1.

D) Provide an example of byte stuffing and explain when it should be used.

We want to decide on start and end of the packet. To do that use STX and ETX.We have an ESC flag to use if the STX and ETX appear in the middle of the data. If ESC appears in the data we prepend an ESC flag. We use this because we don’t want to have a fixed packet length of data.

E) What guarantees does the TCP/IP protocol provide for its users?

TCP is reliable. We have two guarantees:

1. Reliable, no packet dropped. 2) In order packet delivery, OR the connection is dropped. IF any guarantees are broken.

F) What is the internet control message protocol used for?

ICMP is used to send error messages between routers.

G) Provide one example of a program that uses ICMP?

Tracerout sends packets with TTL= 1,2,3,4… We get time exceeded back. That’s hpw we find out hosts on the way.

h) What is Kerckhoff’s principle?

It relates to cryptography. The goal of crypto is to create a secure communication channel. “A cryptosystem should be secure even if everything about the system except private/secret key is public knowledge”.

1. What is a nonce?

A nonce is a number only used once. Example: onetime pad. Provides non-predictability.

j) Why is it important for internet congestion management that UDP packets are preferentially dropped?

UDP is unreliable, but a UDP header is 8 bytes, whil TCP header is 20 bytes. Leads to people using UDP instead of TCP with their own ACK system. UDP does not do congestion control, TCP does. If we would not drop UDP packet, network gets more and more congested until it collapses.

k) what potential problem in routing is the time to live flag in IP designed to prevent?

In case of endless routing loops, or trying to send packets to a host that doesn’t exist, packets might circle in the internet forever if there are enough packets, the network gets congested and collapses. TTL prevents that from happening as its reduced between every router, once it reaches zero, it’s dropped.

K) what is the Fisher consensus problem?

It is impossible to guarantee that any async connected set of nodes can ever agree on a single bit. The way to fix this is basically to have it synchronized. Master on top. Synchronous topology

l) Explain from the network packet perspective, including a diagram, how statistical multiplexing works when an ISP is providing a 5 Gbps connection split between 5 households, each of which has been sold connection of 5 Gbps each( 5x oversubscription).

Packets are sent out on the 5Gbps link in the order that they arrive to the multiplexer.

2.

A)

SEQ: 42. ACK: 11,

ACK: 45, SEQ: 11

SEQ: 45, ACK: 15

1. ACK number is the next byte we except to receive
2. SEQ number is the total amount of data sent.
3. What does the Win=0 segment sent by Host A signify?

Win=0 means the receive buffer is full so B should not send any more data to A.

1. What will Host B do in response?

B will not send A any more data until it receives Win>0.

1. The application at Host A now reads a single byte from the networkand the underlying TCP/IP handling at Host B triggers a condition known as Silly Window Syndrome. Explain what is meant by this term.

B will send A a single byte but the IP header is 20 bytes, TCP header is 20 bytes minimu. So to send 1 byte of data, we need to send 41 bytes in total.

A sends Win=0, Win=1, B sends one byte, Win=0.

1. Method to avoid silly window syndrome?

Don’t signal that you have space in your buffer until you can either receive 1 MSS or or the buffer is half empty. This way, the sender does not send small packets. and the receiver doesn’t ask for them. ASIDE: with ACK piggyback you can delay sending an ACK for up to 50ms. If you are receiving full segments, you have to ACK every second segment.

b) You are specifying a network for a workplace where several surveillance videos will be simultaneously streamed to separate groups of workstations for analysis. Given the choice between WIFI, copper or fibre. Each with identical host-to-host bandwith, which would you specify and why?

Probably wifi access points at every point which broadcasts to every other.

With identical host-to-host bandwith, choose wifi to broadcast to every workstation group, but every wifi access point is a part of a multicast group. Or copper and multicast.

C) what network layer protocol choice would you recommend for this application?

Multicast-IP, broadcast only to those who ask for it.

A long ass question that I don’t want to write down……

3.

100Mbps connection, we want to transfer 250 GB. \* 8 is 2000 Gb.

Step 1, convert to bits, = 2000 Gb or 2Tb, terabits.

Total data: 2000 \* 1.10 (add ten percent) = 2200 Gb.

Lets go: distance = time \* speed.

(data)

====🡺 time = data/ speed = 2200\* 109 / 100 \* 106 = 22 \* 103 seconds. / 60 = 366.666 minutes/ 60 = 6.111 hrs

ii) if the two sites are 20 km apart, how long will it take to transfer the same file using drones, assuming a USB writing speed of 250 MBps, a reading speed also of 250 MBps, and the drone is ready at the sending site?

Dist = time \* speed => time = dist / speed = 250 \* 109 B / 250 \* 106 B/s = 1000 Seconds. = 16 minutes. To read data and write them so 32 minutes total. (takes the same amount of time)

Avg speed of drone is 20 km/h so the flight will take 1 hr. (20km ride)

1:32 time taken in total so the drones are much faster.

4.

Provide examples, not all lol

Determine ip addresses in the subnet | ip addresses not in the subnet

44.36.35.0/27 44.36.35.3 | 45.36.35.1

10.12.13.0/24 10.12.13.200 | 10.1.13.200

18.0.0.0/8 18.0.0.2 (up to 255) | 2. 1.2.3

b) IPv4 addressess are 32 bits, Not enough IP addresser are for everyone. Local IP has the same external IP .One solution is: port forwarding. Rules that say: everything coming to port 4000 is supposed to be routed to local host 192.168.1.100 port 3000.This is basically creating a permanent entry in the routers NAT table.

c) points) The residential router shown in Figure 2 has an external IP address of 14.11.12.144facing the internet, and an internal IP address of 192.168.1.1. There are three internal devices with IP addresses as shown. Hosts IP 192.168.1.30 (using outbound port 54011) and IP 192.168.1.31 (outbound port 54012) both set up individual, direct, ssh connections to host IP 130.208.240.8 at port 22. Give the values of the IP addresses and ports for packets at each step of the round trip between the originating hosts and the destination address, and explain whatis happening. (You may choose port numbers where necessary.)

Dest NAT NAT Origininbound

130.208.240.130 2214.11.12.144 X 192.168.1.1 X192.168.1.30 54011inbound 130.208.240.130 2214.11.12.144 Y 192.168.1.1 Y192.168.1.31 54012outbound 130.208.240.130 6000014.11.12.144 Y 192.168.1.1 Y192.168.1.30 54011outbound 130.208.240.130 7000014.11.12.144 Y 192.168.1.1 Y192.168.1.31 54012

Assigned ports are arbitrary, but must be consistent. deduct half a mark for each in-correct port or ip, cannot be less than 0.

1. 192.168.1.30 | 54011 | 130.208.240.8 | 22

14.11.12.144 | 54011 | 130.208.140.8 | 22 -> port can be randomly chosen no confl.

130.208.240.8 | 22 | 14.11.12.144 | 54011 -> to our ext. ip.

130.208.240.8 | 22 | 192.168.1.30 | 54011

1. If the router is power cycled, the NAT table is lost. When we get a packet on a port, we don’t know how to rewrite destination Ip and Port. The package is dropped. The connection is still kind of open, as the server is expecting packets to arrive to it. TTL expires.

5.

A) You are responsible for setting up the Internet communication network withIceland’s new settlement at the edge of the Boreales Scopuli, near the Martian NorthPole. At its closest approach to the Earth, communication time to Mars from Earth atlight speed is approximately 4 minutes, and at its furthest it is 24 minutes.What is the maximum and minimum round trip time between Earth and Mars?

RTT is packet going from Earth to Mars and back to Earth

Minimum RTT is 2 \* 4 = 8 minutes

Max RTT is 2 \* 24 = 48 minutes.

B) Assume all packets will be sent at light speed, with a segment size of 1400bytes, and that there is a small, but not negligible, chance that any given packet willhave one or more transmission errors due to solar radiation interference. If TCP/IP isused for this application, and the transmission speed is 100Mb/s, how big do the sendand receive window sizes need to be for each connection when Mars is most distantfrom Earth, and when it is closest?

Sliding window: sender keeps track of packets sent and which are ACK’ed receiver keeps track of which are received and in order.

We want to calculate window sizes such that we don’t have to stop and wait for ACK.

8 minutes: Data = speed \* time =100 \* 106 (b/s) \* (8 \* 60s) =3.84 \* 1011 b

48 minutes: 100 \* 106 (b/s) \* (48 \* 60s) =2.304 \* 1012 b

To answer in segments: 11200 b ???

1. We don’t want to have the nagle’s algorithm. If it is enabled, the text report might be buffered, but it might be smaller than the buffer, so if nagle’s enabled, it won’t send the packet until the buffer is full, or the ACK is coming. But it isn’t coming, because we haven’t sent anything.

Nagle: Only send data when:

1. We can send a whole packet, one MSS
2. Ack arrives for previous packet.
3. Y ou decide to redesign this system using UDP, taking the asymmetric application traffic profile into account. While it is vital that the daily reports are received without error, nobody cares if the occasional cat video gets corrupted. Describe in detail how your new application protocol would send traffic in either direction.

Send an ack back even though it’s a UDP just to get it clear If it got there. Basically create our own realiabilty dude. We send the packet and we wait for the ACK. If no ACK, send again. BOOM ez 4 pointer. We want to wait the RTT for the ACK plus a little more time..

6.

A) Networked applications can be classified according to their topology, into one of three broad types, hierarchical, full mesh, and peer-to-peer (p2p). List three general tradeoffs between the p2p and hierarchical topologies that should be considered when designing applications.

B) Which topology is the Internet itself classified as.

Peer to peer topology. The internet has no single point of control, nodes connected somewhat randomly. GOOGLE WAS WRONG HERE, it said mesh topology stupid google I cant ask you anything.

C) One of the key goals of any large scale, distributed system is to distribute load across many servers. Describe how this problem is solved in the Domain Name System (DNS), including a diagram of the relationships between DNS servers.

1. DNS servers support two types of query, iterative and recursive. Explain how each of these works, including a diagram if necessary.
2. What security protocol can be used to protect a DNS server against unauthorized updates?
3. When auditing your companies network you discover that your companies external DNS server is operating as an open resolver. Explain what security issue this represents and exactly how this could be used to attack other Internet hosts.