

--- CS 414 Homework 6 ---

1.

a) In three sentences or less, describe the end-to-end principle.

b) A team of network researchers proposes to re-architect the Internet to replace best-effort delivery with guaranteed delivery. They suggest modifying the routers to operate by using non-volatile storage and hop-by-hop acknowledgements. Under their proposed scheme, each hop (router on a path) receives a packet, stores it on disk or in nonvolatile memory, and notifies the previous hop that the packet has been received. Each packet is thus stored in a persistent memory at all times. Even if a router crashes and restarts, their design allows these stored packets to be recovered and retransmitted. The researchers claim that, when using their scheme, a packet will not be lost in the network even if a router experiences a power failure or a crash/reboot occurs. This eliminates the need for packet-by-packet acknowledgements between the communication endpoints. They claim that their approach will greatly simplify TCP and improve performance because lost packets will be recovered more quickly. Do you agree with this assessment? Briefly describe why or why not.

2.

a) Suppose that you have written a program that needs to transfer small files from a nearby server. You do a test and discover that for a 1GB transfer, the network connection runs at 100MB per second. But when you transfer your files (using a separate TCP connection for each file), the file transfer speed is only 4MB per second. Explain where the factor of 25 was lost.

b) In TCP slow start, at first the sending host will double the number of packets it sends every time it receives all acknowledgements for the previous packets it sent. In other words, the sending host will send one packet, receive the ACK for that packet, send two packets, receive the ACKs for those packets, send four packets, and so on. This exponential growth continues until there is a packet loss. (Subsequent to this loss, the sending host will increase the number of packets linearly, not exponentially.) Consider the scenario where a host H1 has two connections, one to a host HL on the same LAN, and one to a host HW thousands of miles away. The one-way latency to host HL is 3 microseconds, the one-way latency to host HW is 10 milliseconds and the round-trip latency is twice the one-way latency. Assuming no packet losses, and assuming near-infinite bandwidth and processing speeds at all hosts, how long does it take to send the first 1000 packets to each host?

c) You've just built a new wireless network system with a high packet-loss rate, and you notice that file downloads are slow, much slower than can be explained by the packet losses alone. What's gone wrong? How can you fix it? Why is changing your TCP back-off policy not a good answer?

3.

Pretend that you are managing the purchase of a new email server. The old one could be found at mail.LargeCorp.com, which resolved to its address, 10.1.1.1; the new one we want to give the same address (mail.LargeCorp.com) but a new IP address, 10.1.1.2. All files are migrated correctly and the software configured correctly, but the moment that the old mail server is unplugged, everything breaks -- for a period of a day, nobody receives email from their regular correspondents. Strangely, however, a consultant's computer, when attached to the network for the first time can email everyone in the office (though she cannot receive email from any of them at her LargeCorp.com address).

- a) What might have happened here?
- b) What could have been done to prevent this?
- c) What can be done to fix it?

4.

When might you tunnel UDP via TCP, and when might you tunnel TCP via UDP?

5.

a) Suppose a network is a packet switched datagram network and a connectionless service is used. Consider sending a file of F bytes over a path of Q links. Each link transmits at R bytes/sec. The network is lightly loaded so that there are no queuing delays. Propagation delay is negligible. The file is broken into M packets. Suppose each packet has H bytes of header. How long does it take to send the file? (Note: we don't use any TCP slow start, but instead send all packets at once.)

b) Suppose that the network is a circuit-switched network. Further suppose that the transmission rate of the circuit between source and destination is R bytes/sec. Assuming T seconds of set-up time and H bytes of header appended to the entire file, how long does it take to send the file?

c) From the previous discussion, it might seem that circuit-switched networks are faster and therefore more desirable. How would you explain the fact that packet-switched networks became so successful lately?