DEPARTMENT OF COMPUTER SCIENCES AND SOFTWARE ENGINEERING
AUBURN UNIVERSITY

COMP 4320
Introduction to Computer Networks
Spring 2014

Test 1
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11:00am – 12:15pm

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This exam contains 6 questions; make sure your copy has them all. This is a closed-book test. Write all your answers in this test booklet. Give brief and concise but thorough answers to the questions. Where applicable, show all you work in deriving the answers.

1. In the past, a popular network model is the OSI (Open System Interconnection) network model proposed by the ISO (International Standard Organization). Compare between the TCP/IP and the ISO/OSI network reference models.
   (a) What is a network reference model?

Shows the different layers of a given network. It also defines the functionality of each layer.

Network Archetecture

Missing transport layer

   (b) Briefly describe the main difference between the TCP/IP and the ISO/OSI reference models. Be sure to describe the difference layers in each model and the main functions that are in each layer.

TCP/IP

Application - FTP, HTTP, IMAP ect
network - UDP, TPL
link - Ethernet twisted pair
physical -

ISO/OSI adds two layers to the network reference model. ISO/OSI ensures data is delivered, by the network, where ICP/IP only gives best effort. ISO/OSI also handles sessions requiring a state. ICP/IP does not

ISO/OSI

Application - processes
machine - Decoding of data - Encryption - Encoding - etc
session - ensure data Delivery
network - protocols
link - Ethernet twisted pair
physical

   (c) Why was the ISO/OSI model not appropriate for implementing very large computer networks? Give the main reasons.

ISO/OSI has a state, adding overhead to each transaction
ISO/OSI Ensured data was delivered, adding over head.
↳ to complex
↳

2. What are the four main principles used in designing the TCP/IP Internetworking Protocol? Also, for each of these, explain *why* that principle is important for contributing to the successful implementation of an extremely large and complex Internet.

(a) Best effort

Does not ensure data is delivered, but does everything possible to deliver data. This is important because it reduces the requirements of the network lowering the overhead of each packet sent. It also allows the network to be stateless

(b) Stateless

Does not remember anything. This also allows for the network to reduce overhead for each packet being sent. The network does not have disaster-recovery built in.

(c) De-centralized

There is no main processing node for all traffic. Allowing the network to expand as more nodes are added instead of having to always increase size of central node. Also allows for self healing if a node crosses, packets can be routed around dead node.

(d) ~~layering~~ Minimizm → Header info, layers,
& Autonomy → local Interation

To seperate out functionality. Allows for different layers to provide Interfaces for their specific task and allows that layer to be rewritten without Impact on other layers.

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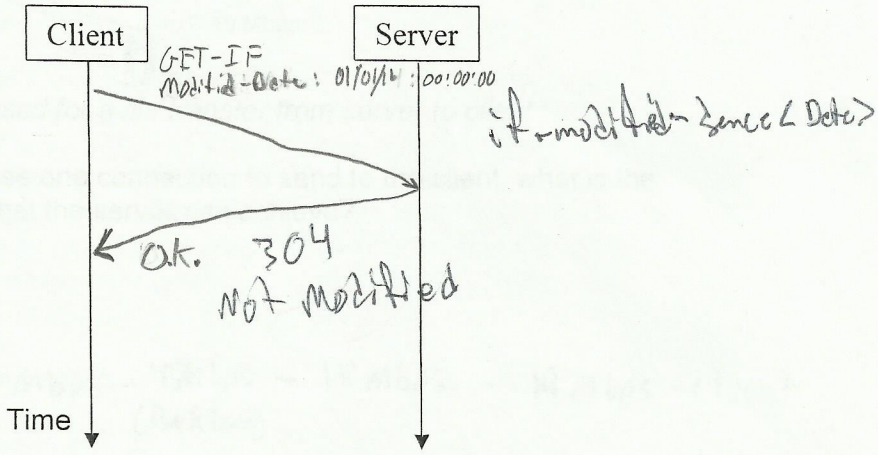
3. Consider the Web proxy server.

(a) Describe how the Web proxy server ensures that its copy of a Web page in its cache is up-to-date and that Web page in the origin server is not modified since its copy was cached.

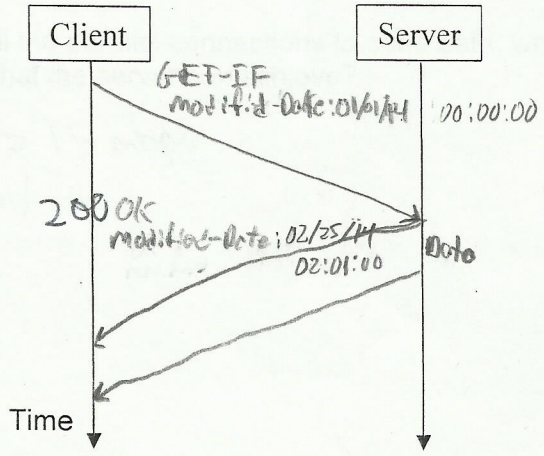
The Web proxy server checks the modified date of the origin server and makes sure that it has not been modified after the date of the proxy webpage.

(b) Show the messages that must be exchanged between the Web proxy server and the origin server in the timeline below. In the messages, show the field in the HTTP header that must be used and the important content of the messages. In the diagrams below, show the above message exchanges for two cases: (i) the Proxy server Web page is *up-to-date*, and (ii) the Proxy server Web page is *out-of-date*.

i. up-to-date



ii. out-of-date



4. Figure 1 shows a sub-net, where there are three connections between the client and the server. Each connection consists of 5 links with transmission rates as shown in Figure 1. All connections use a shared backbone link, whose capacity of 45 Mbps is shared equally among the 3 connections.

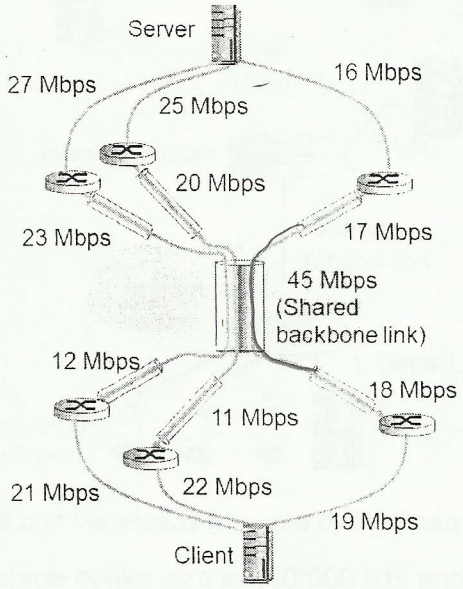


Figure 1. Connections used for a file transfer from server to client

(a) If the server can only use one connection to send to the client, what is the maximum throughput that the server can achieve?

15 because of shared

16 mbps

-2.

Server — 16 mbps — 17 mbps — 45 mbps — 18 mbps — 19 mbps — client
(Backbone)

largest limiting link of all three connections

(b) If the server can use all the parallel connections to send data, what is the maximum throughput that the server can achieve?

Server — 16 mbps → 15 mbps
— 11 mbps — client.
— 12 mbps

-3

39 Mbps

It is the sum of each limiting link in each connection.

5. Consider the following institutional network that is connected to the Internet (Figure 2).

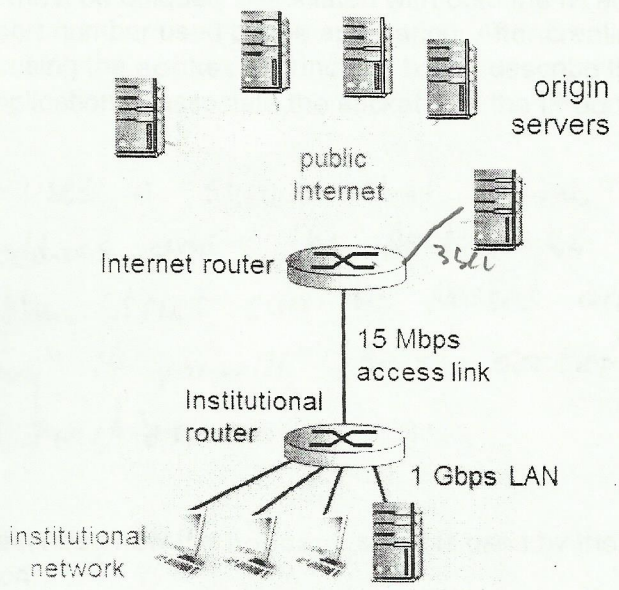


Figure 2. Networks and the access link used by Web servers to Web clients

Suppose that the average object size is 450,000 bits and that the average request rate from the institution's browsers to the origin servers is 32 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is 3 seconds on average. Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institutional router) and the average Internet delay. Assume that if the utilization at the access link is less than 60%, then the queuing delay is 0.

(a) Calculate the access link utilization.

$$\frac{32 \times 450{,}000}{15 \times 10^6} = .96 = 96\%$$

(b) Estimate the total average response time. Justify your answers.

Internet → 3 sec + Internet router queuing delay + low delay in Institutional network = response time > 10 seconds.

(If ever, due to the high access link utilization)

is incalculable. The throughput of the access link would be almost 0, causing massive queuing delays and large drop rates

(c) Now suppose a cache is installed in the institutional LAN. Suppose the cache hit rate is 0.4. Find the total response time.

$.4(32) = 12.8$

thus 19.2 requests per second to Internet.

$$\frac{19.2 \times 450{,}000}{15 \times 10^6} = .576 = 57.6\%$$

Internet → 3 sec + Internet router (very fast) + Institutional router (very fast) + Network (very fast) + Client

response time ≈ ~~3 seconds~~ -2

no delay other than Internet delay, all else very minimal.

6. Consider the socket API for implementing network applications.

(a) A socket must be uniquely associated with both the IP address of the host and the port number used by the application. After creating the socket interface using the `socket()` function, briefly describe the function used by the application to associate the socket with the IP address and port number.

It uses a struct that stores both the IPaddress and the port number together so the struct can be passed around as the "Address" if you will, of the socket.

-2

Use bind function

(b) Briefly described how the `hostent` struct is used by the network application.

The hostent struct serves has a "localhost" value for the network application so it does not have to keep track of the IPaddress and port number of the socket it is using. That is kept on the operating system side of things

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Struct returned by DNS server IPaddress ↔ Domain name

(c) What are the main purposes of the `htonl()` and `ntohl()` functions.

They are to ensure the connection with the host is valid.

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Big & little Indian bits