

UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For the following qualifications :-

B. Sc.

Comp Sci C363: Network Communications

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| COURSE CODE | : | COMPC363 |
| UNIT VALUE | : | 0.50 |
| DATE | : | 03-MAY-01 |
| TIME | : | 14.30 |
| TIME ALLOWED | : | 2 hours 30 minutes |

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TURN OVER

(Answer three questions out of five. College recognized calculators are permitted. In calculations make sure that you show all the working out, and that you take care to include the units for each value).

Question 1

You work for a company that provides networking solutions for customers. One customer wants to provide voice mail capabilities via the Internet, so that staff can benefit from computer telephony integration in accessing voice mails. You have been asked to write a report detailing your solution. Provide the following information for your report.

- a) Answers to the following series of FAQs: -
- i) Why can't base-band digital data be transmitted directly down a fibre-optic cable?
 - ii) Why does mono-mode fibre have the biggest potential bandwidth?
 - iii) What are the causes of PCM30 loss of frame (or multi-frame) alignment?
 - iv) How are PCM30 carriers mapped into SDH?
- [14 marks]
- b) A digital EI carrier frame has 30x8-bit slots available for traffic, 1x8-bit slot for signalling and 1x8-bit slot for synchronisation purposes. Calculate the size of each frame in bits. If frames repeat every 125 μ s, calculate the bit-rate of the EI carrier, and the bit-rate of the signalling channel. [4 marks]
- c) Design a network solution to give the customer voice mail capabilities via the Internet. Draw a diagram of the network solution. Assume that the company has an Ethernet network to connect all employee's PCs together, and a PBX that can be set-up to route unanswered calls onto a carrier. Detail any extra equipment that your solution requires, and assess any hidden costs of your solution. [15 marks]

Question 2

The company 'Engineering Solutions Ltd.' has a variety of high-end PCs that are networked together using Ethernet. You work in the network group that is responsible for maintaining the networked PCs. Currently you have a number of 10Mbps Ethernet segments, connected together using a fast Ethernet backbone network. You need to write a report that includes: -

- a) Background information on the following: -
- i) Why hubs have become a fundamental part of Ethernet networks.
 - ii) The role of Ethernet switches.
 - iii) The Ethernet MAC protocol is often nick-named both 'Listen before talk', and 'Listen while talk'. Identify how these nick-names relate to the Ethernet MAC protocol.
 - iv) How 1-persistent CSMA works, and include in your answer a description of the binary exponential back-off algorithm.
- [10 marks]
- b) An explanation of how the use of twisted pairs has altered between 1 set of Ethernet specifications and the next, and why this is so (e.g. between 10Mbps Ethernet and Fast Ethernet, and between Fast Ethernet and Gigabit Ethernet). [5 marks]
- c) A design for an upgrade for the network that incorporates Fast Ethernet technology for some groups of high-end PCs, and gigabit Ethernet for the backbone. [6 marks]
- d) An explanation of a frame format of an Ethernet, including a calculation of the minimum size of a frame. Assume that the Ethernet network has a network span of 300m, and runs at 1000Mbps over twisted pair, that the propagation speed in copper is 200m / μ s, second, and that the Ethernet MAC protocol is CSMA/CD. [12 marks]

Question 3

You work for a fledgling Internet service provider (ISP), and are designing the company's first Point of Presence (POP).

- a) Provide some technical information that will be offered as a series of FAQs from your content server for your new customers.
- i) What does the protocol stack for web access over the Internet look like? (Layers above the Internet protocol (IP))
 - ii) How does IP provide inter-working between lots of different network technologies?
 - iii) What functionality does the transmission control protocol (TCP) offer over that provided by IP?
 - iv) What function does the domain name server (DNS) serve in the Internet?
- [10 marks]
- b) Draw a diagram that shows how a home user (who has a modem and a phone line) might connect into your POP, over a backbone network to the main Internet. Also in your diagram, you should include a connection to an ISP's content server, and a connection to a DNS. Identify in your diagram where ATM might be used.
- [13 marks]
- c) Consider IP being transmitted over ATM. Calculate the approximate underlying bit-rate required per voice connection. Assume that each IP voice packet contains 160 bytes of data, which corresponds to 40ms worth of audio. Assume that the IP / UDP / RTP header is 40 bytes long, and that ATM cell sizes are 53 bytes, of which 48 bytes are for carrying data.
- [10 marks]

Question 4

A company is going to start offering ADSL technology to the home user for use over the local loop, and is producing some advertising material to launch the product. Your job is to write the technical documents that will be made publicly available over the web. Write technical documentation on the following: -

- a) Voice can be transmitted down the local loop either as an analogue signal, or (having been converted into a digital representation) as a digital signal. Explain the degradation in quality that each might suffer, and include in your answer details of the operation of any devices you might add to both the analogue case and the digital case to enable the voice to be transmitted further.
- [10 marks]
- b) The 'electrical' bandwidth of a voice channel is 4,000Hz. You are going to transmit down the channel using digital data that has two possible levels. Calculate the data transmission rate. Instead of using a two level signal, you have now decided to use multi-level signalling with 9 bits per level. Calculate how many possible levels can be transmitted, and the improved data transmission rate. What is the limiting factor in the use of multi-level signalling?
- [8 marks]
- c) What market is asynchronous digital subscriber line (ADSL) technology aimed at and why? Is ADSL transmission based on analogue and / or digital technology - why? Do you think that the bit-rate achieved by DSL technology can be increased and if so how? Or if not why not?
- [15 marks]

Question 5

The public switched telephone network (PSTN) consists of local exchanges that connect wired users, mobile switching centres that connect mobile users, and the core network that interconnects local exchanges together. You work in the 'advanced technologies' group that is responsible for mobile access to the Internet. Part of your network planning task is to write a document that provides: -

- a) Background information on the following: -
 - i) The functionality of the local exchange
 - ii) The functionality of the mobile switching centre
 - iii) How frequencies are re-used in the cellular environment
 - iv) How a mobile connects to the mobile switching centre

[12 marks]

- b) Design a frequency allocation plan for a small mobile network with 15 cells. Assume that there are 8 frequencies to allocate, that we need uniform coverage, with 2 small 'hotspots' at a train station and an airport

[11 marks]

- c) Explain how a call from a wired network to a mobile phone is made

[10 marks]