2G, 3G Network Planning and Optimization...

Archives

▼ 2009 (56)
  ► Октябрь (15)
  ▼ Сентябрь (41)
    3.8 Network Capacity Comparison For the comparis...
    3.7 Multiple Reuse Pattern Technology3.7.1 Basic...
    3.6 Concentric Cell Technology 3.6.1 Concept I...
    3.5 Aggressive Frequency Reuse Technology 3.5.1 ...
    3.4 Normal Frequency Reuse Technology 3.4.1 C...
    3.3 Frequency Planning Principle Generally, when ...
    3.2 Frequency Division and C/I Requirement 3.2.1 ...
    3 GSM Frequency Planning 3.1 Overview Frequency ...
    2.13 Conclusion Network planning is the foundatio...
    2.12 Repeater Planning 2.12.1 Application Backg...
    2.11 Tunnel Coverage 2.11.1 Characteristic of T...
    2.10 Design of Indoor Coverage System2.10.1 Ch...
    2.9 Dual-Band Network Design 2.9.1 Necessity for...
    2.8 Location Area Design 2.8.1 Definition of Loc...
    2.7 Design of Base Station Address 2.7.1 Address d...
    2.6 Base Station Number Decision After traffic an...
    2.5 Traffic Analysis 2.5.1 Traffic Prediction an...
    2.4 Network Structure Analysis When considering t...
    2.3 Coverage Analysis 2.3.1 Area Division I. Typ...
    2.2 Planning Foundation 2.2.1 Coverage and Capacit...
    2 GSM Radio Network Planning 2.1 Overview The de...
    1.17 CBS Cell Broadcast Service (CBS) is similar ...
    1.16 Call Re-Establishment 1.16.1 Introduction ...
    1.15 HOAs a key technology in the cellular mobil...
    1.14 MS Originated Call Flow 1.14.1 Enquiry Afte...
    1.13 MS Originating Call Flow The MS needs to set ...
    1.12 Location Update In GSM, the paging informati...
    1.11 Authentication and Encryption GSM takes lots...
    1.10 Immediate Assignment Procedure The purpose o...
    1.9 Power Control 1.9.1 Power Control Overview P...
    1.8 Discontinuous Reception and Discontinuous Tra...
    1.7 Frequency Hopping With the ever growing traff...
    1.6 Cell Selection and Re-Selection 1.6.1 Cell S...
    1.5 System Information System information is sent ...
    1.4 Timing advance Signal transmission has a dela...
    1.3 Data Transmission Radio channel has totally d...
    1.2 Multiple Access Technology and Logical Channel...
    1 GSM Principles and Call Flow 1.1 GSM Frequency ...
    Radio Network Planning Optimization The objective ...
    History of GSM 1 GSM Development Mobile telecommun...

четверг, 3 сентября 2009 г.

2.6 Base Station Number Decision

After traffic and coverage analysis, according to the selected base station equipments and parameters, you can obtain the coverage areas of various base stations through link budget. The coverage area helps you calculate the number of base stations required by each area. Then you decide the base station configuration according to traffic distribution. Finally, you must perform emulation using relative planning software so that coverage, capacity, carrier-to-interference ratio can be assured and interference can be avoided.

2.6.1 Characteristics of 3-sector base stations in urban areas

Cellular communication is named because the coverage areas of base stations are extruded through small cellular-shaped blocks. In urban areas, for the purpose of capacity expansion and radio frequency optimization, mainly 3-sector base stations are used. This section explains some basic concepts of a 3-sector base station.

This is a standard 3-sector cellular layout. Thedistance between two 3-sector base stations is R + r, here R = 2r. However, “R” is mainly used in cell radius estimation because the direction along “R” is the direction of the major lobe of the directional antenna. In the design for cellular layout, however, “r” indicates the cell radius.

In a cellular cell, if the included angle between a direction and the direction of the major lobe of the antenna, the coverage distance along this direction is r = R/2, and the path loss along this direction is about 10dB less than that along the direction of the major lobe of the antenna (for the deduction, it is introduced in the following), namely, the equivalent isotropic radiated power (EIRP) along this direction can be about 10dB less than that along the major lobe.

According to this feature, in the cellular layout of this kind, you can adopt the directional antenna whose azimuth beam width ranges from 60 to 65 degrees because their horizontal lobe gain diagram also meets this feature.

If “R” is the cell radius, the cell area is S = 0.6495 × R × R. Sometimes the “r” is used as cell radius, so the cell area is S = 2 5981×r×r. Therefore, when calculating the cell area, you must make clear whether “r” or “R” is used.

The followings deduce the EIRP required along “R” direction and “r” direction.

As shown in Figure 5-3, the coverage distance along “r” direction is half of that along “R” direction, namely, r = R/2. To keep even coverage, you must make the field intensity at the edges of the cell equal, namely, RxlvelB = RxlevelC.

Suppose that the EIPR transmitted from cell A is EIRPR and EIRPr along “R” direction and “r” direction respectively, and the city HATA mode is used for path loss, the path loss from point A and B is expressed as equation (1) :

$\mathrm{EIRPR} – \mathrm{RXLEVB} = 69.55 + 21.66\mathrm{lg}f - 13.82\mathrm{lg}h1 + (44.9 - 6.55\mathrm{lg}h1)\ \mathrm{lg}R$ (1)

And the path loss from pint A to point C is expressed as equation (2):

$\mathrm{EIRPr}- \mathrm{RXLEVc} = 69.55 + 21.66\mathrm{lg}f - 13.82\mathrm{lg}h1 = (44.9 - 6.55\mathrm{lg}h1)\ \mathrm{lg}r$ (2)

Subtract (2) from (1), the equation (3) is expressed as follows:

$\mathrm{EIRPR} - \mathrm{EIRPr} =(44.9 - 6.55\mathrm{lg}h1)\times(\mathrm{lg}R – \mathrm{lg}r) =(44.9 - 6.55\mathrm{lg}h1) \times \mathrm{lg}\ (R/r)$ (3)

Introduce R = 2r, the equation (4) is obtained as follows:

$\mathrm{EIRPR} - \mathrm{EIRPr} = 0.3 \times (44.9 - 6.55\mathrm{lg}h1)$ (4)

When the antenna height “h1” increases from 5m to 100m, the values of (EIRPR - EIRPr) decrease from 12 to 9.5, which can be roughly treated as 10dB.

5.1.2 References for Design of Base Station Parameters

When estimating the number of base stations, you must perform uplink and downlink budget. Based on the coverage division and propagation environment survey, you can obtain some project parameters and apply them to link budget.

2.6.3 Uplink and Downlink Balance

After base station parameters are specified, you can perform link budget to estimate the coverage area of the base station. In addition, you must consider the sensitivity of the base station equipments at this time.

In a mobile communication system, radio links are divided into two directions, namely, uplink and downlink. For an excellent system, you must perform a good power budget so that the balance is present between uplink signals and downlink signals. Otherwise, the conversation quality is good for one party but bad for the other party at the edges of the cell. If uplink signals are too bad, the mobile station cannot start a call even if signals are present.

However, the because the fading for uplink channels and downlink channels is not totally the same and the other factors such as the difference of the performances of receivers are present, the calculated uplink and downlink are not absolute, but the there a fluctuation of 2 to 3 dB.

The measurement report on uplinks and downlinks at the Abis interface can tell whether the uplink and downlink reach a balance. In addition, dialing tests in actual network can also tell whether the balance between uplinks and downlinks are reached. If the conversation quality on downlinks uplinks becomes poor simultaneously, it means that the downlinks and uplinks are balance.

& Note:

Some carriers provide the traffic statistics on uplink and downlink measurement, which can also tell whether the balance between uplinks and downlinks are reached.

I. Link budget model

When calculating uplink and downlink balance, you must consider the functions of the tower amplifier first. In a base station receiving system, the thermal movement of the active parts and radio frequency (RF) conductors cause thermal noise, which reduces the signal-to-noise ratio of the receiving system. In this case, the receiving sensitivity of the base station is restricted and the conversation quality is reduced. To improve the receiving performance of the base station, you can add a low-noise amplifier under the receiving antenna. And this is the principle of the tower amplifier.

The contributions of the tower amplifier to uplinks and downlinks are judged according to the performance of its low-noise amplifier and gain. In fact, it is the tower amplifier that reduces the noise coefficient of the base station receiving system. The power amplifier can improve the coefficients for the uplink receiving system (start from the output end of the receiving antenna). However, if the functions of the tower amplifier are quantified by this, the uplink improved value can be represented by the NFDelta (it is the reduced value of the noise coefficient of the receiving system) after a tower amplifier is added to the system.

(1) No tower amplifier

When there is no tower amplifier, the sensitivity of the equipments at the duplexer input interface at the top of the base station cabinet are taken as a reference.

For downlink signals, if,

Mobile station receiver output power = Poutm

Base station diversity received gain = Gdb

Base station receiving level = Pinb

Base station side noise deterioration = Pbn

Antenna receiving gain = antenna transmitting gain (according to reciprocity theorem)

The following equation can be obtained:

Pinb + Mf = Poutm + Gam – Ld + Gab + Gdb – Lfb – Pbn

Generally, Pmn is almost equal to Pbn, so the following equation can be obtained:

Poutb = Poutm + Gdb + (Pinm – Pinb) + Lcb

(2) With tower amplifier

If a tower amplifier is present, the improved value of the noise coefficients of the uplink receiving system can be represented by NFDelta, so the equation Poutb = Poutm + Gdb + (Pinm – Pinb) + Lcb can be developed into the following equation:

Poutb = Poutm + Gdb + (Pinm - Pinb) + Lcb + NFDelta

The two equations, Poutb = Poutm + Gdb + (Pinm – Pinb) + Lcb and Poutb = Poutm + Gdb + (Pinm - Pinb) + Lcb + NFDelta are used to calculate base station transmit power when the uplinks and downlinks are balance. Here,

Pinb is the base station receiving sensitivity

Pinm is the mobile station receiving sensitivity

Gdb (antenna diversity receiving gain) is 3.5dB

According to the requirements in protocols GSM05.05, the mobile station transmit power and the reference receiving sensitivity of the mobile station and base station are specified in Table 5-10. At present, however, the sensitivities in actual systems are greater than the reference values listed in the following table.

II. Bass station sensitivity

This section further introduces the base station sensitivity and the functions of the tower amplifier.

Receiver sensitivity refers to the minimum signal level needed to by the input end of the receiver when the certain bit error rate (BER) is met. The receiver sensitivity detects the performances of the following components:

Receiver analog RF circuit

Intermediate frequency circuit and demodulation

Decoder circuit

Three parameters are used to measure the receiver bit error performance. They are frame expurgation rate (FER), residual bit error rate (RBER), and bit error rate (BER). When a fault is detected in a frame, this frame is defined as deleted one.

Here,

FER indicates the ratio of the deleted frames to the total received frames. For full rate voice channels, the FER is present when the 3-bit cyclic redundancy check (CRC) detects errors or bad error indication (BFI) is caused. For signaling channels, the FER is present when the fire code (FIRE) or other packet codes detect errors. The FER is not defined in data services.

FBER indicates the BER that are not announced as deleted frames, namely, it is the ratio of the bit errors in the frame detected as “good” to the total number of bits transmitted in “good” frames.

BER indicates the ratio of the received error bits to all transmitted bits.

Because BER occurs at random, the statistical measurement is mainly applied to measure receiver error rate. That is, sample multiple measuring points on each channel and when the number of measuring points is certain, if the BER of each measurement is within the required limit, the BER of this channel meets the BER as required.

However, the number of sampled measured points and the limit value of the BER must meet the following conditions:

For each independent sampled measuring point, the times for it to pass a “bad” unit must be as fewer as possible, that is, the probability must be smaller than 2%.

For each independent sampled measuring point, the times for it to pass a “good” unit must be as more as possible, that is, the probability must be greater than 99.7%.

The measurement has vivid statistical features.

The measuring time must be reduced to the minimum.

As a result, you can measure the receiver sensitivity through measuring whether the receiver BER has reached the requirement while entering sensitivity level to the receiver.

Enter the reference sensitivity level to the receiver in various propagation environments. For the data produced after receiver demodulation and channel decoding, the indexes for FER, RBER.

The requirements on BCCH, AGCH, PCH, and SACCH are the same as that on SDCCH.

The value of “a” in this table depends on the channels. It is 1 for base stations, and 1 to 1.6 for mobile stations.

III. Contributions of tower amplifier to base staiton sensitivity

In terms of technical principles, the tower amplifier reduces the noise coefficients of the base station receiving system, which is helpful for improving the sensitivity of the base station receiving system.

In an actual system, to improve the receiving performance of the base station, you can add a low-noise amplifier near the feeder of the receiving antenna.

In a mobile communication system, the receiver sensitivity = noise spectrum intensity (dBm/Hz) + bandwidth (dBHz) + noise coefficient (dB) + C/I (dB).

Here the noise spectrum intensity, bandwidth, and noise coefficient are system thermal noise. C/I is the signal-to-noise ratio required at the Um interface. In a narrow band system, C/I indicates the modulation performance required by the receiver baseband, and it is a positive number.

In a spreading communication system, because spread spectrum gain is present, the value of C/I is far beyond the requirement of the modulation performance of the receiver baseband, and it is a negative number.

When there are n* cascaded receivers, the equivalent noise coefficient is as follows:

Here,

Gn indicates the receivers gain at each level (including the loss at each level).

Fn indicates the noise coefficient of the receivers at each level.

The noise coefficient of the passive device is equal to its loss, and the gain of the passive device is the reciprocal of the loss.

According to the previous equation, the noise coefficient of the cascading system is determined by the receivers at the first level.

It must be pointed out that the linear values of the parameters must be applied in the previous equation, so the “F” is a linear value, which must be converted into a logarithm. Moreover, according to this equation, the noise the cascaded receivers are determined by the noise coefficient (F1) of the receivers at the first level.

However, when the tower amplifier stops working, because the loss is present on duplexer and bypass connectors, about 2dB of redundant loss is introduced on reverse link.

According to the equation , the following two assumptions conclude the regularity of the effect of tower amplifier on the base station system.

(1) Assumption 1

Hereunder is a series of assumptions:

F1 = 2.5 dB (1.7783), noise coefficient of the tower amplifier

F2 = 4.5 dB (2.8184), noise coefficient of the base station

G = 2 (15.849) dB, tower amplifier gain

Loss of the feeder and other passive devices = 3 dB (2)

Gain of the feeder and other passive devices G0 = –3 dB (1/2)

Noise coefficient of the feeder and other passive devices F0 = 1/G0

When the tower amplifier is not added, the noise coefficient of the base station receiving system with the antenna output end as reference point is as follows:

$F = F0 + (F2-1)/G0 = 10*\log (2 + (2.8184-1)/0.5) = 7.5dB$

When the tower amplifier is added, the noise coefficient of the base station receiving system with the antenna output end as reference point is as follows:

$F = F1 + (F0 - 1)/G + (F2 - 1)/(G*G0) = 10*\log(1.7783 + (2 - 1)/15.849 + (2.8184 - 1)/(15.849 \times 0.5) = 3.2dB$

At this time, the added tower amplifier improves the noise coefficient, and FDelta is 4.3dB, that is, the uplink is improved by 4.3 dB.

(2) Assumption 2

Hereunder is a series of assumptions:

F1 = 2.2 dB (1.6596), noise coefficient of the tower amplifier

F2 =2.3 dB (1.6982), noise coefficient of the base station

G = 12 (15.849) dB, tower amplifier gain

Loss of the feeder and other passive devices = 3 dB (2)

Gain of the feeder and other passive devices G0 = –3 dB (1/2)

Noise coefficient of the feeder and other passive devices F0 = 1/G0

When the tower amplifier is not added, the noise coefficient of the base station receiving system with the antenna output end as reference point is as follows:

$F = F0 + (F2 - 1)/G0 = 10*\log (2 + (1.6982 - 1)/0.5) = 5.3dB$

When the tower amplifier is added, the noise coefficient of the base station receiving system with the antenna output end as reference point is as follows:

$F = F1 + (F0 - 1)/G + (F2 - 1)/(G*G0) = 10*\log(1.6596+(2 - 1)/15.849 + (1.6982 - 1)/(15.849 \times 0.5)) = 2.6dB$

At this time, the added tower amplifier improves the noise coefficient, and FDelta is 2.7 dB, that is, the uplink is improved by 2.7 dB.

According to the previous calculation, the following conclusions can be obtained:

The tower amplifier improves the noise coefficient of the base station receiving system, thus improving the receiving sensitivity of the base station.

The tower amplifier improves uplink signals effectively, which is also helpful for improving the receiving sensitivity of the base station.

The gain of the antenna amplifier reduces the effect of the components installed behind the tower amplifier against noise coefficient.

When the feeder is long and the loss of the feeder is great, if the tower amplifier is added, the noise coefficient of the base station receiving system and the uplink signals will be greatly improved.

The smaller the noise coefficient of the tower amplifier is, if the tower amplifier is added, the greater the noise coefficient of the base station receiving system is improved. However, if the noise coefficient of the tower amplifier is too great, it may cause the noise coefficient of the base station receiving system to deteriorate.

When the receiving sensitivity of the base station is great and the feeder is short, the tower amplifier makes a little improvement on the noise coefficient of the base station.

If the tower amplifier improves the base station sensitivity, the base station is more sensitive to outside interference.

2.6.4 Cell Coverage Estimation

In actual project planning, the effective coverage area of a base station largely depends on the following factors:

Effective base station transmit power

Working band (900MHz or 1800MHz) to be used

Antenna type and location

Power budget

Radio propagation environment

Carriers; coverage requirements

Based on the indexes of QoS for the mobile network and the actual applications, this section introduces the coverage area of the base station in different environments theoretically.

If the following assumptions are present:

The antenna height of GSM 900MHz and GSM 1800MHz base stations are 30 meters.

The sensitivities of the GSM900 MHz 2W (33 dBm) mobile station and GSM 1800MHz 1W (30 dBm) mobile station are -102 dBm and -100 dBm respectively.

The mobile station height is 1.5 meters and the gain is 0 dB.
When the combiner and divider unit (CDU) is used, the sensitivities of the 900MHz base station and 1800MHz base station are -110dBm and -108dBm respectively.
The CDU loss is 5.5dB, and the SCU loss is 6.8dB.
The gain of the 65-degree directional antenna is 13dBd for the 900 MHz mobile station and 16dBd for the 1800MHz mobile station.
The feeder is 50m in length. For 900MHz signals, the feeder loss is 4.03dBm/100m. For 1800MHz signals, the feeder loss is 5.87dB/100m.
In general cities, select Okumura propagation model.
No tower amplifier and the downlinks are restricted according to the calculation of the uplink and downlink balance.
According to the previous assumptions, the calculated results are as follows:
(1) Outdoor coverage radius of the 900 MHz base station in urban areas
The minimum received level of the mobile station dBm. The coverage radius is calculated according to the maximum TRX transmit power. The maximum TRX transmit power for the 900 MHz base station W (46 dBm).
The EIRP of the base station antenna is:
(dBm)
Here,
LCOM indicates the combiner loss
Lbf indicates the feeder loss
Gab indicates the antenna gain of the base station
And the allowed maximum propagation loss is:
(dB)
According to the Okumura propagation model introduces earlier,
Here,
indicates the antenna height of the base station.
indicates the antenna height of the mobile station.
“f” = 900 MHz.
(dB)
According to the previous known number, the outdoor coverage radius of the 900 MHz base station in urban areas can be obtained, that is, d = 2.8km.
(2) Coverage radius of the 900 MHz base station in urban buildings
The minimum received level of the mobile station (dBm).
(dB)
Therefore, the coverage radius of the 900 MHz base station in urban buildings can be obtained, that is, d = 0.75km.
If the previous assumptions are present, this indicates that the 900 MHz base station can cover the outdoor areas 2.8 km away, but for the subscribers on the first floor of the buildings 750 m away, the quality of the received signals is not satisfying.
(3) Coverage radius of the 900 MHz base station in suburban areas
The minimum received level of the mobile station (dBm).
(dB)
The Okumura propagation model in suburban areas must be modified as follows:
Therefore, the coverage radius of the 900 MHz base station in urban areas can be obtained, that is, d = 5.4km, so it is obvious that the coverage radius of the base station with the same configuration is larger in suburban areas that in urban areas.
(4) Outdoor coverage radius of the 1800 MHz base station in urban areas
The minimum received level of the mobile station (dBm). Because the maximum transmit power of the 1800 MHz TRX is 40W (46dBm), the coverage radius is calculated based on this maximum transit power.
(dBm)
(dB)
For the 1800 MHz base station, the Okumura propagation model is:
In addition, f = 1800 MHz and (dB).
According to the previous known number, the outdoor coverage radius of the 1800 MHz base station in urban areas can be obtained, that is, d = 1.7km.
(5) Coverage radius of the 1800 MHz base stations in urban buildings
The minimum received level of the mobile station (dBm).
(dB)
If the previous assumptions are present, this indicates that the 1800 MHz base station can cover the outdoor areas 1.7km away, but for the subscribers on the first floor of the buildings 500m away, the quality of the received signals is not satisfying.

2.6.5 Base Station Address Planning

I. Overview
When planning base station addresses, first you must estimate the number of the base stations needed in various coverage areas according to the coverage distance and the divisions of the coverage areas. For the convenience of prediction and emulation, you must plan an initial layout the base station addresses with the help of maps and the estimated results.
II. Planning methods
The base station address can be planned based on standard girds, or it can be planned from a specific area.
(1) Plan base station address based on standard grids
First you set the base stations in the coverage areas according to the distance of the standard grids, and then adjust the address layout and project parameters according to the estimated coverage results to meet the coverage requirement. After that, continue the planning according to the following instructions:
If a satisfying address layout is obtained, you must analyze the capacity of the base stations to be planned according to this layout, and determine the reasonable number of base stations. When designing the capacity, you must calculate the number of TRXs needs to be configured for each base station, and then analyze and adjust the configuration of the base station according to the number of the configured TRXs.
The adjustment of the configuration of the base station is determined by subscriber distribution. If the number of base stations in some areas does not meet capacity requirement, another base stations must be added.

(2) Plan base station address based on a specific area
According to this method, you are required to start the planning from the areas where the subscribers are most densely distributed or the planning work is quite hard to be performed. As a result, you must fully survey the subscriber distribution, landforms, and ground objectives within the coverage area to position the key coverage area where the center base stations should be planned. And these center base stations function as ensuring the coverage and capacity in important areas.
After the layout of these center base stations is determined, you can plan other base station addresses according to coverage and capacity target. And this is how the final layout of the base station addresses come from. After the overall solution is determined, the subsequent steps are performed according to the first planning method.

& Note:
The difference of the traffic intensity and the abnormality of the landforms and ground objectives result in irregularity of the radio coverage. Therefore, the distance between base stations varies. Generally, this distance is smaller in the areas where traffic intensity is great. In some hot areas, you can ensure the system capacity by using micro cells and distributed antennas to provide multi-layer coverage.
For restrictions from frequency resources are present, you must consider avoiding interference while ensuring system capacity.
There is no standard available for the layout of the base station addresses. A good planning solution is selected based on the integrated performance of the network.

2.6.6 Coverage Prediction

The coverage prediction is to predict the coverage of the network to be constructed according to the selected base station addresses, designed base station types, suitable electronic maps, and network planning tools to judge whether the coverage meet the requirements of the subscribers.
The coverage of a base station is determined by the following factors:
Indexes of QoS
Output power of transmitters
Available sensitivity of receivers
Direction and gain of antennas
Working bands
Propagation environment (such as landforms, city constructions)
Application of diversity reception
If the predicted results of the network coverage fail to meet the requirements, you can take the following adjusting measures:
When there are subscribers distributing beyond the cell coverage area, but it is not economical for you to install a base station, you can use a repeater to ensure the requirement of those subscriber.
When the signals are weak or blind zones are present within the coverage area, you can consider whether to use micro cells according to actual conditions.
If a large blank area is present between neighbor cells, you can increase the antenna height and add base stations according to the principles of cell splitting.
When the cell coverage area fails to meet the co-channel interference index, you can adjust the frequency configuration of the cell, adjust base station addresses, or adjust design of the parameters, such as antenna specification, antenna height, azimuth angle, tilt angle, and transmit power.
& Note:
When taking these adjusting measures, you must consider the mutual effect between base stations.
Автор: ourdot на 1:37

0 коммент.:

Отправить комментарий

Подпись комментария: Выбрать профиль...

Отправить комментарий Просмотр

Следующее Главная страница Предыдущее

Подписаться на: Комментарии к сообщению (Atom)