIENCE

A LEVEL 4 MODULE, SPRING SEMESTER 2011-2012

## **Advanced Computer Communications**

Time allowed TWO hours

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*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 THREE questions out of five**

*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 the Internet Protocol.
  - (a) Describe the relationship between *layering* and *encapsulation*, and show how IP (the Internet Protocol) encapsulates data for transmission. [5 marks]
  - (b) Illustrate how a host A transmitting an IP packet to a receiving host B uses ARP (address resolution protocol) when both A and B are in the same broadcast domain on a single Ethernet. Describe the differences when host B is on a different Ethernet network to host A. [10 marks]
  - (c) The IP header contains three fields labelled TTL (time-to-live), DF (don't fragment) and MF (more fragments). For each one, describe how it is used, and why the feature it provides is necessary. Select one of the three and describe an alternative approach, comparing it to the original. [10 marks]
  
2. This question concerns transport protocols.
  - (a) Give three features TCP (transmission control protocol) provides that UDP (user datagram protocol) does not, and describe a situation where UDP is thus a more appropriate transport protocol than TCP. [5 marks]
  - (b) Describe the mechanisms TCP uses to provide reliability in connection setup and data transmission, with reference to fields in the TCP header. [10 marks]
  - (c) Naively adding reliability to a protocol can lead to *congestion collapse* in the network. Describe how this occurs, and state and compare two different mechanisms that avoid it. [10 marks]
  
3. This question concerns Ethernet and ATM (asynchronous transfer mode).
  - (a) Describe *Pure Aloha*, providing a formula for the probability of a successful packet transmission based on number of stations and transmission probability. State the effect of using Pure Aloha on the channel throughput. [10 marks]
  - (b) Ethernet is an example of a *connectionless* network, while ATM is an example of a *connection-oriented* network. State what these terms mean and compare the different ways in which each manages *capacity*. [10 marks]
  - (c) Discuss some of the problems that arise when supporting IP over ATM. [5 marks]
  
4. This question concerns naming.
  - (a) After booting, a user requests a web browser visit the site *example.com*. Describe the DNS (domain name system) name resolution or resolutions that take place, starting from initiation of the process by the web browser itself. Include in your answer description of the difference between *recursive* and *iterative* resolution, and the use and impact of *caching*. [10 marks]
  - (b) Explain why DNS lookups usually use the UDP transport protocol, but zone transfers usually use TCP. Describe how the use of UDP for DNS lookup impacted the encoding of names in DNS. [10 marks]
  - (c) How can DNS be used to provide load balancing among servers, and how does this use of DNS interact with caching in DNS resolvers and client software? [5 marks]

5. This question concerns routing and forwarding.

- (a) State which fields in the IPv4 header are used to decide where to forward a packet, which fields are modified during the forwarding process, and why. [5 marks]
- (b) A router with four network interfaces has the following static routes installed:

Prefix	Interface
172.23.6.0/25	eth0
172.23.6.0/23	eth1
172.16.0.0/12	eth2
172.17.0.0/16	eth3
0.0.0.0/0	eth2

Showing your working, explain which interfaces would be used to send packets to the following three destination IP addresses:

172.18.42.34  
172.23.6.118  
128.243.40.11

[10 marks]

- (c) Describe the three phases of a link state routing protocol, in terms of what each phase aims to achieve and how each phase works. Illustrate your answer by considering the network graph defined as follows:

Source Node	Destination Node	Link Metric
A	B	5
A	C	2
B	C	1
B	D	1
C	D	3

where each row gives the metric associated with a bidirectional link connecting the two specified nodes. Briefly discuss what happens if the link between nodes B and C fails.

[10 marks]