

14-740: Fundamentals of Computer and Telecommunication Networks

Spring 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	_____ (19 possible)
Page 3	_____ (9 possible)
Page 4	_____ (27 possible)
Page 5	_____ (25 possible)
Page 6	_____ (20 possible)
Total	_____ (100 possible)

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

signature

date

True or False: 2 points each.

Clearly circle the word "True" or "False." You do not need to provide a reason.

1. **True** or False: A circuit-switched network can be a store-and-forward network.
2. True or **False**: A packet-switched network cannot be a store-and-forward network.
3. True or **False**: A packet-switched network cannot provide connection-oriented services.
4. **True** or False: Professor Nace would love to have me visit him during his office hours. I think I'll go have a chat with him sometime soon!
5. True or **False**: 100 Gbps Ethernet is faster (i.e. it has lower transmission delay) than 10 Gbps Ethernet because the propagation speed (i.e. the variable s) is faster.
6. Answer the following questions about the Application Layer: (3 points each, 9 points total)

What is the mission of the Application Layer?

Provide user with access to network resources

What does the Application Layer use for addresses (there are multiple potential answers. Provide any one)

Domain names, URLs, Twitter handles

The Application Layer uses what data type?

Message

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!

Multiple-Answer Problems: Choose one **or more** answers by clearly circling the letter on the left. (3 points each)

7. What is the business interface of a Tier-1 company connecting networks with another Tier-1 company?

- a) Transit
- b) Peering (THIS ONE)
- c) Peer-to-peer
- d) IXP
- e) Private peering
- f) POP

8. **Where** do Tier-1 companies connect their networks to Tier-2 companies?

- a) Transit
- b) Peering
- c) Peer-to-peer
- d) IXP (THIS ONE)
- e) Private peering (THIS ONE)
- f) POP (THIS ONE)

9. **Why** does a Tier-2 company connect networks with another Tier-2 company?

- a) Lower latency (THIS ONE)
- b) Higher latency
- c) Lower costs (THIS ONE)
- d) Higher costs
- e) To avoid paying peering costs
- f) To share customers

10. The internet's layered architecture has a so-called "narrow waist."

a) What layer is referred to by "narrow waist?" (3 points)

Network Layer

b) Why is it important that there be a "narrow waist?" (4 points)

This well-chosen set of capabilities is the glue that provides a common method of exchanging packets over a wide collection of networks.

c) What troubles has the "narrow waist" caused for the evolution of the internet? (4 points)

Evolution is tough: Getting from IPv4 to IPv6 means changing everyone's narrow waist in an interoperable fashion.

11. In a single sentence for each, describe the MISSION of each type of nameserver: (4 points each, 16 points total)

Authoritative nameserver: Actually knows the definitive answer to DNS queries

Local nameserver: The first or default nameserver contacted by a host

TLD nameserver: Knows the IP addresses of authoritative nameservers for each domain under their portion of the hierarchy

Root nameserver: Knows the IP addresses of all TLD nameservers

Don't write down here. This is not considered "space provided." Anything you write down here will not be graded (nor even read).

12. Choose a Queueing Theory equation from the equation sheet (almost any will do) and write a description about how that equation can help in the design of an internet router. Your description must be clear enough that:

- I'm convinced you understand the equation and all the variables in it.
- I'm convinced you understand the applicability to networking.

Do not be vague! For instance, don't just say that performance will be better. Instead describe why the use of this equation leads to specific effects that will be better. (15 points)

Many answers are possible. Here's one. Little's law ($L = \lambda W$) lets us calculate average number of packets in the system (L) based on arrival rate (λ) and total time in the system (W). The packet arrival rate is a design parameter of the router, and W is a design requirement. By knowing how many packets will be in the system (and thus, how many need to be queued), we can determine how big the memory on the router should be, as it will need to handle (at an average) this many packets.

13. Hard drive space and bandwidth are two resources that provide motivation for the development of a P2P network. List two other resources, mentioned in class, that have also driven P2P network development. (5 points each, 10 points total)

CPU cycles, or anonymity, or "Edge-ness" (i.e. low latency to other peers)

The highlighted lines haven't yet been taught to you, so mistakes relating to them were not marked off

14. There are 0 - 5 things wrong with the following description of the traceroute algorithm. If there are zero, write "Everything is fine! If there are more than zero, state for each, in a single sentence, how you would correct it. (10 points)

The traceroute algorithm works by sending, by default, 3 probes for each of the routers along the path and three for the target host. The algorithm starts with the nearest router. A probe is sent, addressed to that router. The round-trip-time of the probe is measured and a line is printed in the terminal showing the router name and the RTT of each probe. When the target address is reached, that probe is sent with a port number that is unlikely to be in use. The target machine will send back an error message. When the algorithm receives this error message, it will immediately terminate, knowing that it reached the target machine.

Mostly true. Obvious error #1: the probes are not addressed to the intermediate router, instead, "A probe is sent, addressed to the target host, but with a counter specifying how many hops it is allowed to take."

Less obvious error #2: "All probes are sent with a port number that is unlikely to be in use."

Subtle error #3: "it will print a last status line for the three probes reaching the target, and then terminate"

15. If your browser has downloaded the main HTML file for content from the origin web server, it might discover links in that file that also need to be followed and the linked content downloaded. In what ways will that process (following links, downloading content) be different if a CDN is being used? (10 points)

The links will have been rewritten to URLs on the CDN company's servers.

The DNS query will be answered by a CDN company nameserver, which will geolocate the query and provide the IP address of a geographically close CDN-owned cache.