Problems and Solutions (Chapter 1)

1. Why do you need wireless services when adequate wired infrastructure exists in most parts of the United States?

   [Solution]

   - Convenience (remote control, cordless phone).
   - Travelling (mobile phones).
   - Disaster area or emergency situations without infrastructure.

2. What are the challenges for wireless networking?

   [Solution]

   - Reduced size (cost and power).
   - Higher capacity and throughput.
   - Protocols with reduced complexity.
   - Efficient mobility management.
   - High speed mobile infrastructure network to support real-time data communication.
   - Secure communication and strong authentication techniques.

3. What are the unconventional applications of wireless networks?

   [Solution]

   Smart phones, highly functional wireless multimedia services, astronomical research (use your imagination for monitoring different physical parameters).

4. What are the household applications that use wireless schemes to control functionally?

   [Solution]

   Wireless technology has been adapted for use in homes. One application of this technology is Home Automation. An increasing number of new homes are being designed as "smart homes". Home automation utilizes the technology in many different ways, from wireless detector lights to integrating and controlling a home's heat, ventilation and air-conditioning.

   Another application of wireless technology being introduced is WiFi, which allows two or more devices in the same geographical area to be connected together and communicate with each other. For example, an internet connection and printers can be shared without cables running throughout the house.

5. How many cellular service providers are present in your area? Which of the multiple access technique supported by each system? What are the cell size and transmitting power level? What are the number of subscribers in your area?

   [Solution]

   There are many cellular service providers presented in Cincinnati. The most popular ones are: T-Mobile; Sprint PCS; AT&T Wireless; Verizon Wireless; Cingular Wireless; etc. Among them, Verizon wirelss and Sprint PCS use CDMA. T-Mobile, AT&T Wireless, and Cingular Wirelss use GSM, and basically TDMA.

6. How is an ad hoc network different from a cellular network?

   [Solution]

   No base stations, information is forwarded in peer-to-peer mode using multi-hop routing, created on ad hoc basis.

7. List some prospective application areas for sensor networks?

   [Solution]

   Battlefield surveillance, machinery prognosis, biosensor, environmental monitoring.

8. Look at your favorite web site and find what is meant by "web-in-the-sky"?

   [Solution]

   Seamless internet access.

9. What are the advantages of different wireless service provoders in an area? Explain clearly.

   [Solution]

   Users would get benefit if there are many wireless service providers in one area. Competition means more plans to choose from, more "great offers" to take advantage of. Setting up a wireless network is no easy undertaking and requires significant funding. Different Wireless providers in one area may share sites to cut costs and minimize public concerns over cellular transmission towers. Better coverage can be provided if there are different wireless service providers in one area.

10. Can a network be wireless, but not mobile? Explain your answer carefully.

    [Solution]

    Yes, for example, microwave backbone network, controlled robot, portable laptops with ethernet connections.

11. What are the limitations if a network is mobile with no wireless support?

    [Solution]

    Limited mobility depending on the length of wire.

12. Why is "anytime anywhere" access not required for all applications? Explain clearly.

    [Solution]

    "Anytime anywhere" access is essential for military and defense areas as well as to a limited class of life-threatening applications like nuclear power, aviation and medical emergencies. However, for most day-to-day operations, "anytime anywhere" feature may not be needed or at best desirable.

13. What are the pros and cons of having different size cells for wireless networking?

    [Solution]

    Smaller the cell size, low power consumption, low operating cost but increased infrastructure cost. Smaller the cell size, more users in a small area (user density) can be accommodated in the network.

14. Why do you have difficulty in using your cell phone inside an elevator?

    [Solution]

    Weak signal. EM waves are absorbed or reflected depending on metal in elevator.

15. What phenomenon do you observe when a cell phone is used while traveling a long metallic bridge?

    [Solution]

    Weak signal. Same as above.

16. How do you compare a cell phone with a satellite phone?

    [Solution]

    Satellite phone equipment is very costly but it is truly global, while cell phone equipment is not expensive, but with limited coverage area. Also, the delay in satellite phones, is much large.

17. In an airplane in the air, what happens if you use

    (a) A walkie-talkie?

    (b) A satellite phone?

    (c) A cell phone?

    [Solution]

    (a) Very little interference.

    (b) No interference as they operate in different band.

    (c) Air ground interference.

18. What are the similarities between frequency hopping and TDMA?

    [Solution]

    TDMA divides the spectrum into narrow band channels. In TDMA, the same channel is assigned to multiple users. The available time is divided into a number of time slots. These slots are assigned to users sharing the same channel. Frequency Hopping sends its transmissions over a different carrier frequency at different times.

19. If a total of 33 MHz of bandwidth is allocated to a particular cellular telephone system which uses two 25 kHz simplex channels to provide full duplex voice channels, compute the number of simultaneous calls that can be supported per cell if a system uses:

    (a) FDMA

    (b) TDMA with 8-way time multiplexing

    Assume that additional bandwidth is reserved for the control channels.

    [Solution]

    (a)

    $$\frac{33 \cdot 10^6}{25 \cdot 10^3 \cdot 2} = 660.$$

    (b)

    $$\frac{33 \cdot 10^6 \cdot 8}{25 \cdot 10^3 \cdot 2} = 5280.$$

20. Many types of sensors are comercially available. Looking at different web sites, can you prepare their cost-size-performance tradeoff?

    [Solution]

    to be answer by student