CHAPTER 16

PRACTICE SET

Questions

Q16-1. WiMax defines a wireless WAN.

a. The *fixed WiMax* uses a star-topology to create a wireless WAN between a *base station* (BS) and some *fixed subscribed stations* (FSubs).

b. The *mobile WiMax* also uses a star-topology to create a wireless WAN between a *base station* (BS) and some *mobile subscriber stations* (MSubs).

Q16-3. This is the case of a *mobile WiMax*. The mobile phone communicates with a *mobile subscriber station* (MSub).

Q16-5. A *mobile switching* center connects cells, records call information, and is responsible for billing.

Q16-7. In a *hard handoff*, a mobile station communicates with only one base station. In a *soft handoff*, a mobile station communicates with two base stations at the same time.

Q16-9. *D-AMPS* is a digital cellular phone system that is backward compatible with AMPS.

Q16-11. *CDMA* encodes each traffic channel using one of the rows in the Walsh-64 table.

Q16-13. A *GEO* satellite has an equatorial orbit since the satellite needs to remain fixed at a certain spot above the earth.

Q16-15. A satellite orbiting in a *Van Allen belt* would be destroyed by the charged particles. Therefore, satellites need to orbit either above or below these belts.

Q16-17. *GPS* is a satellite system that provides land and sea navigation data for vehicles and ships. The system is also used for clock synchronization.

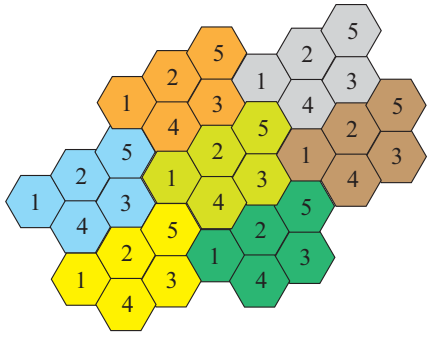
Problems

P16-1. Let us assume that WiMax uses only TDM. In each time slot, a frame is in the air. The base station fills the data to send to substation in the downstream subframe; the substations fills the data to send to the base station in the upstream subframe. Let us give a very simplified example to make the point clear. Assume that the time slot is one minute and the communication is instantaneous. This means in each minute there is a frame in the air.

a. During the first half of each minute, the base station is sending data to the substations and the substations are receiving data from the base station (downstream communication).

b. During the second half of each minute, the substations are sending data to the base station and the base station is receiving data from the substations (upstream communication).

P16-3. The following figure shows one possibility.



P16-5. *In AMPS*, there are two separate bands for each direction in communication. In each band, we have 416 analog channels. Out of this number, 21 channels are reserved for control. With a reuse factor of 7, the maximum number of simultaneous calls in each cell is

$$\text{Maximum number of simultaneous calls} = (416 - 21) / 7 = 56.4 \approx 56$$

P16-7. In *GSM*, separate bands are assigned for each direction in communication. This means 124 analog channels are available in each cell (assuming no control channels). Each analog channel carries 1 multiframe. Each multiframe carries 26 frames (2 frames are for control). Each frame allows 8 calls. With a reuse factor of 3, we have

$$\text{Maximum number of simultaneous calls} = [(124) \times 24 \times 8] / 3 = 7936$$

P16-9. A 3-KHz voice signal is modulated using FM to create a 30-KHz analog signal. As we learned in Chapter 5, the bandwidth required for FM can be determined from the bandwidth of the audio signal using the formula

$$B_{FM} = 2(1 + \beta)B.$$

AMPS uses $\beta + 1 = 5$. This means *BFM* = $10 \times B = 30$ KHz.

P16-11. *GPS* satellites are orbiting at 18,000 km above the earth surface. Considering the radius of the earth, the radius of the orbit is then (18,000 km + 6378 km) = 24,378 km. Using the Kepler formula, we have

$$\text{Period} = (1/100)\ (\text{distance})^{1.5} = (1/100)\ (24{,}378)^{1.5} = 38062 \text{ s} = 10.58 \text{ hours}$$

P16-13. *Globalstar* satellites are orbiting at 1400 km above the earth surface. Considering the radius of the earth, the radius of the orbit is then (1400 km + 6378 km) = 7778 km. Using the Kepler formula, we have

$$\text{Period} = (1/100)\ (\text{distance})\ 1.5 = (1/100)\ (7778)1.5 = 6860 \text{ s} = 1.9 \text{ hour}$$

P16-15. In problem P16-6 we showed that the maximum simultaneous calls per cell for D-*APMS* is 356. Using the total bandwidth of 50 MHz (for both directions), we have

$$\text{Efficiency} = 356 / 50 = 7.12 \text{ calls/MHz}$$

P16-17. In problem P16-8, we showed that the maximum simultaneous calls per cell for *IS-95* is 1100. Using the total bandwidth of 50 MHz (for both directions), we have

$$\text{Efficiency} = 1100 / 50 = 22 \text{ calls/MHz}$$