EE122: Introduction to Computer Networks Homework 7
Department of Electrical Engineering and Computer Sciences SOLUTIONS
UNIVERSITY OF CALIFORNIA BERKELEY

Total points = 10

Question 1

Suppose that wireless station H1 has 1000 long frames to transmit. (H1 may be an AP that is forwarding an MP3 to some other wireless station.) Suppose initially H1 is the only station that wants to transmit, but that while half-way through transmitting its first frame, H2 wants to transmit a frame. For simplicity, also suppose every station can hear every other station's signal (that is, no hidden terminals). Before transmitting, H2 will sense that the channel is busy, and therefore choose a random backoff value.

Now suppose that after sending its first frame, H1 returns to step 1; that is, it waits a short period of times (DIFS) and then starts to transmit the second frame. H1's second frame will then be transmitted while H2 is stuck in backoff, waiting for an idle channel. Thus, H1 should get to transmit all of its 1000 frames before H2 has a chance to access the channel. On the other hand, if H1 goes to step 2 after transmitting a frame, then it too chooses a random backoff value, thereby giving a fair chance to H2. Thus, fairness was the rationale behind this design choice.

Question 2

(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

Question 3

If the correspondent is mobile, then any datagrams destined to the correspondent would have to pass through the correspondent's home agent. The foreign agent in the network being visited would also need to be involved, since it is this foreign agent that notifies the correspondent's home agent of the location of the correspondent. Datagrams received by the correspondent's home agent would need to be encapsulated/tunneled between the correspondent's home agent and foreign agent, (as in the case of the encapsulated diagram at the top of Figure 6.19).

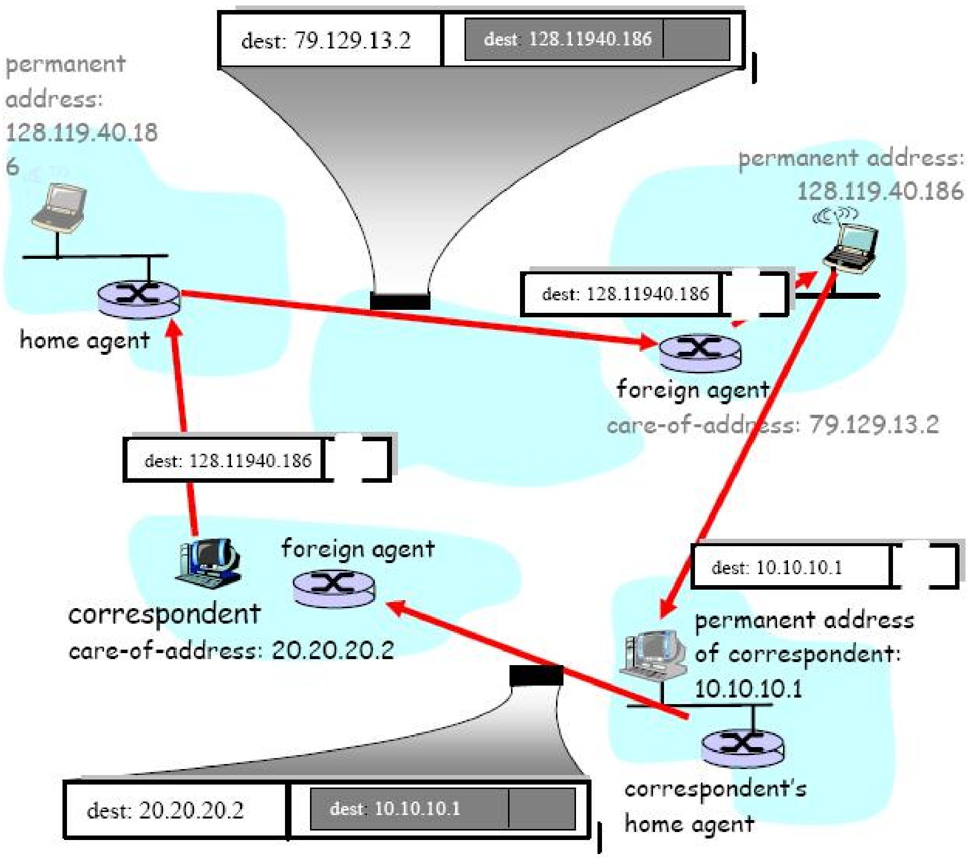

Figure 1: Figure for Question 3

Question 4

First, we note that chaining was discussed at the end of section 6.5. In the case of chaining using indirect routing through a home agent, the following events would happen:

- The mobile node arrives at A, A notifies the home agent that the mobile is now visiting A and that datagrams to the mobile should now be forwarded to the specified care-of-address (COA) in A.
- The mobile node moves to B. The foreign agent at B must notify the foreign agent at A that the mobile is no longer resident in A but in fact is resident in B and has the specified COA in B. From then on, the foreign agent in A will forward datagrams it receives that are addressed to the mobile's COA in A to the mobile's COA in B.
- The mobile node moves to C. The foreign agent at C must notify the foreign agent at B

that the mobile is no longer resident in B but in fact is resident in C and has the specified COA in C. From then on, the foreign agent in B will forward datagrams it receives (from the foreign agent in A) that are addressed to the mobile's COA in B to the mobile's COA in C.

Note that when the mobile goes offline (i.e., has no address) or returns to its home network, the datagram-forwarding state maintained by the foreign agents in A, B and C must be removed. This teardown must also be done through signaling messages. Note that the home agent is not aware of the mobile's mobility beyond A, and that the correspondent is not at all aware of the mobile's mobility. In the case that chaining is not used, the following events would happen:

- The mobile node arrives at A, A notifies the home agent that the mobile is now visiting A and that datagrams to the mobile should now be forwarded to the specified care-of-address (COA) in A.
- The mobile node moves to B. The foreign agent at B must notify the foreign agent at A and the home agent that the mobile is no longer resident in A but in fact is resident in B and has the specified COA in B. The foreign agent in A can remove its state about the mobile, since it is no longer in A. From then on, the home agent will forward datagrams it receives that are addressed to the mobiles COA in B.
- The mobile node moves to C. The foreign agent at C must notify the foreign agent at B and the home agent that the mobile is no longer resident in B but in fact is resident in C and has the specified COA in C. The foreign agent in B can remove its state about the mobile, since it is no longer in B. From then on, the home agent will forward datagrams it receives that are addressed to the mobiles COA in C.

When the mobile goes offline or returns to its home network, the datagram-forwarding state maintained by the foreign agent in C must be removed. This teardown must also be done through signaling messages. Note that the home agent is always aware of the mobiles current foreign network. However, the correspondent is still blissfully unaware of the mobiles mobility.

Question 5

1. Wavelength $\lambda = c/f = (3 \times 10^8 \text{ m/s})/(1.9 \times 10^9 \text{ Hz}) = 0.157$ m. Need to cover distance $\lambda/4 = 0.0393$ m to move from a point of destructive interference to a point of constructive interference. Therefore, time taken = 0.0393 m$/(3 \text{ km/hr}) = 47.2$ ms. This time is also referred to as the coherence time.
2. In both the cases, since the coherence time is less than the latency constraint, time diversity should work.