HW3 solution:

Chapter 5, Problems 8, 11, 15, 16, 17.

Problem 8.

The length of a polling round is

$$N(Q/R + t_{poll}) .$$

The number of bits transmitted in a polling round is NQ. The maximum throughput therefore is

$$\frac{NQ}{N(Q/R + t_{poll})} = \frac{R}{1 + \frac{t_{poll}R}{Q}}$$

Problem 11.

At $t = 0$ A transmits. At $t = 576$, A would finish transmitting. In the worst case, B begins transmitting at time $t = 224$. At time $t = 224 + 225 = 449$ B's first bit arrives at A. Because $449 < 576$, A aborts before completing the transmission of the packet, as it is supposed to do.

Thus A cannot finish transmitting before it detects that B transmitted. This implies that if A does not detect the presence of a host, then no other host begins transmitting while A is transmitting.

Problem 15.

a)

$$\frac{900m}{2 \cdot 10^8 m/\sec} + 4 \cdot \frac{20bits}{10 \times 10^6 bps}$$

$$= (4.5 \times 10^{-6} + 8 \times 10^{-6})\sec$$
$$= 12.5\mu\sec$$

b)

- At time $t = 0$, both A and B transmit.
- At time $t = 12.5\mu\sec$, A detects a collision.
- At time $t = 25\mu\sec$ last bit of B's aborted transmission arrives at A.
- At time $t = 37.5\mu\sec$ first bit of A's retransmission arrives at B.
- At time $t = 37.5\mu\sec + \frac{1000bits}{10 \times 10^6 bps} = 137.5\mu\sec$ A's packet is completely delivered at B.

c) $12.5\mu\sec + 5 \cdot 100\mu\sec = 512.5\mu\sec$

Problem 16.

The time required to fill $L \cdot 8$ bits is

$$\frac{L \cdot 8}{64 \times 10^3}\sec = \frac{L}{8} m\sec.$$

b) For $L = 1{,}500,$ the packetization delay is

$$\frac{1500}{8} m\sec = 187.5 m\sec.$$

For $L = 48,$ the packetization delay is

$$\frac{48}{8} m\sec = 6 m\sec.$$

c)

$$\text{Store-and-forward delay } = \frac{L \cdot 8 + 40}{R}$$

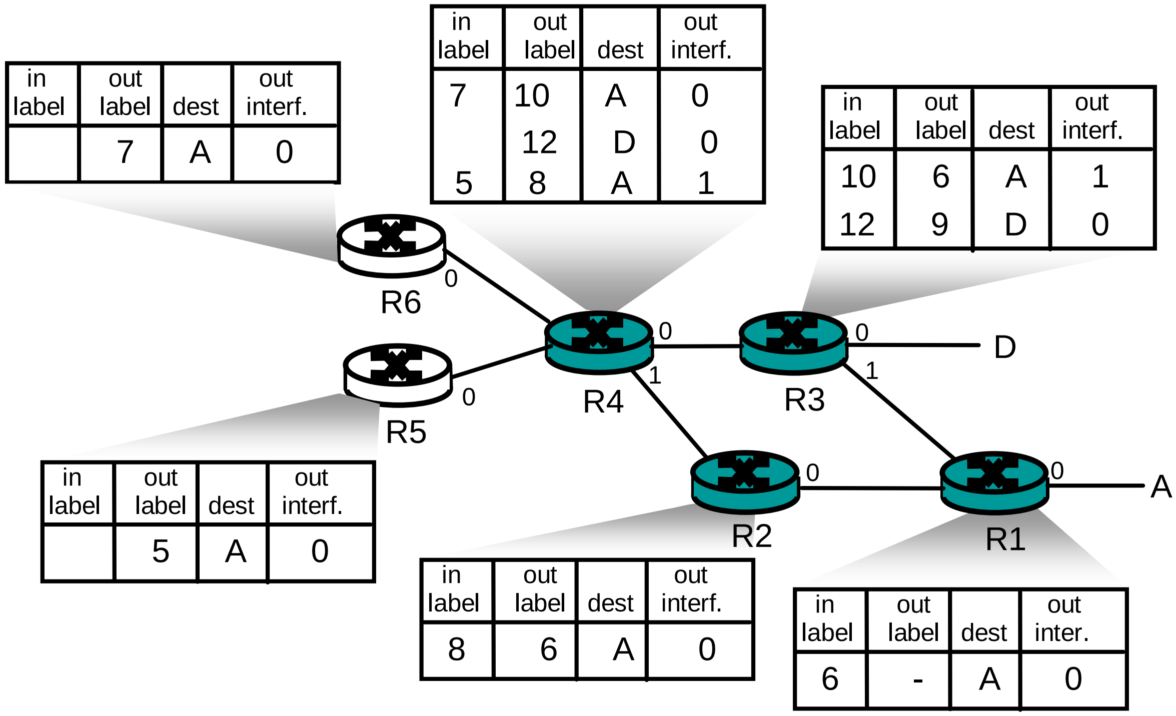
For $L = 1{,}500$, the delay is

$$\frac{1500 \cdot 8 + 40}{155 \times 10^6}\sec \approx \frac{12}{155} m\sec \approx 77\mu\sec$$

For $L = 48,$ store-and-forward delay $< 1\mu\sec$.

d) Store-and-forward delay is small for both cases for typical ATM link speeds. However, packetization delay for $L = 1500$ is too large for real-time voice applications.

Problem 17.



Chapter 6, Problems 4, 7, 9, 11, 12.

Problem 4.

a) The two APs will typically have different SSIDs and MAC addresses. A wireless station arriving to the café will associate with one of the SSIDs (that is, one of the APs). After association, there is a virtual link between the new station and the AP. Label the APs AP1 and AP2. Suppose the new station associates with AP1. When the new station sends a frame, it will be addressed to AP1. Although AP2 will also receive the frame, it will not process the frame because the frame is not addressed to it. Thus, the two ISPs can work in parallel over the same channel. However, the two ISPs will be sharing the same wireless bandwidth. If wireless stations in different ISPs transmit at the same time, there will be a collision. For 802.11b, the maximum aggregate transmission rate for the two ISPs is 11 Mbps.

b) Now if two wireless stations in different ISPs (and hence different channels) transmit at the same time, there will not be a collision. Thus, the maximum aggregate transmission rate for the two ISPs is 22 Mbps for 802.11b.

Problem 7.

a) Recall that in distance vector routing, information about a change in destination passes only between neighboring nodes, when the neighboring nodes exchange routing updates/information. (The is in contrast to link state routing, where all changes in routing are broadcast to all routers, and thus all routers learn about changes in the network after just one link state broadcast). Thus, all routers will not be able to route to the mobile node immediately, under the assumption of distance vector routing.

b) Under distance vector routing, different routers may indeed have a different view of the visited network for the mobile node. A router will not know about the changed visited network until that information propagates to it via the pair-wise exchanges of routing information between routers on the path to the mobile node.

c) The timescale is roughly on the order of the diameter of the network (i.e., the length of the longest source-destination path). This is because routing information propagates only via pair-wise exchange between neighboring routers on the path. Thus the time it would take to propagate information from any point in the network to any other point is, in worst case, on the order of the diameter of the network

Problem 9.

Because datagrams must be first forward to the home agent, and from there to the mobile, the delays will generally be longer than via direct routing. Note that it *is* possible, however, that the direct delay from the correspondent to the mobile (i.e., if the datagram is not routed through the home agent) could actually be smaller than the sum of the delay from the correspondent to the home agent and from there to the mobile. It would depend on the delays on these various path segments. Note that indirect routing also adds a home agent processing (e.g., encapsulation) delay.

Problem 11.

Two mobiles could certainly have the same care-of-address in the same visited network. Indeed, if the care-of-address is the address of the foreign agent, then this address would be the same. Once the foreign agent decapsulates the tunneled datagram and determines the address of the mobile, then separate addresses would need to be used to send the datagrams separately to their different destinations (mobiles) within the visited network.

Problem 12.

If the MSRN is provided to the HLR, then the value of the MSRN must be updated in the HLR whenever the MSRN changes (e.g., when there is a handoff that requires the MSRN to change). The advantage of having the MSRN in the HLR is that the value can be provided quickly, without querying the VLR. By providing the address of the VLR Rather than the MSRN), there is no need to be refreshing the MSRN in the HLR.