SPOTWAVE
coverage made simple

SpotCell 112/212 – CDMA Reverse Link Power

Introduction

IS-95 based CDMA networks use two different methods to control mobile transmit power within a network: open loop power control and closed loop power control. This technical note defines how the CDMA reverse link power operation relates to SpotCell products.

CDMA reverse link power control

Open loop power control is used only when a call is initiated: phones in standby mode autonomously set their power levels based on received signal strength from the Base Station.

Base Station operation

Once a link has been established with the Base Station, closed loop power control is used by the mobile to make reverse link transmit power adjustments as commanded by Base Station. These adjustments are based on pre-defined link metrics such as Received Signal Strength (RSSI), Signal-to-Interference Ratio (Ec/Io) or Frame Error Rate (FER).

In closed loop mode, the Base Station uses the “Transmit Power Adjust” parameter to set the transmit power of each mobile in its coverage area. This parameter (in dB) is the amount that the mobile must increase or decrease its reverse link transmit power from the nominal open loop set point in order to sustain a high quality link.

To keep network interference low, all mobiles within the sector are continuously monitored (at > 800Hz) and commanded to transmit the minimum power required to sustain the link.

Mobile operation

For example, a typical mobile with a forward link received signal strength of

-80dBm may transmit its first “access probe” on the reverse link at +5dBm based on the open loop algorithm.

Where this level is not sufficient for the Base station to detect it, the mobile will increase its transmit power in small increments. The step size and maximum number of steps that the mobile will attempt before giving up and declaring a failed call is defined by the network. Typically, mobiles will increase the transmit power by at least 20dB to overcome multipath fading.

SpotCell application

A mobile operating in the coverage area served by a SpotCell adaptive repeater will require a small amount of transmit power adjust on the reverse link to establish the link due to the higher gain in the forward link of the SpotCell. This can result in a slightly higher failure rate for call setup at the edge of the coverage area. However, the presence of the SpotCell ensures that the actual mobile transmit power will be reduced by the gain provided by the SpotCell.

For example, where the nominal forward link received power at the SpotCell Donor antenna is -90dBm, the SpotCell will provide 90dB gain for a 0dBm transmit power from the SpotCell. If the mobile is within 20m of the SpotCell Coverage Antenna (line-of-sight), its forward link received power level will be >-70dBm.

The SpotCell will provide >80dB gain in the reverse link resulting in a mobile transmit power of <0dBm (compared with >+10 if it was co-located with the SpotCell Donor antenna. In such an example, the path-loss

1 Hines Road, Suite 204, Ottawa ON, K2K 3C7 Canada | E-mail: support@spotwave.com | www.spotwave.com
Tel: (613) 591-1662 | Fax: (613) 591-8107 |

introduced by the walls of the structure ensure that the mobile would probably not be able to establish calls in the coverage area (where RSSI < -100dBm).

The SpotCell adaptive gain control not only provides coverage where none existed, but also ensures increased battery life for the mobile and reduced levels of interference in the network.

CDMA phones in test mode

In test mode, most CDMA mobiles display the "transmit power adjust" parameter instead of the actual reverse link "transmit power" level.

Figure 1 shows a plot of both transmit power and transmit power adjust versus forward link RSSI for a mobile within the coverage area of a SpotCell. It shows that where the mobile is far from the Coverage unit (forward link RSSI < -75dBm), the Transmit power is < 0 to +5 and Transmit Power Adjust is <+5dB.

However, when the phone is close to the coverage unit, (RSSI >60dBm), the Transmit power bottoms out at -15dbm so the Transmit Power Adjust is forced to increase to +14dB.

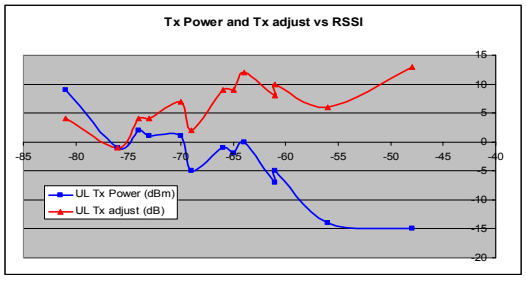

Figure 1: TX power & TX adjust power vs. RSSI

Transmit power vs. transmit power adjust

In order to get the corresponding transmit power output from the transmit power adjust displayed on the phone please use the following formula:

$$TX_{\text{dbm}} = \text{-}73\text{-}RX_{\text{dbm}} + TXADJ_{\text{db}} \ (800 \text{ MHz})$$

$$TX_{\text{dbm}} = \text{-}76\text{-}RX_{\text{dbm}} + TXADJ_{\text{db}} \ (1900 \text{ MHz})$$

Using the example above, a 1900 MHz CDMA phone displaying a receive signal of -48 dBm, with a transmit power adjust of +13 dB, the phone transmit power is:

-76 – (-48) + (13) = -15 dBm

For a receive signal of -74 dBm, with a transmit power adjust of +4, the phone transmit power is:

-76- (-74) + 4 = +2 dBm

Summary

In the SpotCell coverage area, higher gain on the forward link requires the transmit power adjust to compensate on the reverse link gain. CDMA phones display transmit power adjust in relation with their location and the closed loop power control requirements.

1 Hines Road, Suite 204, Ottawa ON, K2K 3C7 Canada | E-mail: support@spotwave.com | www.spotwave.com
Tel: (613) 591-1662 | Fax: (613) 591-8107 |