Power Control in CDMA

A proper power control on both the uplink and downlink has several advantages: System capacity is improved or optimized. Mobile battery life is extended. Radio path impairments are properly compensated for. Quality of service (QoS) at various bit rates can be maintained. The reverse link (uplink) uses a combination of *open loop* and *closed loop* power control to command the mobile station to make power adjustments The mobile station and the base station receiver measure the received power and use the measurements to maintain a power level for adequate performance. The mobile unit measurement is part of the open loop power control while the base station measurement is part of the closed loop power control. In the closed loop mode, the mobile station transmitter power is controlled by a signal from the base station site. Each base station demodulator measures the received SNR for that mobile station and sends a power command either to increase or decrease mobile station power. The measure-command-react cycle is performed at a rate of800 times per second for each obile station in IS-95. The power adjustment command is combined with the mobile's open loop estimate and the result is used to adjust the transmitter gain. This solves the near far interference problem, reduces interference to other mobiles using the same

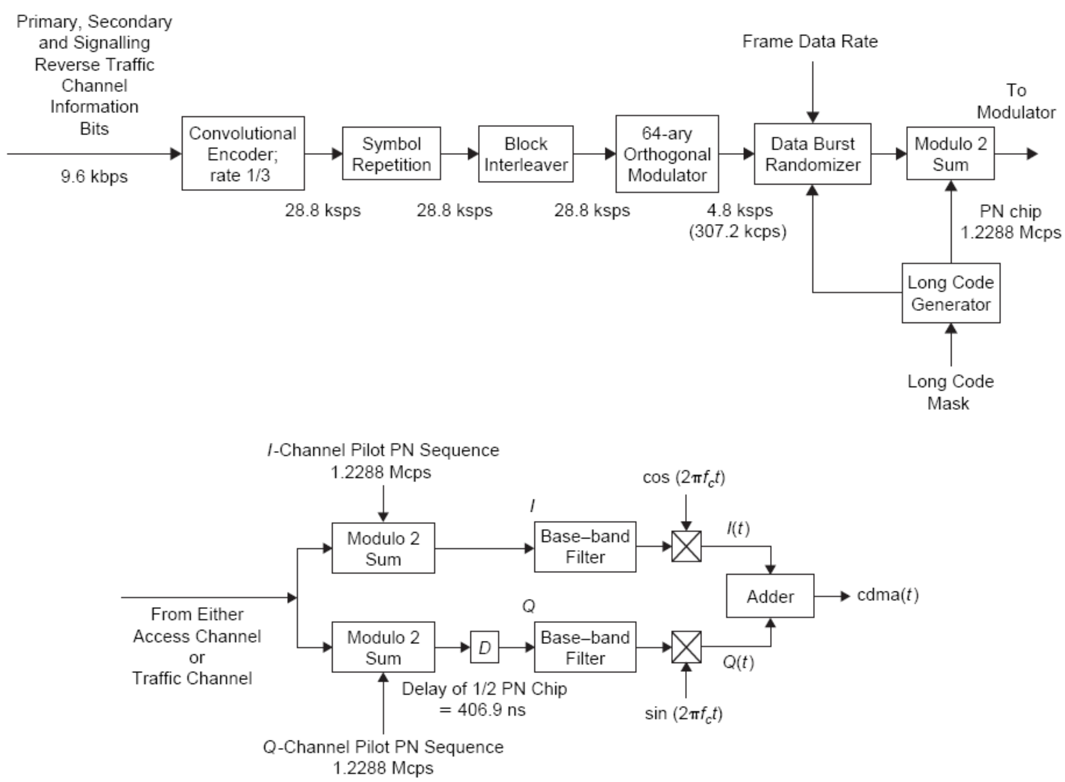

Figure 11.17 Reverse traffic channel.

CDMA radio channel, helps to overcome fading, and conserves battery power in portable and mobile units. On the uplink, the objective of the mobile station is to produce a nominal received power signal at the base station receiver. Regardless of the mobile's position or propagation loss, each mobile should be received at the base station with almost the same power level. If the mobile's signal arrives at the base station with a lower power level than the required power level, its error rate performance will be high. On the other hand, if the mobile's signal is too high, it will interfere with other users with the same CDMA radio channel causing performance degradation unless the traffi c load is decreased.

Similarly, a combination of open loop and closed loop power control is used on the forward link (downlink) to keep SNR at the mobile almost constant. Forward link power control mitigates the corner problem. Mobiles at the edges of cells normally require more power than those close to the center of the base station for two reasons: more transmission loss and more interference from adjacent base stations. This is known as the *corner problem*. Forward link power control minimizes interference to mobiles in the same base station (in multipath environments) as well as mobiles in other base stations. Using the downlink power control, the base station transmits the minimum required power, hence, minimizes the interference to mobiles in the surrounding base stations. The outer loop power control is the fi ner power control over the closed loop power control. It adjusts the target signal-to-interference ratio (SIR) in the base station according to the needs of the individual radio links and aims at a constant quality, which is usually defi ned as a certain target bit error rate (BER) or frame error ratio (FER). The required SIR depends on the mobile speed and multipath profi le. The outer loop power control is typically implemented by having the base station to each uplink user data frame with frame quality indicator, such as a cyclic redundancy check (CRC) result, obtained during decoding of the particular user data frame.

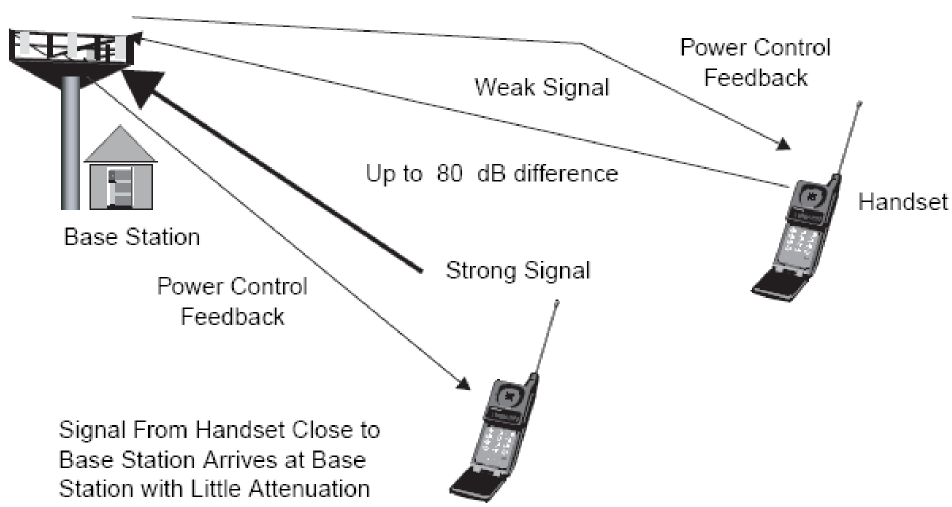

Figure 11.19 Power control in CDMA.

Open Loop Power Control

In the open loop power control, the mobile uses the received signal to estimate the transmission loss from the mobile unit and the base station.

$$T(r) = 10 \log \frac{p_r(r)}{p_t}$$

$$L(r) = T(r) - G_t - G_r$$

where:

p_t = transmitter's power output
$p_r(r)$ = received power at distance r from the transmitter
G_t = antenna gain of transmitter

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