Birzeit University
Computer Systems Engineering Department

ENCS 535 – Computer Networks
1st Exam, Fall 2008

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Student's name: _____

Student's ID #:_____

PLEDGE: No aid given, received, or observed.

Signature: _____

Instructions:

- **You have 90 minutes** to complete the exam.
- There are 5 questions, and 8 pages (including this cover page)
- The exam is closed book. Textbooks, notes, laptops, personal digital assistants, and cellular phones are NOT allowed. However, **calculators are permitted.**
- Answer all questions in the space provided on the exam paper. Use the back of pages if it is necessary.
- Question marks are listed by the question.
- Please, do not separate the pages, and indicate your Student ID at the top of every page.
- No questions will be answered during the exam. If there is an ambiguity, state your assumptions and proceed.
- Please, fill out the exam attendance sheet when provided by the proctor after the exam starts.
- The total number of points for each question is given in parenthesis. There are 100 points total.

GOOD LUCK

Question 1: Answer the following True/False questions by writing either T or F beside the each sentence.
[30 marks total, 1.5 marks each]

1	The header, data body, trailer passed down from a higher layer are treated as a whole as the data packet body by a lower layer.	**T**
2	For queuing delay analysis part, if traffic density larger than 1, then the average rate at which the bits can be transmitted from the queue exceeds the rate at which the bits arrive at the queue.	**F**
3	Transport layers can provide guarantees about bandwidth, reliability, and latency.	**F**
4	Circuit switching networks require signaling and control for establishing circuits.	**T**
5	UDP is the preferred over TCP for transferring a real-time voice over IP networks.	**T**
6	HTTP runs on top of TCP, while DNS runs on top of UDP.	**T**
7	Two distinct Web pages (for example, http://www.birzeit.edu/index.html and http://www.birzeit.edu/faculty.html can be sent over the same persistent connection.	
8	HTTP Web Servers use port 80 to listen for client requests.	**T**
9	HTTP's conditional GET prevents any messages from being sent over the Internet on a cache hit.	**F**
10	The Last-Modified: header in the HTTP reply message indicates when the object in the response was last modified.	**T**
11	FTP is a stateless protocol.	**F**
12	FTP is said to use "out of band" communication because it does not conform to TCP standards.	**F**
13	Before sending a packet into a datagram network, the source must determine all of the links that packet will traverse between source and destination.	**F**
14	A root DNS server contains all of the host-address mappings for every host on the Internet.	**F**
15	While using email clients (e.g., Outlook Express, Foxmail) to send emails, these applications will connect directly to the receiver's mail server and "push" the email into their mailbox via SMTP protocol.	**F**
16	SMTP uses persistent connections.	**T**
17	IMAP is used between mail servers to send e-mail messages.	**F**
18	HTTP server is stateful and it uses cookie technology to keep track of users.	**F**
19	P2P networks hide your identity from the authorities	**F**
20	In BitTorent, a tracker tracks peers participating in the torrent. It does not have a copy of the file itself, but it helps manage the file transfer process.	**T**

Question 2: Multiple Choice -- Choose the best answer from the choices given. And fill the table below with the letter of the correct answer to corresponding question number. [40 marks total, 2 marks each]

1	2	3	4	5	6	7	8	9	10
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**

1. If R is link bandwidth, L is packet length, and a is average packet arrival rate, then traffic intensity can be defined mathematically as:
   a. RL/a.
   b. **aL/R**
   c. Ra/L.
   d. RLa.
   e. None of the above.

2. Which of the following approaches to switching share network resources?
   a. Circuit switching.
   b. Packet switching.
   c. Both of the above.
   d. None of the above.

3. FDM and TDM are two approaches to:
   a. Circuit switching.
   b. Packet switching.
   c. Both of the above.
   d. None of the above.

4. If the average packet loss of a packet-switched network is very high, this may indicate that:
   a. The queuing delay is very long
   b. The queue buffers at the routers are very small
   c. The traffic intensity is very high
   d. **All of the above**

5. The transfer of an HTML file from one host to another is:
   a. **Loss-intolerant and time insensitive.**
   b. Loss-intolerant and time sensitive.
   c. Loss-tolerant and time insensitive.
   d. Loss-tolerant and time sensitive.

6. Which of the following is used to contain an Internet standard?
   a. **RFC**
   b. IETF.
   c. DNS
   d. PPP.
   e. None of the above.

7. Which of the following in not part of the Internet edge:
    a. **Interconnected routers and switches**
    b. Client and server systems
    c. Peer-to-peer systems
    d. Hosts running networking applications

8. Application-layer and transport-layer protocols exist in:
    a. Each and every node in the Internet
    b. The server end systems only
    c. **The end systems or hosts only**
    d. The switches and routers only

9. The transport layer is used to provide:
    a. **Logical communication between processes.**
    b. Logical communication between hosts.
    c. Logical communication between adjacent network entities.
    d. All of the above.
    e. None of the above.

10. Which of the following provides a connection-oriented transport service?
    a. **TCP**
    b. UDP.
    c. IP.
    d. HTTP.
    e. None of the above.

11. The User Datagram Protocol (UDP) is an example of a:
    a. connection-less network layer protocol
    b. connection-oriented network layer protocol
    c. **connection-less transport layer protocol**
    d. connection-oriented transport layer protocol
    e. all of the above

12. Which of the following helps improve the performance of DNS?
    a. Its distributed nature.
    b. Iterated requests.
    c. Caching.
    d. **All of the above.**
    e. None of the above.

13. Which of the following is not a benefit of using a proxy server for a web cache?
    a. It reduces load on the access link.
    b. It decreases response times for client requests.
    c. **It increases reliability.**
    d. It reduces load on the origin server.
    e. All of the above are benefits from proxy servers.

14. The Simple Mail Transfer Protocol (SMTP) is an example of a:
    a. "pull" protocol at the application layer
    b. **"push" protocol at the application layer**
    c. "pull" protocol at the transport layer
    d. "push" protocol at the transport layer
    e. cross-layer protocol design

15. The "persistent connection" feature in HTTP:
    a. avoids repeated TCP connection handshaking
    b. can transfer multiple embedded objects (serially, one at a time)
    c. can download typical Web pages more efficiently than non-persistent HTTP
    d. all of the above

16. For the World Wide Web as an application, the user agent is:
    a. The user's mouse.
    b. The user's monitor.
    c. The user's keyboard.
    d. All of the above put together.
    e. None of the above.

17. Suppose a client sends an HTTP request message with the If-modified-since: header. Suppose the object in a server has not changed since the last time that client retrieved the object. Then the server will send a response message with the status code:
    a. 304 Not Modified.
    b. 404 Not Found.
    c. 200 OK.
    d. 403 Permission Denied.
    e. None of the above.

18. What does "TTL" in DNS resource record mean?
    a. Transistor-Transistor-Logic.
    b. Time-To-Live.
    c. Trace-Time-Life
    d. Non of the above

19. What information is used by a process running on one host to identify a process running on another host?
    e. The host name or Internet address of the host.
    f. The port number the process is listening on.
    g. a) and b)
    h. non of the above

20. Suppose a web server has 10 ongoing TCP connections. How many server-side sockets are used?
    a. 1 server-side sockets are used.
    b. 11 server-side sockets are used.
    c. 10 server-side sockets are used.
    d. There is insufficient information to answer the question.

Question 4 [6 marks]
Consider that two hosts A and B are connected by a path of Q links with each link has a data rate of R bits per second. The physical length of each link is m meters and the propagation speed along each link is S meters per second. Host A is to send data packets to host B. Each packet has a fixed length of L bits and is appended by a header of length h bits.
 Assuming that the network is a circuit-switched network with a setup time of t_s seconds. How long does it take to send a single packet from A to B?

Answer:

$d_{total} = d_{Trans} + d_{Prop} + t_s = (L+h)/R + Q (m/s) + t_s$

Question 4: cache [15 marks total, 5 marks each]

Assume that a local area network sees about 250 web requests per second, with an average object size of 10Kb. The 10Mbps LAN is connected to the Internet over a 3Mbps link. The average web server on the Internet takes 1.5 seconds to respond to a web request, and the router on the link to the Internet has an average 15 second queuing delay for incoming traffic due to its high utilization.

a. Calculate the average latency (delay) for each web request.

LAN Utilization (Traffic intensity) = 250*10KB/10Mbps = 0.25
Link Utilization (Traffic intensity) = 250*10KB/3Mbps = 0.83 which is high, *so there is a queuing delay*
       latency = internet latency + **queing latency** + link transport time + LAN transport time
            = 1.5 + 15 + 10/3000 + 10/10000 = 16.5 seconds

b. Calculate the average latency for each web request if the link to the Internet were upgraded to a 10Mbps link.
This upgrade would bring the link utilization down from 83% to about 25%, eliminating the queuing delay. Thus:
       latency = internet latency + queing latency + link transport time + LAN transport time
            = 1.5 + 10/10000 + 10/10000 = 1.5 seconds

c. Calculate the average latency for each web request if a web cache were added to the LAN and had a 40% hit rate.
This upgrade would reduce incoming traffic by 40%, bringing the link utilization down from 83% to about 50%, eliminating the queuing delay. Furthermore, the latency due to HTTP's conditional GET will be minimal since it will only be paid once per connection, not once per object. Thus:
       latency >= 0.6 * 1.5 seconds +
            0.4 * (10/10000) = 0.9 seconds

Question 5: DNS service: [9 marks total]

Suppose you open a startup company "starwar" and want to set up your company network. Your network has the following servers:

1. DNS server: "dns1.starwar.com" with IP as "128.119.12.40"
2. Web server: "starwar.com" with two IP as "128.119.12.55" and "128.119.12.56". The web server also has a name as "www.starwar.com".
3. Email server: "galaxy.starwar.com" with IP as "128.119.12.60"

Your company's email address is "username@starwar.com".

a). (4 marks) What resource records (RRs) do you need to provide to the upper-level ".com" Registrar?

(starwar.com, dns1.starwar.com, NS)
(dns1.starwar.com, 128.119.12.40, A)

b). (5 marks) What RRs do you need to put in your company's DNS server?

(starwar.com, 128.119.12.55, A)
(starwar.com, 128.119.12.56, A)
(www.starwar.com, starwar.com, CNAME)
(galaxy.starwar.com, 128.119.12.60, A)
(starwar.com, galaxy.starwar.com, MX)