Chapter 10

2. You have temporarily moved to a new area and you would like to use your cell phone. What alternatives do you have if (a) There is no service provider in that area? (b) There is no agreement between your wireless phone service provider and the service provider in the new area? (c) The area is covered only by a satellite phone service?

[Solution]

(a) It is impossible to use a cell phone where no service provider (including satellite phone service) exists.

(b) If there is no agreement, there is nothing you can do in the new area. You can register your cell phone to the new service provider in the new area, if that employs the same technology and reprogrammed for new frequency band and/or code.

(c) Subscribe your cell phone to a satellite phone service provider, if it is capable to use the satellite frequency band.

7. In the backbone network, it is desirable to find the shortest path from the source to the destination. How do you do this in a wireless network environment, where the subscribers do have finite mobility? Explain clearly.

[Solution]

In a wireless network, a HA (home agent) and FA (foreign agent) can be used to deal with the mobility. If the subscribers have finite mobility, the HA and FA are able to cooperate with each other to locate the subscriber. When a source want to send a message to a destination and the HA has the current location information of the destination, then the message can be delivered to a destination subscriber along the shortest path as in the backbone network.

8. What is the use of “attachment points” from one network to another network? Explain its significance in wireless network routing?

[Solution]

They are the gateway routers which route the packets into/out of one network to another network. Gateway routers support routing within backbone.

10. What is meant by bidirectional tunneling? Why do you need HA-FA in addition to HLR-VLR pair? Explain clearly.

[Solution]

The bidirectional tunneling approach is that when an MS moves into a foreign network, a binding update is sent to the HA, which then responses with a binding acknowledgement. After that, a bidirectional tunnel is created by HA to the FA that is currently serving the MS and HA encapsulates the packets for the MS.

Chapter 11

2. How do you differentiate between different types of handoff? Explain.

[Solution]

Handoff can be classified into two different types: hard handoff and soft handoff. Hard handoff is also known as break before make and is characterized by releasing current radio resources from the prior BS before acquiring resources from the next BS. Both FDMA and TDMA employ hard handoff.

The feature of soft handoff is that two base stations are connected to the same mobile station during the handoff. Soft handoff can be used only in CDMA. In CDMA, the same channel is used in all the cells, if the code is not orthogonal to other codes being used in the next BS, the code could be changed. It is possible for an MS to communicate simultaneously with the prior BS as well as the new BS for some short duration of time, during the process of handoff.

7. What are the similarities and the differences between AMPS and GSM? Explain clearly.

[Solution]

The major differences between AMPS and GSM is that AMPS uses analog technology while GSM uses digital technology. AMPS has poor performance for data transfer while GSM has higher data transfer. GSM features a subscriber identity module (SIM) smart card, which holds all of a subscriber's personal information (including his phone number) and phone settings, in AMPS only its HLR contain that data. AMPS and GSM support roaming, but GSM allows for different system compatibility, hence a user can travel from one system to the other. Both systems use control channels to initiate calls, AMPS uses 21 control channels while GSM uses 3 control channels. AMPS is less secure than GSM.

9. Why is a smart card needed in GSM, while it is not required in AMPS? Explain the logic behind this.

[Solution]

GSM systems worldwide, feature a subscriber identity module (SIM) smart card, which holds all of a subscriber's personal information (including his phone number) and phone settings. The card can be switched from phone to phone, making the new phone receive all calls to the subscriber's number. The SIM card makes it possible to roam around the world where other GSM networks are operating. Any GSM phone becomes immediately programmed after plugging in the SIM card, thus allowing GSM phones to be easily rented or borrowed. SIM cards can be programmed to display custom menus for personalized service. All this information requires digital technology especially when digital transmissions provide for highly private conversations and complex authentication schemes that would allow the user to access certain privileges, something not found in the analog radio frequency modulation (FM) that is used in AMPS. AMPS system predates GSM, and hence functions more like a walkie-talkie almost exclusively for voice transmissions, hence the need for complex operations that require the usage of digital technology is not needed.

11. A cellular system employs CDMA scheme. Is it possible to use TDMA (instead of CDMA)? If not, why not; and if yes what may be the potential advantages? Explain clearly.

[Solution]

Yes, a TDMA scheme can replace a CDMA scheme if the appropriate modifications are considered. The potential advantages would be that we would have less complexity involved in the system. Smaller bandwidth allocation is needed and power control is not a problem as the near-far problem is greatly minimized. However, the number of users in a TDMA system is lower than in a CDMA.

12. One approach of using Walsh code in a CDMA system is to assign a code permanently to each subscriber. What are the advantages, disadvantages, or limitations of such an approach?

[Solution]

Advantages of this scheme is that we can have the code encoded in the smart card, and hence the user can access it faster and achieve faster communications. The disadvantage comes at the security involved. If the same user keeps on using the same codes over and over, then a patient hacker can eavesdrop and eventually figure out the codes and can use them for malicious purposes. The limitations to this approach is that because these codes are orthogonal, then we are limited by the number of codes we can generate. Therefore, a user who is assigned a code and is not using it represents a wasted resource that can be used by another user.

15. Why is the far-near Problem present in CDMA and not in FDMA?

[Solution]

CDMA requires tight power control as it suffers from near-far effect. In other words, a user close to the base station transmitting with the same power as a user farther away will drown the latter's signal. All signals must have more or less equal power at the receiver. While in FDMA all together different frequencies are used, this problem does not exist. The signals with different frequencies can not affect each other signals as the signals are distinct, which is not the case in CDMA where the same frequency is used to transmit 2 calls, each with a different code.

22. What is the future of SMS services and how do you compare with paging? Explain clearly.

[Solution]

The next step in the evolution of SMS, which requires substantial changes in the network infrastructure, is the Multimedia Messaging Service (MMS) that allows a combination of text, sounds, images and video. MMS will support pictures and interactive video. It will be possible, for example, to send mobile greeting cards and visiting cards using MMS. Paging has similarity with SMS. But SMS is from a mobile user to another mobile user, and is transported by appropriate signaling.

Chapter 13

1. What are the differences between cellular and ad hoc networks?

[Solution]

Cellular network model supports the needs of wireless communication by installing BSs as access points. Communications between two mobile nodes completely rely on the wired backbone and the fixed base stations. In an ad hoc network, no such infrastructure exists and the network topology may change dynamically in an unpredictable manner since nodes are free to move in an arbitrary direction with a random speed.

3. A given ad hoc network consists of 100 nodes and the mobility of the nodes is such that every one second, two existing radio connections are broken, while two new radio links are established. Assuming each node is connected to exactly four adjacent nodes. Find the total number of links in the network.

[Solution]

Number of link connections = 100 * 4 = 400. As each link is connected to two nodes, the number of links 400/2 = 200.

4. In Problem P13.3, if the updated message is sent every 5 seconds, what is the upper limit on the number of messages initiated periodically if a table-driven routing protocol is to be used? Explain clearly.

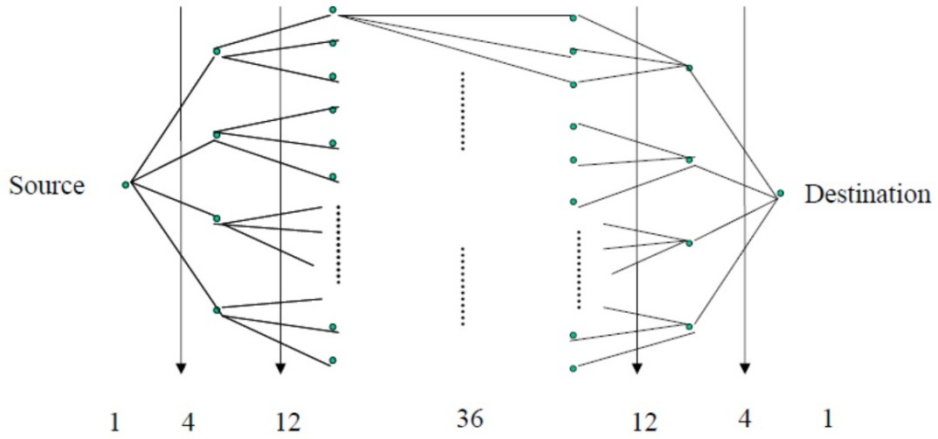
[Solution]

Because every one second, two existing connection are broken, two new radio links are established, so, every one second, there are four updating message, if the updated message is sent every 5 seconds, the upper limit on the number of messages initiated is 4 * 5 = 20.

5. In Problem P13.4, if the destination node is located at 5 hops apart from a given source node, what is the maximum possible value of (a) The number of alternate paths of length of 5 hops? (b) Alternate disjoint paths of length 5 hops?

[Solution]

(a) Alternate paths means a source node S can take A-B-C to destination D, it also can take M-L-N to destination D if the formal link fails. If the destination node is located at 5 hops apart from a given source node, every node is connected to exactly 4 adjacent node, therefore, source can connect with four adjacent node, among these four adjacent nodes, every node mostly can connect with another 3 nodes, then from 4 nodes arrive to destination. Therefore, there would be 4 * 3 * 3 * 1 * 1 = 36 alternate paths (maximum).



(b) For disjointness, no intermediate node should be common among the paths. One simple way is to have a unique path between 12 nodes after 2 links from either source or destination, giving 4 *3 *1 *4 = 48 disjoint paths (maximum).

7. A snapshot of an ad hoc network is shown in Figure 13.19.

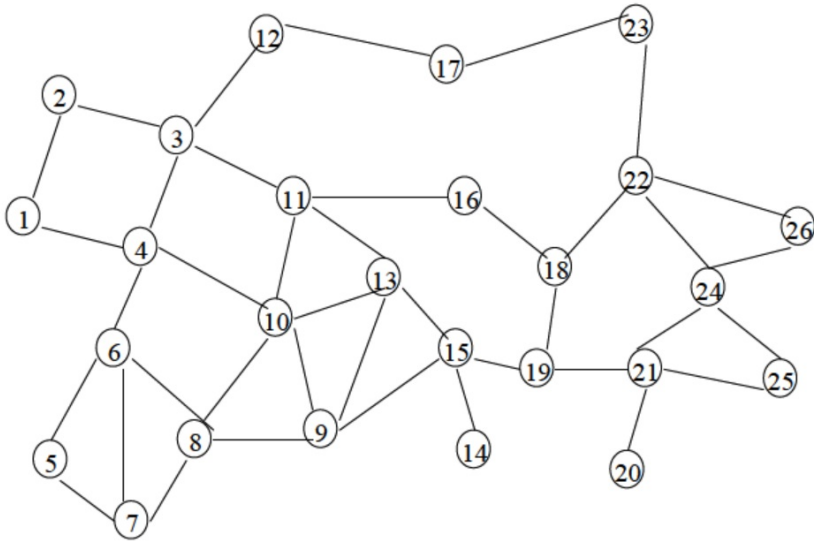


Figure 13.19 for problem 13.7

describe briefly the process taken to

(a) How can you create a route from the source node 6 to the destination node 23 using DSR algorithm?

(c) What changes would you do in part (a) if you use the AODV protocol?

[Solution]

(a) By using DSR algorithm to create a route from 6 to 23, node 6 at first checks its route cache to determine whether it already has a route to the destination 23, if it has, it will use this route. If it does not have such a route, it initiates route discovery by broadcasting a route request packet. This route request contains the address of node 23. A reply is generated when the route request reaches either node 23, or an intermediate node whose route cache contains an unexpired route to the

destination.

(c) For AODV, node 6 broadcasts a route request packet (RREQ) to its neighbors, which then forwards the request to their neighbors, and so on, until either node 23 or a node with “fresh enough” route to node 23 is located. The main difference between the DSR and AODV is that DSR uses source routing and AODV uses forwarding tables at each node. During the process of forwarding the RREQ, nodes record in their route tables the address of the neighbor from which the first copy of the broadcast packet is received, thereby establishing a reverse path.