Archives

понедельник, 28 сентября 2009 г.

3.2 Frequency Division and C/I Requirement

3.2.1 Frequency Division

The GSM cellular system can be divided into GSM 900MHz system and DCS 1800MHz system in terms of the band to be used. The carrier spacing is 200 KHz.

I. GSM 900MHz

It has 124 channel numbers. The absolute radio frequency channel number (ARFCN) is 1–124, and a protection band with 200 KHz in width is reserved at the two ends. According to the documents prescribed by the relative government department of China, China Mobile uses the 890–909/936 –954MHz band, and the corresponding ARFCN is 1–95 (generally, the channel number 95 is for reservation only). For China Unicom, it uses the 909–915/954–960MHz band, and the corresponding ARFCN is 96–124. For the bands defined for the carriers from other countries, they can be calculated by the following formulas:

Base station reception: f1 (n) = [890.2 + (n – 1) x 0.2] MHz

Base station transmit: f2 (n) = [f1 (n) + 45] MHz

II. DSC 1800MHz

It has 374 channel numbers. The ARFCN is 512–885. The relationship between the frequency and the channel number (n) are listed in the following:

Base station reception: f1 (n) = [1710.2 + (n – 512) x 0.2] MHz

Base station transmit: f2 (n) = [f1(n) + 95] MHz

China Mobile uses the 1710–1720 MHz band, and the corresponding ARFCN is 512–561. China Unicom uses the 1745–1755 MHz, and the corresponding ARFCN is 687–736.

3.2.2 C/I

C/I stands for carrier-to-interference ratio. In the GSM system, frequency reuse will cause intra-frequency interference. The intra-frequency is related to both the reuse distance and the cell radius.

If the intra-frequency cell and the service cell work at the same time, the MS locating in the center of the service cell will receive both the useful signals from this service cell and the interfering signals from the intra-frequency cells.

For the omni-directional base station with regular frequency reuse, there are 6 intra-frequency interference sources at the first layer, namely, the 6 intra-frequency reuse cells in orange. There are 12 intra-frequency interference sources at the second layer, namely, the 12 intra-frequency reuse cells in yellow. However, the 12 intra-frequency interference sources has only a little effect on the 6 interference sources at the first layer, so it can be neglected.

If the radio propagation environment between the 6 intra-frequency reuse cells and the service cell is the keeps stable.

When the MS locates at the edge of the service cell, it will receive the poorest signals form the service cell but the strongest interfering signals. In this case, the needed C/I can be expressed by the following equation:

If the cellular layout is improperly designed, the interfering sources will increase and the C/I will decrease. According to the previous equations, the more the cells in each cluster, the greater the C/I and the better the network quality are, but the frequency utilization ratio will be lower. In addition, the GSM interference is related to the traffic load. The intra-frequency interference reaches the greatest when the traffic load reaches the peak.

Generally, the 4 x 3 frequency reuse pattern is used in GSM frequency planning. For the areas where the traffic is great, you can use other frequency reuse patterns, such as 3 x 3 and 1 x 3. No matter which frequency reuse pattern you take, you must meet the requirement on interference-to-protection ratio.

Apart from the intra-frequency interference caused by normal frequency reuse, there are other abnormal interferences. They are listed in the following:

Multipath signal interference (It occurs when useful signals fall outside the delay equalizer of the system.)

Outside signal interference (It refers to the signals from the radar, illegal wireless equipments, and environment noises.)

In the GSM system, the requirements on the C/I are listed in the following:

For intra-frequency C/I, it must be equal to greater than 9 dB. In actual projecting, a margin of 3 dB is needed, namely, it is equal to or greater than 12 dB.

For adjacent-frequency C/I, it must be equal to or greater than -9 dB. In actual projecting, a margin of 3 dB is needed, namely, it is equal to or greater than -6 dB.

When the carrier offset reaches 400 KHz, the C/I must be equal to or greater than -41 dB.

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