Test Preparation Questions #1

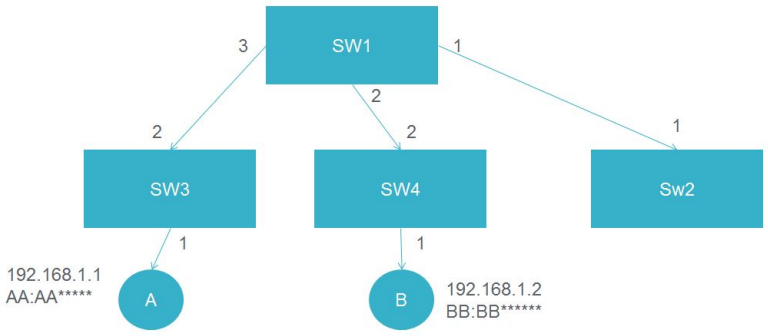
Covers: Udacity Lessons 1 through 5.2 and associated papers.

Instructions: These questions are ungraded. They are provided as a tool to help you prepare for the closed book tests in this course. It is recommended that you work through these questions as you complete sections of material and papers, rather than leaving them for the week before the Test. You are encouraged to discuss these questions on Piazza with your fellow students!

We will post an answer key the week before the test with model answers.

Architecture and Principles

1. How does the "narrow waist" allow a large variety of different protocols to be used on the Internet?
2. Discuss how the design principles of the Internet are manifest in the ARP protocol. Also discuss how the absence of some points from the design principles (e.g., security and mobility) has influenced ARP.
3. What are the advantages of using circuit-switched networks instead of packet-switched networks (like the Internet) for streaming video?
4. In what way are caching HTTP proxies a violation of the end-to-end argument? Also, what are the consequences of this?
5. Why is it important for encryption to be end-to-end? In other words, what are the consequences if we perform encryption, but not in an end-to-end manner?
    a. (Bonus question: Gmail uses HTTPS to secure communication between your browser and the Gmail servers. Is this encryption "end-to-end"?)
6. The forwarding tables for all switches in this network are initially empty. Host 192.168.1.1 sends and ARP request to discover the MAC address of the host with IP 192.168.1.2. What entries will be in the forwarding table of each switch after host 192.168.1.1 receives the ARP reply?



7. When a host on the private network side of a NAT with IP 192.168.1.100 opens a TCP connection to a web server at 123.45.67.89, what entry will be added to the following

NAT table, and what will be the source and destination IP and port on the packet that the NAT router forwards on the WAN (public) side? (Recall that the default port for HTTP is port 80.)

Public IP	Public Port	Private IP	Private Port
98.76.54.32	35564	192.168.1.100	22
98.76.54.32	5416	192.168.1.101	80
98.76.54.32	15885	192.168.1.105	6843

8. How does the Spanning Tree Protocol (STP) improve the reliability of Ethernets?
9. Explain why 2T*C represents the number of outstanding bits (or bits "in flight") for a TCP flow. (Note: another way to write this would be RTT*C)
10. Suppose a particular router normally supports 1000 flows at a time. The average round-trip time (RTT) of each flow is 63ms, and the bottleneck link is 5 Mbps. According to the new thinking on buffer sizes (i.e., Appenzeller 2004), what size should the buffer on this router be?

Reading - DARPA Internet Protocols

11. Discuss the advantages of the fate-sharing survivability model present in Internet Protocols today, and how this model differs from a distributed state/replicated survivability model.
12. Explain how the Internet architecture achieves the flexibility required to support a wide variety of networks? What functions is the network assumed to provide, and more importantly, what functions of the network are NOT assumed?
13. How has the ARPANET design goal of distributed resource management across the network not been met in today's Internet?
14. Describe two of the design advantages of datagrams as the basic architectural feature of the Internet.

Reading - End to End Arguments

15. Consider a networked application that is latency sensitive and requires guaranteed delivery and of data packets between network hosts. Assume that errors in transmission are very rare. Would a network that violates the end-to-end principle by implementing packet acknowledgements and checksums within the low-level network architecture be a suitable choice for this application?
16. Describe how the end-to-end argument supports clear definitions between network layers? (i.e. why is reliable, in-order delivery packets a feature of a transport layer protocol and not the internet layer? Why is IP a connectionless protocol?)

IP Addressing and Forwarding

17. Consider a subnet that has the following IP addresses. What is the smallest subnet (i.e., subnet with the longest prefix) that could include all these addresses? (Use CIDR, i.e. "slash", notation.)
    192.168.165.1

192.168.165.96
192.168.160.1
192.168.179.145

18. How many addresses are in the subnet 10.11.12.128/26 ? (Show your work.)
19. Now consider a router with the following forwarding table:

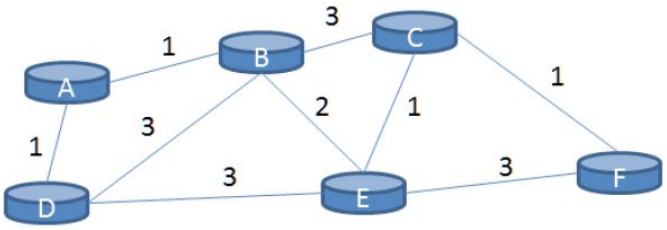
Subnet	Next Router	Cost
73.214.32.0/20	192.168.1.1	3
73.214.0.0/16	192.168.2.1	4
73.214.42.0/24	192.168.3.1	5
73.214.37.0/24	192.168.4.1	6

(Note: 42 = 32 + 8 + 2 and 37 = 32 + 4 + 1)

a. To which router will a datagram with destination IP address 73.214.106.198 be sent next?
b. To which router will a datagram with destination IP address 73.214.42.64 be sent next?
c. To which router will a datagram with destination IP address 73.214.39.216 be sent next?

Routing

20. Consider this network and the Distance Vector algorithm:



Router D has this distance vector:

A	B	C	D	E	F
1	3	6	0	3	7

It receives a distance vector update from E, which is this:

A	B	C	D	E	F
3	2	1	3	0	3

What does router D update its distance vector to?

A	B	C	D	E	F

21. Suppose you are operating an enterprise network (such at Georgia Tech's network, or a medium-sized corporation's network) and you decide to use RIP for your intra-AS routing. List two advantages that using RIP gives you (in contrast to using OSPF or IS-IS).
22. List two reasons for using Autonomous Systems (AS) in the Internet.
23. BGP provides three ways for network operators to enforce policies on their networks. List these ways.

Other Network Layer Protocols

24. In an Internet where some routers are IPv6 routers (i.e., they support both IPv6 and IPv4) but most are IPv4 routers (that support only IPv4), how can two hosts communicate with each other using IPv6? (In other words, how can IPv6 be used if not *all* the routers are IPv6 routers?)
25. Explain the ways in which DNS (the Domain Name System) achieves fault-tolerance, i.e., such that most or all domain names can be resolved to IP addresses even if some (but not all) DNS servers crash.
26. Consider a NAT router with the following entry in its translation table:

138.76.29.7, 5001	10.0.0.1, 3345
.....	.....

    a. What does the NAT router do when it receives a packet on the WAN (Internet) interface with the destination address/port 138.76.29.7:5001?
    b. What does the NAT router do when it receives a packet on the LAN (Local Area Network) interface with the source address/port 10.0.0.1:3345?
    c. How does this entry get added to the NAT router's translation table? (Assume the client is on the LAN side and the server is on the WAN side.)
27. What is the difficulty with hosting a server (e.g. a web server) behind a NAT router (i.e. on the LAN side)?
28. What is the difficulty with running a peer-to-peer application behind a NAT router?

Reading - BGP Routing Policy in ISP Networks

29. Why is BGP considered an incremental protocol?
30. What does it mean for an attribute in the BGP decision process to be set by policy? Give an example of how a route can be determined by policy.

31. Describe how an AS can set import filtering policies to protect itself from falsified BGP updates.

Router Design Basics

32. Describe the basic functions any router on the Internet must be able to perform in order to route traffic. What are some of the hardware features present on modern routers that support these functions?
33. Describe the purpose of a Maximal Matching switching algorithm commonly used to schedule traffic on router crossbars.
34. How would a router schedule bandwidth for a single timeslot (1s) for the following forwarding demands using a Max-Min Fairness algorithm (in Mb): 1.8, 2.4, 3.0, 5.3, 6.4, 1.0, 2.2, 8.0? Assume the algorithm can forward at most 25.6 Mb of data in a single timeslot.

Reading – Are we there yet?

35. Why has deployment of IPv6 been slow to gain momentum despite the exhaustion of IPv4 address space?