

## EXAMINATIONS – 2013

### TRIMESTER 2

NWEN 243

Network Applications

**Time allowed:** THREE HOURS

**Instructions:** Closed Book

Answer all questions

There are 6 questions, each question is worth 30 marks.

Question 1: Physical and Datalink Layers

Question 2: Network Layer

Question 3: Transport Layer

Question 4: Cryptography and Security

Question 5: Email/FTP/DNS/Web Service

Question 6: Web Caching/P2P/Multimedia Streaming

Only silent non-programmable calculators or silent programmable calculators with their memories cleared are permitted in this examination

No other materials are permitted.

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Question 1: Physical and Datalink Layers

[30 MARKS]

a)

i. [4 Marks] List two sources of signal degradation in wire.

2 ea. Limited Bandwidth, Attenuation, Delay distortion, Line Noise

ii. [2 Marks] What is Wave Division Multiplexing in Optical Fibre?

Multiple signals carried by different light frequencies (colour)

b)

i. [4 Marks] How many wires do I need to physically connect 15 computers in a fully connected topology?

15 is a large number, so they don't draw and count.  $n(n - 1) / 2 = 15 * 14 / 2 = 105$

ii. [4 Marks] How many wires do I need to physically connect 15 computers using a Bus?

1, or if counted as separate links, 14.

c)

i. [4 Marks] Explain what happens when a packet arrives at a hub.

A hub is network transparent. Incoming messages are simply copied from the incoming link to the outgoing links. There is no management, and the hub is not concerned about who or what is connected on any link.

ii. [6 Marks] Outline what happens when a packet arrives at a switch.

A Switch is network active. When an incoming packet arrives at an interface, the switch looks up the destination in its table. If there is an entry, send the packet down that link (unless it is the sending link, in which case drop the packet). If the destination is not in the table, send the packet out on all outgoing links and add to the table.

d)

[6 Marks] Outline and explain CSMA/CD.

2 ea.

\* Carrier Sense – check no one else is already talking (Multiple Access)

\* Collision Detection – listen while transmitting, if your data is corrupted, then someone else is sending too (collision).

\* Back off, with say, random or priority etc.

a)

BGP is an internet routing protocol.

i. [2 Marks] What does the BGP acronym stand for?

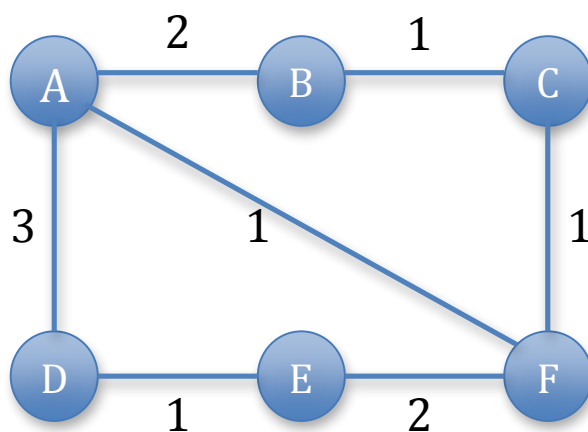
**Boarder Gateway Protocol**

ii. [4 Marks] What does BGP do?

**BGP connects autonomous systems, ISPs, etc. Allowing routing between bits of the IPv4 address space, via prefixes.**

b)

Consider the following network using the Distance Vector algorithm:



After learning the direct links, A's routing table looks like this:

$D^A()$	B	D	F
B	2		
C		3	
D			
E			
F			1

i. [6 Marks] Give the tables for nodes B, D and F at the same point in time.

**2 ea. B, A->2, C-1 : D, A->3, E->1 : F, A ->1, C->1, E->2**

**Make sure they are in the right columns!**

ii. [2 Marks] A gets an update from F, give the resulting table at A.

$D^A()$	B	D	F
B	2		

C		3	$1 + 1 = 2$
D			
E			$1 + 2 = 3$
F			1

iii. [2 Marks] A next gets an update from B, give the resulting table at A.

D <sup>A()</sup>	B	D	F
B	2		
C	$2 + 1 = 3$	3	2
D			
E			3
F			1

c)

Y

ou have been given the IPv4 range 193.222.87.0/24. You need to split this into 4 equal subnets.

i. [8 Marks] What are the 4 subnet addresses?

2 ea.

193.222.87.0/26

193.222.87.64/26

193.222.87.128/26

193.222.87.192/26

ii. [2 Marks] What is the subnet mask?

255.255.255.192 = 26

iii. [4 Marks] A host in this network has the IP 193.222.87.203. Give the IP address it would use for broadcast.

193.222.87.255

Question 3: Transport Layer

[30 Marks]

a)

[2 Marks] What is the role of the Transport Layer?

Application to application delivery of data.

b)

i. [1 Mark] TCP/IP are \_\_\_\_glass protocols.

Hour. Hey, free marks anyone?

ii. [4 Marks] Why are they so described?

They take an n:m application to media mapping problem and turn it into a n:1 and 1:m problem. This thin neck resembles the neck of an hourglass.

c)

i. [4 Marks] What is a Socket?

A socket is a software endpoint for communication. It forms the interface between the OS controlled local network stack and the application.

ii. [4 Marks] What is a port?

A port is a address space for a protocol on a machine. It differs depending on the protocol, e.g. UDP and TCP port numbers are different for the same numeric value.

ii. [4 Marks] What are headers?

Contain meta information for coordinating the distributed ends of the various layers.

d)

ll following questions relate to **TCP**

A

i. [2 Marks] What is piggybacking?

Send acks on data packet, rather than separately.

ii. [4 Marks] Distinguish between flow and congestion control.

Flow control advised the sender of the recievers buffer limits, so as not to send more data than the receiver can handle.

Congestion control limits the rate at which data can be sent in to the network. When segments are lost (assumed due to congestion) the rate is reduced and then begins to increase again. Over time this should tend to a fair share of network capacity.

iii. [5 Marks] Outline the steps taken when a **server** gets a client connection request.

Slide 28, lecture 7. NOT handshaking, the word server should indicate this.

Question 4: Cryptography and Security

[30 Marks]

- a) [3 Marks] Give an example of how trusted and trustworthy differ.

NSA agent, blah blah blah. Snowden I suppose.

- b) [3 Marks] State Kerckhoffs's Principle.

“All algorithms must be public; only the keys are secret”

- c) [3 Marks] Distinguish between transposition and substitution cyphers.

Transposition retains value, changes place. Substitution, retains place, changes value.

- d) [3 Marks] What is a polyalphabetic Cypher?

Uses alternative enciphering alphabets, usually depending on position in text.

- e) [7 Marks] Using a OTP – encode and then decode the following string “GO”. You must show your working. The ASCII : Binary conversion is given below.

G: 0100 0111

O: 0100 1111

The (not so) random bits are: 0101 0101 0101 0000

0100 0111 0100 1111

0101 0101 0101 0000

0001 0010 0001 1111 (Result of XOR)

0001 0010 0001 1111 (Result of XOR)

0101 0101 0101 0000 (apply the random bits again)

0100 0111 0100 1111

G O

- f) [3 Marks] Why does the locked box analogy not work in reality?

Because the order of application in crypto matters, i.e.  $B(A(x)) \neq A(B(x))$

- g) [8 Marks] Show how a KDC enables a session key to be safely established.



Slide 7, Lecture 14.

a)

Refer to the electronic mail delivery process as illustrated in Figure 1.

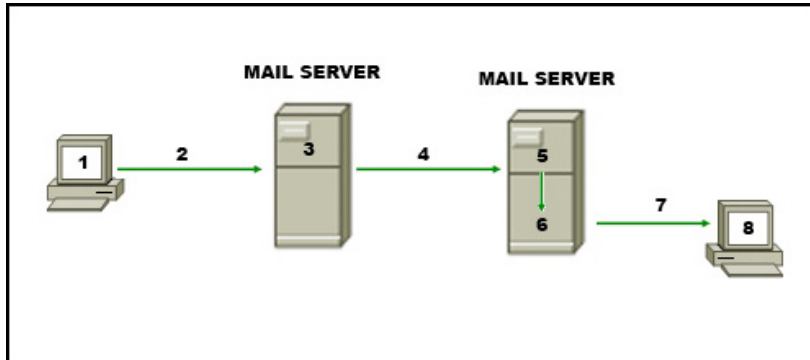


Figure 1

i. [5 Marks] Which software component is used in each of steps 1, 3, 5, 6, and 8?

**1.MUA 3.MTA 5.MTA 6.MDA 8.MUA**

ii. [3 Marks] Which protocol is used in each of steps 2, 4, and 7?

**2.SMTP 4.SMTP 7.POP**

b)

i. [2 Marks] Suppose that the stream data transfer mode is used to transfer a file through a FTP data connection. Explain how the file sender can signal to the receiver the end of the transmission of the file.

**The file sender can signal the end of the transmission of a file by closing the data connection.**

ii. [4 Marks] Explain why the stream data transfer mode is by far the most widely used in real FTP implementations.

**Of the three data transfer methods, stream mode is the one that is by far the most widely used in real FTP implementations. There are likely three reasons for this.**

**First, it is the default and also the simplest method, so it is the easiest to implement and one that is required for compatibility.**

**Second, it is the most general, because it treats all files as simple streams of byte without paying attention to their content.**

**Third, it is the most efficient method because no bytes are wasted on "overhead" such as headers.**

c)

The domain name system (DNS) is a hierarchical distributed naming system for computers, services, or any resource connected to the Internet or a private network.

i. [1 Mark] Who is responsible for managing the top-level domain name space?

The Internet Corporation for Assigned Names and Numbers -- ICANN

ii. [4 Marks] In DNS, multiple name servers are often used for each DNS zone. Explain how secondary servers should be selected.

Servers should be placed so that it is likely that at least one server will be available to all significant parts of the Internet, for any likely failure.

Consequently, placing all servers at the local site, while easy to arrange, and easy to manage, is not a good policy.

Secondary servers must be placed at both topologically and geographically dispersed locations on the Internet, to minimize the likelihood of a single failure disabling all of them. They should also be connected to the Internet via quite diverse paths.

d)

i. [2 Marks] What is a Web Service?

A Web Service is a standards-based, language-agnostic software entity, that accepts specially formatted requests from other software entities on remote machines via vendor and transport neutral communication protocols, producing application specific responses.

ii. [2 Marks] State the use of the default namespace in an XML document.

Adding a prefix to every element in the document decreases readability and increases document size. Therefore, XML namespaces allow us to use a default namespace in a document. Elements belonging to the default namespace don't require prefixes.

iii. [3 Marks] Demonstrate the use of default namespace through a simple XML document.

```
<table xmlns="http://www.w3.org/TR/html4/">
  <tr>
    <td>Apples</td>
    <td>Bananas</td>
```

</tr>  
</table>

iv. [2 Marks] What is the UDDI business registry?

The UDDI Business Registry provides a place for a company to register its business and advertise its services.

People or businesses that need a service can use this registry to find a business that provides the service.

v. [2 Marks] In a WSDL document, which element is used to specify the network address of the endpoint hosting the Web Service?

The port element which associates a single protocol-specific address to an individual binding element.

a)

[3 Marks] List at least THREE benefits of Web Caching?

Help to reduce cost

Help to reduce latency

Help to reduce server workload

Help to reduce network bandwidth consumption

b)

[4 Marks] Identify at least FOUR potential benefits of increasing cache capacity in Web browsers.

Further reduced bandwidth requirement, because you can get what you need locally.

Further reduced latency, because the requested information is locally available to you.

Further reduced cost, because you do not need to use the networking service to satisfy every single request.

Access interesting information even when you are offline.

Keep a historic copy of the information - e.g. can help you to keep track of modifications made to a Web page.

c)

[4 Marks] What is open proxy and who can use an open proxy?

An open proxy is a proxy server that is accessible by any Internet user.

Generally, a proxy server only allows users within a network group (i.e. a closed proxy) to store and forward Internet services such as DNS or web pages to reduce and control the bandwidth used by the group. With an open proxy, however, any user on the Internet is able to use this forwarding service.

d)

Peer-to-Peer (P2P) networks serve as an important paradigm for constructing Internet applications.

i. [3 Marks] Explain the key concept of P2P overlay networks.

A peer-to-peer network is a network of computers configured to allow data and services to be shared with everyone or with selected users. A pure peer-to-peer network does not have the notion of clients or servers,

but only equal peer nodes that simultaneously function as both "clients" and "servers" to the other nodes on the network. This model of network arrangement differs from the client-server model where communication is usually to and from a central server.

ii. [6 Marks] Explain the drawbacks of both the structured and the unstructured P2P networks.

The main disadvantage with such networks is that the queries may not always be resolved. Popular content is likely to be available at several peers and any peer searching for it is likely to find the same thing, but if a peer is looking for rare data shared by only a few other peers, then it is highly unlikely that search will be successful. Moreover, flooding also causes a high amount of signalling traffic in the network and hence such networks typically have very poor search efficiency.

The main disadvantage of structured P2P networks include: (1) Underlying network path can be significantly different from the path on the DHT-based overlay network; (2) Higher overheads for popular content; and (3) high maintenance cost for node joins and leaves.

iii. [2 Marks] Propose a simple mechanism that encourages fairness in P2P overlay networks.

Each peer keeps track of peers it has received segments. When a peer asks to download from it, check its list, if the peer has provided segments in the past, the peer gets a higher priority. Otherwise, the peer gets a lower priority.

e)

[3 Marks] State the THREE main problems to be solved in order to allow a best-effort multimedia service to be implemented at the application-level.

Limited bandwidth

Random network delays

Packet loss

f)

[5 Marks] Outline the Interleaving scheme used by multimedia protocols to handle the effect of packet loss.

Interleaving makes no attempt to replace a lost chunk. Instead it attempts to "hide" it by reducing the impact. For example, consider four

consecutive chunks of an audio stream. Each chunk can be divided into four quarters and can be further rearrange into different transmission blocks. If one block lost in transit, we still have 3/4 of each chunk. The lost sound is unlikely to be noticed.

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