NUI Galway
OÉ Gaillimh

Semester 1 Examinations 2015 / 2016

Exam Code(s)	3BCT
Exam(s)	Third Year Computer Science & Information Technology
Module Code(s)	CT3531
Module(s)	Networks and Data Communications 2
Paper No.	1
External Examiner(s)	Dr. J. Power
Internal Examiner(s)	Prof. G. Lyons Dr. M. Madden *Dr. D. Chambers

Instructions: Answer any 4 questions.
All questions carry equal marks.

Duration	2 hrs
No. of Pages	4
Department(s)	Information Technology
Requirements	None

Question 1

a) What are the main advantages of using a Digital Signal instead of an Analog Signal? Suppose we have a communications channel with 20MHz of bandwidth. How many bits/sec can be sent over one of these channels if 1024-level digital signals are used? Assume a noiseless channel. 12 MARKS

b) LTE (4G) mobile internet channels are generally about 10MHz wide in terms of bandwidth. What is the minimum signal-to-noise ratio (in decibels) required to transmit a 100Mbps data stream through one of these channels? Also, what is the minimum number of signal levels required in the transmitted digital signal to achieve that data rate? 13 MARKS

Question 2

a) Most existing wired Local Area Networks are now based on Cat-5 UTP type cabling. Suggest a suitable modulation and encoding scheme that facilitates fully duplex 100Mbps data transmission using one cable pair in each direction. The physical signal that is transmitted over the cable should have a maximum frequency component of about 31.25Mhz. 10 MARKS

b) Explain how analog to digital conversion works. In this context, why has the PCM sampling time, as used in digital speech encoding for the telephone network, been set at 125μS? What is the resulting data rate required to transmit a single digitised voice channel using the standard PCM encoding scheme? What type of channel is typically used to aggregate multiples of these voice conversations into a single data stream e.g. using time division multiplexing techniques? 15 MARKS

Question 3

a) What are the main enhancements provided in IPv6 over IPv4 and what impact is this protocol likely to have in the way we use the internet? Why has the new protocol not included protocol header support for IP fragments? How many IPv6 addresses are typically being allocated to each customer by ISPs? Give an example of what an IPv6 address will look like. 12 MARKS

b) There are well known problems with the performance of TCP that can occur when a sending application delivers data to TCP one byte at a time or a receiving application reads data from TCP one byte at a time. An example of what can cause such problems is the individual keystrokes transmitted and received during a remote login session. Explain fully how these problems can occur and describe possible solutions to mitigate against these issues in TCP. 13 MARKS

Question 4

a) Explain briefly the role and function of the RIPE organisation. What kind of information may be found in the RIPE database? 5 MARKS

b) In the context of email handling what does the term "DNS Blacklist" mean and how are these used by mail servers? Describe how email transfer agents cope with the transmission of messages containing multiple parts and in some cases arbitrary binary data e.g. image files. Compare the relative merits of using POP3 vs IMAP for delivery of email to clients. 10 MARKS

c) Describe using an appropriate example the purpose and the operation of the Domain Name System (DNS). What Protocols and Port numbers does DNS normally use? Given the following set of DNS Resource records, if you sent an email to joe@cs.vu.nl what SMTP server(s) could be used to receive and process the incoming message?

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; Authoritative data for cs.vu.nl
cs.vu.nl.          86400   IN   SOA      star boss (952771,7200,7200,2419200,86400)
cs.vu.nl.          86400   IN   TXT      "Divisie Wiskunde en Informatica."
cs.vu.nl.          86400   IN   TXT      "Vrije Universiteit Amsterdam."
cs.vu.nl.          86400   IN   MX       1 zephyr.cs.vu.nl.
cs.vu.nl.          86400   IN   MX       2 top.cs.vu.nl.

flits.cs.vu.nl.    86400   IN   HINFO    Sun Unix
flits.cs.vu.nl.    86400   IN   A        130.37.16.112
flits.cs.vu.nl.    86400   IN   A        192.31.231.165
flits.cs.vu.nl.    86400   IN   MX       1 flits.cs.vu.nl.
flits.cs.vu.nl.    86400   IN   MX       2 zephyr.cs.vu.nl.
flits.cs.vu.nl.    86400   IN   MX       3 top.cs.vu.nl.
www.cs.vu.nl.      86400   IN   CNAME    star.cs.vu.nl
ftp.cs.vu.nl.      86400   IN   CNAME    zephyr.cs.vu.nl

rowboat                    IN   A        130.37.56.201
                           IN   MX       1 rowboat
                           IN   MX       2 zephyr
                           IN   HINFO    Sun Unix

little-sister              IN   A        130.37.62.23
                           IN   HINFO    Mac MacOS

laserjet                   IN   A        192.31.231.216
                           IN   HINFO    "HP Laserjet IIISi" Proprietary
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10 MARKS

Question 5

Assume that you are working for a large corporation that is using the private IP address range 172.16.0.0/16 for its internal network. The company management wants to be able to accommodate at least 30 departments where each department has its own routed subnet with at least 2000 hosts per department subnet. You are requested to design the network layout. Answer the following questions and fully explain the logic behind each answer:

a) What subnet mask will need to be used? 5 MARKS

b) What is the maximum number of subnets that the company network can accommodate given that there are at least 2000 hosts per subnet? 5 MARKS

c) What are the valid host addresses on the first and second subnets? 5 MARKS

d) What is the network and broadcast address for the last available subnet? 5 MARKS

e) What other private IP ranges could the company use if needed? 5 MARKS