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3. In spread spectrum (SS) systems using code division multiple access (CDMA), it is desirable to equalize the received power level from all mobile units at the BS. This is crucial to system performance because all users have the same frequency allocation.

Cellular systems use the two kinds of power control. **Open-loop power control** depends solely on the mobile unit, with no feedback from the BS, and is used in some SS systems. In SS systems, the BS continuously transmits an unmodulated signal, known as a pilot. The pilot allows a mobile unit to acquire the timing of the forward (BS to mobile) CDMA channel and provides a phase reference for demodulation. It can also be used for power control. The mobile unit monitors the received power level of the pilot and sets the transmitted power in the reverse (mobile to BS) channel inversely proportional to it. This approach assumes that the forward and reverse link signal strengths are closely correlated, which is generally the case. The open-loop approach is not as accurate as the closed-loop approach. However, the open-loop scheme can react more quickly to rapid fluctuations in signal strength, such as when a mobile unit emerges from behind a large building. This fast action is required in the reverse link of a CDMA system where the sudden increase in received strength at the BS may suppress all other signals.

Closed-loop power control adjusts signal strength in the reverse (mobile to BS) channel based on some metric of performance in that reverse channel, such as received signal power level, received signal-to-noise ratio, or received bit error rate. The BS makes the power adjustment decision and communicates a power adjustment command to the mobile unit on a control channel. Closed-loop power control is also used to adjust power in the forward channel. In this case, the mobile unit provides information about received signal quality to the BS, which then adjusts transmitted power.

Table 10.2 shows the power classes used in the GSM standard, which is a TDMA standard and is discussed in Section 10.3. GSM defines eight classes of base station channels and five classes of mobile stations, according to their power output. Adjustments in both directions are made using closed-loop power control.

Table 10.2 GSM Transmitter Classes

Power Class	Base Station Power (watts)	Mobile Station Power (watts)
1	320	20
2	160	8
3	80	5
4	40	2
5	20	0.8
6	10	
7	5	
8	2.5	