

TELE 3118: Network Technologies Sample Mid-Session Test

Question I [20]: Provide one-line answers to the following (2 points each):

- (a) What do you understand by the term “statistical multiplexing”, and what benefit does it offer?

Statistical multiplexing refers to the ability to share a resource on a demand basis rather than allocating a fixed portion a priori. In data networks this allows more efficient of link bandwidth – link bandwidth is not pre-allocated, instead packets use bandwidth as needed.

- (b) Name four access network technologies. In other words, name four ways in which a computer at home/work can physically connect to the Internet.

Dial-up via phone line, ADSL, cable modem, Wireless (e.g. Unwired).

- (c) List one advantage and one disadvantage of packet-switching over circuit-switching.

Packet switching makes more efficient use of network resources by virtue of statistical multiplexing. Packet switching does not provide as good quality-of-service guarantees as circuit switching.

- (d) Using the CSMA/CD MAC protocol eliminates the possibility of collisions – true or false? Justify your answer.

False, if two transmitters sense an idle channel they can both start transmitting more or less simultaneously causing a collision. Of course both will detect the collision and abort, but collisions can happen.

- (e) Does an Ethernet switch modify Ethernet headers?

No, an Ethernet switch does not modify any part of the packet, including the Ethernet headers.

- (f) Why are layer-2 loops in an Ethernet LAN more dangerous than layer-3 loops in the wide-area Internet?
Ethernet frames can loop forever, consuming LAN bandwidth, while IP packets are dropped when their TTL expires.
- (g) Does a NAT (Network Address Translation) router modify the IP header? The TCP/UDP header?
Both – the NAT router replaces the IP address and changes the TC/UDP port number.
- (h) Is it a good idea to fuse Ethernet and IP addressing by mandating that the bottom 4 bytes of the Ethernet address of a host be the same as the IP address of the host? Why or why not?
No, IP addresses are hierarchical and therefore not portable, while Ethernet addresses are portable but not hierarchical. Fusing them would require sacrificing either portability or hierarchy.
- (i) You want to run four server machines for your home business, so you buy an ADSL package from your ISP that gives you multiple static public IP addresses. Your ISP gives you the subnet 202.19.43.248/29. What address/mask would you configure on each of your servers?
Addresses 202.19.43.249, 202.19.43.250, 202.19.43.251, and 202.19.43.252.
- (j) What combined functionality do the “16-bit identifier”, “flags” and “fragment offset” fields in the IP header provide?
Fragmentation and reassembly of IP packets.

Questions II [6]: You are designing an error control strategy for sending 4-bit messages.

- (a) [2] What is the minimum number of redundant bits required for the receiver to be able to detect all 1-bit errors? Describe how the redundant bits are generated.

A 1-bit checksum suffices. The checksum bit could be based on parity, say such that the number of ones in the codeword is always odd.

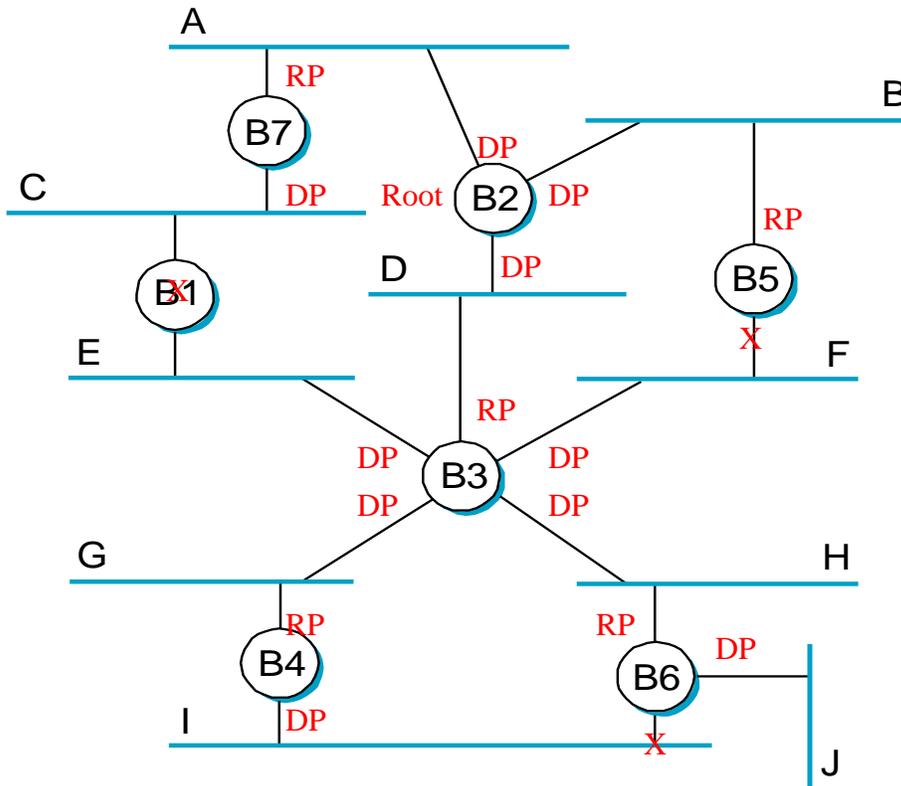
- (b) [2] What is the minimum number of redundant bits required for the receiver to be able to correct all 1-bit errors? Show how you determine this.

If r denotes the number of redundant bits required to correct all one-bit errors, then $2^4(1 + 4 + r) \leq 2^{4+r}$. Solving yields $r = 3$ as the minimum number of redundant bits required to correct all one-bit errors.

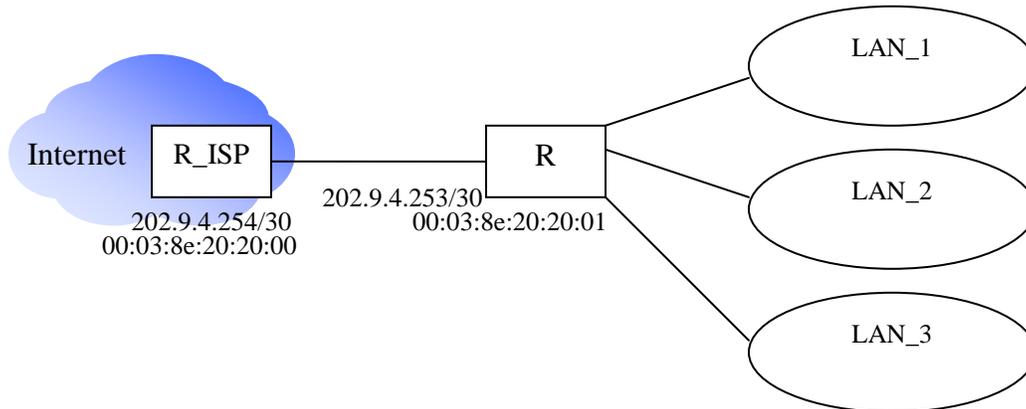
- (c) [2] What is the minimum number of redundant bits required for the receiver to be able to correct all errors of up to 2 bits? Show how you determine this.

If r denotes the number of redundant bits required to correct all two-bit errors, then $2^4(1 + 4 + r + \frac{(4 + r)(3 + r)}{2}) \leq 2^{4+r}$. Solving yields $r=6$ as the minimum number of redundant bits required to correct all two-bit errors.

Question III [4]: Consider the bridged Ethernet LAN shown in the figure below. The spanning tree protocol makes bridge B1 the root and disables some switch ports to ensure a loop-free topology. Now suppose that bridge B1 has a catastrophic failure, and the spanning tree reconfigures to make bridge B2 the new root. Mark the new role of each port on each switch (except B1) below. Use “DP” to indicate designated port, “RP” for root port, and an “X” symbol to indicate that the port is disabled. Assume that all LANs have equal cost, and in the case of identical cost to the root, assume that the tie is broken in favour of the lower bridge-id.



Question IV [10]: You are running the corporate IP network of your organization. You have three Ethernet LANs, all connected to router R, which also has a link to your ISP. You have obtained IP address block 202.9.4.0/24 from the ISP, of which the sub-block 202.9.4.252/30 is reserved for the link between your router and the ISP (the respective addresses for each end are as shown in the figure). The default gateway for your network is 202.9.4.254. The MAC addresses of the routers are as shown in the figure.



- (a) [2] Assign IP address-blocks (i.e. IP subnet and mask) to each of the three LANs, assuming that each LAN has at most 50 hosts.
LAN_1: 202.9.4.0/26, LAN_2: 202.9.4.64/26, LAN_3: 202.9.4.128/26.
- (b) [2] Assign IP address/mask to interfaces of router R on each LAN.
LAN_1: 202.9.4.1, LAN_2: 202.9.4.65, LAN_3: 202.9.4.129.
- (c) [3] List all the entries in the routing table of router R. Entries should be three-tuples of the form $\langle addr, mask, next-hop \rangle$ with an optional flag to indicate direct/local routes. Hint: there should be 5 routing entries in total.
*202.9.4.0/26 \rightarrow L:202.9.4.1; 202.9.4.64/26 \rightarrow L:202.9.5.65,
 202.9.4.128/26 \rightarrow L:202.9.4.129; 202.9.4.252/30 \rightarrow L:202.9.4.253;
 0.0.0.0/0 \rightarrow 202.9.4.254.*
- (d) [1] What routing entry is required at the ISP's router so that it forwards packets destined for your organization to your router R?
202.9.4.0/24 \rightarrow 202.9.4.253.
- (e) [1] A host in LAN A with Ethernet MAC address 00:03:8e:10:10:4f sends a packet to a host 66.94.234.12 with MAC address 00:03:8e:10:10:7d in the Internet. What are the source and destination IP addresses, and source and destination MAC addresses in the packet transmitted by the host to router R?
 $\langle 202.9.4.2, 00:03:8e:10:10:4f \rangle \rightarrow \langle 66.94.234.12, 00:03:8e:20:20:01 \rangle.$
- (f) [1] The packet above now traverses from router R to router R_ISP. What are the source and destination IP addresses, and source and destination MAC addresses now?
 $\langle 202.9.4.2, 00:03:8e:20:20:01 \rangle \rightarrow \langle 66.94.234.12, 00:03:8e:20:20:00 \rangle.$