14-740: Fundamentals of Computer and Telecommunication Networks

Fall 2017
Quiz #1: Version A
Duration: 45 minutes

Name:___**Answer Key**___ Andrew ID: _____

Important:

- Each question is to be answered in the space provided. Material written on the back of the page or in space above or below the question will not be graded.

- This is a closed book exam -- you may not use any reference materials, crib sheets, or formula cards.

- Calculators are not needed, nor allowed.

- **Write legibly**. Unreadable work will be considered incorrect.

- At the end of the final duration, you will be told to "Cease Work." Immediately stop writing and turn in your paper. Any writing after this point will result in a zero grade.

Page 2	_____ (21 possible)
Page 3	_____ (34 possible)
Page 4	_____ (15 possible)
Page 5	_____ (16 possible)
Page 6	_____ (14 possible)
Total	_____ (100 possible)

I understand that the CMU and course policies on cheating apply to this quiz.

_____
signature   date

1. True or False (circle one or the other): HTTP has a fixed-width message format. (You do not need to provide a reason). (2 points)

2. What is the relationship between DNS zones and DNS nameservers? (5 points)

   Each zone is served by a redundant set of nameservers, who are the authority over

   RRs for that zone.

3. As shown in this graph from Norton2010, transit prices have plummeted exponentially through the years (about 30% drop per year). Nevertheless, the Tier-1 ISPs continue to be very profitable. Explain this apparent contradiction. (5 points)
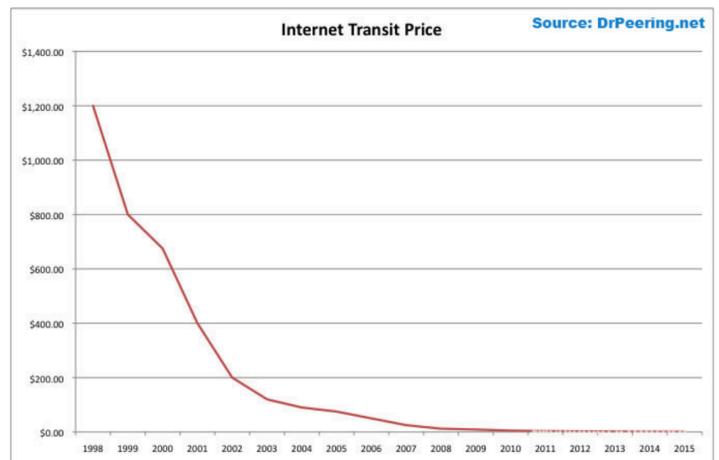
   Internet traffic is growing even faster

   than the transit prices are falling. (Growth is about 50% per year)

4. List two advantages and one disadvantage of a layered architecture when compared to a monolithic architecture. Your answer could be specific to networks, but need not be. (3 points each, 9 points total)

   Adv: Details of lower layers is not needed

   Adv: Protocols in each layer can be developed independently

   Disadv: Information hiding affects performance / Duplication of lower layer function

Don't write down here. This is not considered "space provided." Anything you write down here will not be graded (nor even read). The same applies on the rest of the pages, too!

5. For each of the following components, choose "Core," "Edge," "Both," or "Neither" to reflect which portion they are most closely related. Circle exactly one for each component. (2 points each, 10 points total)

Your laptop	Core	Edge	Both	Neither
INI's webserver	Core	Edge	Both	Neither
CMU switch in Cyert hall	Core	Edge	Both	Neither
Router in Tier-1 backbone	Core	Edge	Both	Neither
Connections between existing networks	Core	Edge	Both	Neither

Edge, Edge, Core, Core, Core

6. In the Norton2010 paper, the author describes the typical billing method whereby an ISP calculates the monthly cost of transit for a customer. In a few sentences, describe the process in enough detail to prove you read the paper. (12 points)

At five-minute intervals, the byte counter on the router link is sampled. The delta

between the sample and the previous sample is stored, correcting for counter

overflow and resets (i.e. from a reboot). At the end of the month, the deltas are

sorted and the 95th largest percentile value is used for the actual bill.

7. Describe the message format structure of an HTTP request. At the very least, identify the four different types of lines. If you list more detail, you will get more points. (12 points)

Line 1: Method, URL and HTTP version

1+ lines: Header lines

Blank line (i.e. nothing but a CRLF)

Optional entity body (data)

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8. I am using DNS to lookup the IP address of host.example.com from my laptop. Describe the sequence of messages that result.

In the following table, list each of the eight messages sent. The From/To columns should list descriptions of machines. The Contents column should describe the payload fields and may be phrases like "don't know" or "A record for host.example.com."

Assume the most common scenario, with recursion always requested, and no caching in any nameserver. (15 points)

From	To	Contents
my laptop	Local NS	A record for host.example.com?
Local NS	Root	A record for host.example.com?
Root	Local NS	Don't know, talk to NS at .COM TLD A record for ns.com
Local NS	ns.com	A record for host.example.com?
ns.com	example.com	A record for host.example.com?
example.com	ns.com	host.example.com A record Authoritative answer
ns.com	local ns	host.example.com A record
local ns	my laptop	host.example.com A record

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9. For each P2P network type (Napster, Gnutella and Kazaa) describe the method used to search for a particular file. Make sure to be specific about message types, data in the message (if known) and destinations for the messages. (12 points)

Napster: Peers send search requests to a central server

Gnutella: Peers flood their neighbors with Query messages. Neighbors repeat the

flooding for a limited scope. Peers with the content responde with QueryHit messages.

Kazaa: Peers send search requests to their supernode. Supernode may answer if one

of their ordinary nodes has the file, else they flood the request to their neighbor

supernodes.

10. Time for a short question! What is the organization responsible for making standards and developing protocols for the internet? (4 points)

    IETF, the Internet Engineering Task Force

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11. A single-core router receives 1000 packets per second, on average. It can process each one in 500 microseconds (again, on average). Make sure to include units in all answers. (14 points total)

    a. What is the most specific Kendall53 notation for this router? (2 points)

    M/M/1

    b. What is λ (lambda)? (2 point)

    1000 packets / second

    c. What is μ (mu)? (2 point)

    1 packet / .0005 seconds = 2000 packets / second

    d. What is ρ (rho)? (2 point)

    λ / μ = 1000 packets per second / 2000 packets per second = .5

    e. What is the probability of having exactly two packets in the queue? (3 points)

    $p_3 = (1-\rho)\rho^3 = (1-.5)(.5)^3 = (.5)^4 = 1/16$

    f. What is the average number of packets in the queue? (3 points)

    $L_q = \rho^2 / (1-\rho) = (.5)^2/(.5) = .5$ packets

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