Application of Smart Antenna in TD - SCDMA

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Abstract: With the rapid development of global communications business, future personal communication wireless mobile communication technology has aroused great concern. Way to eliminate the impact of co-channel interference (CCI), multiple access interference (MAI) and multipath fading becomes a major factor in improving the performance of wireless mobile communication systems. The smart antenna uses the digital signal processing technology to generate the spatial directional beam so that the antenna main beam is aligned with the direction of arrival of the user signal. The side lobe or the zero point is aligned to the direction of the interfering signal to reach the full efficient use of the mobile subscriber signal, thus remove or suppress the interference signal purpose. Compared with other increasingly deep and mature interference removal technology, the application of smart antenna technology in mobile communication is even more in the ascendant and showing great potential. One of the key technologies of the third generation mobile communication standard TD-SCDMA system submitted by our country is the intelligent antenna technology. The paper introduces the history and development of the smart antenna in detail, and deeply analyzes the application of the smart antenna in TD-SCDMA. The application of smart antenna has been developed.

Key words: TD-SCDMA, smart antenna

1 Introduction to Smart Antennas

1.1 Introduction

With the rapid development of mobile communication, more and more business will be carried out through the way of radio waves, limited spectrum resources facing increasing pressure on the demand capacity. For the second generation of mobile communication system GSM, in some large cities in China, it face a problem- capacity supply difficulties, the cell radius of the cell has been very small, and the current application of research as the focus of 3G and its business model will have a higher demand. High-speed data services will serve as a major feature of 3G network services, which makes the network data traffic, especially in the downward direction will be significantly improved. Therefore, in order to achieve in the 3G system and the second generation system obvious difference service, fully embodies the advantages of 3G system in business ability, network capacity will be the network operators must focus on the issue. In the present case, smart antenna technology will be one of the most effective ways to improve network capacity, especially for 3G in the form of self-interference as the main form of interference communication system.

Antenna pattern gain characteristics can be based on the signal situation in real-time adaptive changes in the antenna known as the smart antenna. Unlike the general antenna, the smart antenna includes the radio frequency part and the signal processing and control part. At the same time, due to the size and cost of the terminal restrictions, so the current focus on the smart antenna research focused on the base station.

Currently, omnidirectional antennas or sector antennas are commonly used, these antennas have a fixed antenna pattern, and the smart antenna will have a pattern feature that changes in real time according to the signal condition (see figure):

As shown in the figure, in a system using a sector antenna, for a terminal in the same sector, the base station communicates using the same pattern characteristics, and the system relies on the difference in frequency, time and codeword to avoid inter- interference. In systems that smart antennas are used, the system will be able to differentiate the user's location with a smaller scale and form a targeted pattern, thereby maximizing the useful signal, minimizing the interfering signal, in frequency, time and code word on the basis of the system to improve the ability to distinguish users from the space. This is equivalent to extending a new dimension on a frequency and time basis, which greatly improves the capacity of the system and the associated directories.

1.2 Smart antennas and the basic concept of the proposed

(1) Smart antenna

The smart antenna is developed on the basis of adaptive filtering and array signal processing technology, which is an antenna in the communication system that can enhance the performance of the antenna by adjusting the receiving or transmitting characteristics. It uses the spatial characteristics of signal transmission to distinguish the required signal and interference signal from the spatial position and the angle

interference signal. At the same time, signal and interference signal position and the angle of incidence changes, automatically adjust the antenna array pattern, to achieve intelligent tracking environment changes and the purpose of user movement, to achieve the best transceiver signals, to achieve dynamic 'spatial filtering' effect. The purpose of using smart antenna mainly has the following three points:

A) Enhance the received signal by providing the best gain.

B) Suppress interference by controlling the antenna zero.

C) Increase the channel capacity with spatial information.

(2) The basic concept of smart antenna

The smart antenna is a bi-directional antenna mounted at the base station and obtains directivity through a set of fixed antenna elements with programmable electronic phase relationships and can simultaneously acquire the directional characteristics of the links between the base station and the mobile station.

The principle of the smart antenna is to direct the radio signal to the specific direction, generate the space directional beam, so that the antenna main beam signal arrival direction DOA (Direction of Arrival), sidelobe or zero-aligned interference signal arrival direction, to full efficient use of mobile user signals and the purpose of deleting or suppressing interference signals. At the same time, the smart antenna technology utilizes the difference of the signal space characteristics among the mobile users, and receives and transmits multiple mobile user signals on the same channel through the array antenna technology without interfering with each other, making the radio spectrum utilization and signal transmission more effective. Without the need to increase the complexity of the system, the use of smart antennas meets the quality of service and network expansion needs.

1.3 Classification and characteristics of smart antennas

Smart antennas mainly include two types: switch beam system and adaptive array system. In both cases, only the adaptive array system can identify, track and minimize the interfering signal while providing the best gain for the useful signal.

Multi-beam antenna

The multi-beam antenna covers the entire user area with multiple parallel beams, each of which is fixed and the beam width is determined with the number of antenna elements. When the user moves in the cell, the base station selects from the different corresponding beams to make strongest received signal. Because the user signal is not necessarily in the center of the beam, when the user is located at the edge of the beam and the interference signal is located in the center of the beam, the receiving effect is the worst, so the multi-beam antenna cannot achieve the best signal reception, generally only as the receiving antenna. However, compared with adaptive antenna array, multi-beam antenna has the advantages of simple structure, and no need to determine the direction of arrival of the user signal.

Adaptive antenna array generally uses 4 ~ 16 antenna array element structure, the array spacing is half a wavelength. Antenna array elements are linear, ring and flat. Adaptive antenna array is the main type of smart antenna, you can complete the user signal reception and transmission. The adaptive antenna array system uses digital signal processing technology to identify the arrival direction of the user signal and forms the main beam of the antenna in this direction.

1.4 The composition of the smart antenna

The smart antenna includes an RF antenna array section and a signal processing section, wherein the signal processing section controls the reception and transmission characteristics of the antenna array in real time based on the information obtained regarding the communication situation. This information may be the case of the received wireless signal; in the case of using closed loop feedback, it may also be feedback from the correspondent party regarding the reception of the transmitted signal.

Due to the complexity of the wireless signal in mobile communication, the working mode of adjusting the characteristics of the antenna in real time according to the communication situation has high requirements for the accuracy of the algorithm, the amount of computation and the hardware equipment that can complete the operation in real time. This determines the development of smart antennas is a phased, progressive process.

2 The basic mechanism and working principle of smart antenna

2.1 Basic structure

As the name suggests an adaptive antenna array consists of multiple antenna elements, each antenna is followed by a weighter (that is, multiplied by a factor, which is usually a complex number, both the amplitude and the phase, and only the phase in the phased array radar is adjustable), and finally combined with the adder, then structure of the smart antenna complete the airspace processing. At the same time with airspace, time domain processing capacity of the smart antenna in the structure is relatively complex, each antenna is followed by a Delayed tap weighting network (the same structure as the time domain FIR equalizer). The main meaning of adaptive or intelligent means

that these weighting factors can be appropriately changed and adaptive adjusted. The above describes the structure when the smart antenna is used as a receiving antenna. When the transmitter is used, the structure changes slightly. Before the adder or weighting network is placed on the antenna, there is no added combiner.

2.2 Working principle

Assuming that the narrowband condition of the antenna transmission is satisfied, that is, the response output of an incident signal at each antenna element is only phase difference without amplitude change, which is determined by the difference in the length of the path from which the incident signal arrives at each antenna. If the incident signal is a plane wave (only one incident direction), these phase differences are uniquely determined by the carrier wavelength, the incident angle, and the antenna position distribution. Given a set of weighted values, certain incident signal strength, different angles of the signal due to the difference between the antenna phase differences, the combiner after the output signal strength will be different.

The antenna with the incident angle as the abscissa and the corresponding smart antenna output gain (dB) for the ordinate is called the direction (antenna term). The pattern of the smart antenna is different from the omni antenna (ideally Line), and closer to the direction (directional) antenna pattern, that is, the main lobe (main lobe), sidelobes (side lobe), etc., but compared to the smart antenna is usually a narrow main lobe, more flexible main and sidelobe size, positional relationship, and larger antenna gain (antenna terms, an important indicator of the antenna, is the ratio of the strongest gain to the average gain of each direction), and the difference between the fixed antenna and the fixed antenna is : Different weights usually correspond to different directions, we can change the weight to select the appropriate pattern.

2.3 Smart antenna development stage

This process is usually divided into the following three stages (Figure 1).

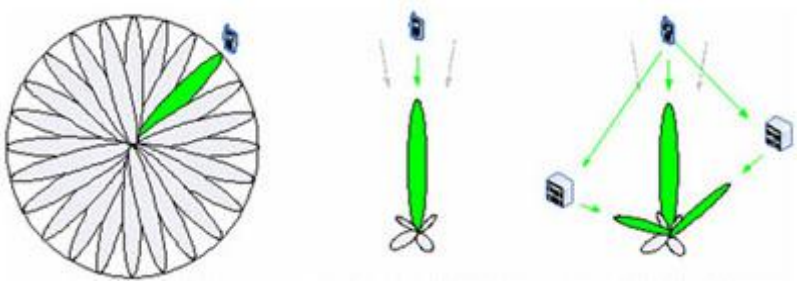

Figure 1 Development of smart antenna

● The first stage: Switch beam conversion. In the antenna side, some narrow lobes are defined in advance, and the beam used for sending and receiving is determined in real time according to the incoming wave direction of the signal, aiming at aligning the maximum antenna gain direction to the effective signal and reducing the interference in the transmission and reception process. This method is located between the sector antenna and smart antenna, to achieve the operation is relatively simple, but the performance is relatively limited.

● Phase 2: Adaptive (strongest) signal direction. According to the strongest arrival direction of the received signal, the parameters of the antenna array are adaptively adjusted to form a reception and transmission antenna pattern for aligning the direction. This is the initial stage of dynamic adaptive beamforming, performance is better than switch beam conversion, while the algorithm is also more complex, but has not yet reached the optimal state.

● The third stage: The best way to adapt communication. According to the information of the obtained communication situation, the parameters of the antenna array are adjusted in real time, and the antenna characteristic of maximizing the useful signal is minimized and the interference characteristic of the interference signal is minimized. This is the ideal way to work with smart antennas, which can greatly improve the utilization of the system's wireless spectrum. But its algorithm is complex, real-time computing volume, but also need to further explore the actual situation of the best algorithm.

At present, the application of smart antenna is mainly concentrated in the second stage, and because of the rapid development of mobile communication, smart antenna technology in the application of 3G, including a wide range of attention to solve the smart antenna in practical applications of various problems, And also to seek more 'smart' adaptive algorithm and implementation of the program is the focus of the current work and the main content.

3 The key technology of smart antenna

The application of smart antenna in mobile communication is divided into mobile station and base station. This part only discusses the implementation technology of smart antenna used in base station. Among them, intelligent transmission technology, receiving technology and dynamic channel assignment are three key technologies.

3.1 Intelligent receiving technology

In the smart antenna CDMA system, the inter-symbol interference (ISI) caused by multiple users' multiple access interference (MAI) and multipath channel can cause distortion of the user signal arriving at the base station due to the occupation of the same channel by different users. Using channel estimation and equalization techniques, the user signals are separated and restored (ie, multiuser detection MUD). The entire upstream channel is equivalent to a multiple single-input multiple-output system.

On the other hand, in order to provide the basis for intelligent emission, uplink also need to estimate the parameters reflect the user space location information, such as the incident angle (DOA), spatial features (SS), their accuracy estimates will directly affect the downstream selective delivery performance. At present, the method of intelligent receiving is mainly based on high-resolution array signal processing method and signal-based time domain structure method. The former method and the molecular space method and the method based on the parameter estimation criterion. The latter method mainly uses the time domain information and transcendental characteristics of the signal to carry out the airspace processing.

3.2 Intelligent launch technology

In the cellular system, in order to meet the requirements of the quality of multimedia service communication, the transmitted signal power must be dynamically controlled. When the total power balance of the cells in the whole cellular system is ensured (the interference of each cell is basically stable), different transmission rates and different bit error rate are required.

The intelligent transmission technology utilizes the user's spatial difference to ensure that each user only receives the downlink signal from the base station, which is not disturbed by the base station in the same channel to other user signals. There are two ways to achieve intelligent transmission based on feedback and based on uplink parameter estimation. The former method is that the base station returns the training signal of the base station through the mobile station and estimates the response of the downlink channel. The disadvantage is that the bandwidth is wasted. Based on the uplink parameter estimation method, the beamforming scheme of the downlink is determined by the estimation of the uplink signal by using the invariance of some characteristic parameters relative to the uplink and downlink. TD-SCDMA uses the latter method.

In the time division duplex (TDD) system, the upper and lower downlinks use the same carrier frequency. When the channel characteristic change is relatively slow, the upper and lower channel characteristics can be approximated, the uplink channel is estimated, and the downlink parameters are set. In the frequency division duplex (FDD) system, the uplink and downlink carrier frequencies are different, and the channel characteristics of the uplink and downlink are very different. The upper and lower link characteristics are estimated separately. Therefore, in the FDD system, Antenna is much more complex than it is used in TDD systems, and this is the advantage of the TDD system over FDD systems.

3.3 Dynamic channel allocation

Communication, channel allocation is to protect the quality of communication, the effective use of one of the key technologies. After the introduction of the air separation channel system, the dynamic allocation technology of empty, frequency, time and code channel has become a new technical difficulty. The three channel allocation techniques latter are deterministic and can be dynamically allocated by the system according to the user's situation, but the air separation channel assignment is different. At the base station, the difference between the received power and the user direction angle difference is greater than the antenna lobe of the user, can share the same time, frequency domain channel. In this way, the spatial distribution channel allocation becomes a dynamic condition combination problem, and with the user space position movement, in order to track the user, the air separation channel must change accordingly, at any time to dynamically allocate. The allocation of the air separation channel must be combined with time, frequency channel allocation and switching, which requires the formation of an efficient algorithm to accommodate the user's mobility. For CDMA systems, the channel allocation is relatively simple because of its capacity being soft capacity. Smart antenna itself has a power control function, its performance is better than the existing power control technology. While the handoff between base stations will be more flexible.

4 Use and Application Prospect of Smart Antenna

(CCI, Co-C), FDMA (TD) system (such as GSM) due to frequency reuse, and the inter-symbol interception (ISI) caused by delay propagation, Channel Interference, CDMA, Multiple Access Interference (MAI), and so on, the link performance, system capacity decline, the balance, code matching filter, RAKE receiver, channel coding and decoding technology are to fight or reduce their impact. These

techniques are actually used when the frequency domain information, and in fact useful signal, the delay version (delay version) and the interference signal in the frequency domain at the same time, in the airspace (incident angle DOA, Direction Of Arrival) diversity, antenna diversity, especially the sector antenna, can be seen as an initial use of this part of the resources, and to make full use of it only by using smart antenna technology.

4.1 Smart antenna use

Smart antenna is a better technology to enhance the shrinkage. In the early days of mobile communications, operators want to save as much as possible, with the use of few base stations to cover as large a region as possible, which means that the user's signal may have experienced more than before reaching the BTS (base station transceiver device) long path of propagation, there is a large path loss (path loss). In order to make the received signal is not below the threshold, increase the mobile station transmits power, or increases the base station antenna reception gain. The transmission power is usually limited, really feasible to increase the antenna gain, relatively speaking with a smart antenna to achieve greater gain than with a single antenna easy.

In the middle and late stages of the development of mobile communication, in order to expand the system capacity, support more users, need to shrink the cell range, reduce the frequency reuse coefficient to improve the frequency utilization rate, the commonly used method is cell division and sector to the increase in interference, the original distance (in fact, with the path loss) effectively reduce the CCI and MAI increased proportionately. But the use of smart antenna, with the help of the signal and the interference signal at the angle of incidence differences, select the appropriate combination of weights to form the correct antenna reception mode, that is, the main lobe alignment of useful signals, low gain sidelobes aligned with the main interference signal , which can more effectively suppress interference, reduce the frequency reuse factor more proportionately (such as making the multiplexing factor 3 possible in GSM), and simultaneously support more users (in CDMA). From a certain point of view we can see the smart antenna as a more flexible, narrower mainframe fan antenna.

Another advantage of the smart antenna is to reduce the multipath effect. The CDMA receiver can use the RAKE receiver to separate and coherently merge the multipaths with a delay difference greater than one chip. The smart antenna can be divided by the delay of the smart antenna. Sub-multipath for further separation, thereby more effectively reducing the multipath effect.

The main purpose of using smart antenna technology is to more effectively combat the mobile communication channel, and the time division, code division multiple access system channel transmission environment is essentially the same, so in addition to the specific algorithm differences, the smart antenna can be applied to a variety of time division, code division multiple access systems, including commercial second-generation systems, that is, a widely applicable system.

Another possible use of smart antennas is to make emergency call positioning and to provide higher positioning accuracy because it also provides information on the reach and angle of information that can be used for positioning.

4.2 Application Prospect of Smart Antenna in 3G

3G generally uses CDMA-based multiple access technology, relying on the orthogonality between codewords to distinguish between different users, so the receiving end of the various signals between the incomplete synchronization, scrambling code is not completely orthogonal, TDD system time slot deviation and other issues may be in the system between the user to form a certain degree of interference. At the same time, on the basis of theoretical analysis, a large number of simulation and field test results also prove that in the 3G communication system, the network interference will exceed the inherent thermal noise of the system and become the main factor to control the system performance. In the interference and capacity of the contradiction on the basis of the capacity and coverage, capacity and performance, coverage and performance issues such as interchangeability has been a consensus, as 3G network planning and operation of the main features.

In the business characteristics, 3G to high-speed data services, video telephony and the ability to enhance the value-added services as its main advantage of the formation of 2G system services advantage, which will inevitably make 3G has much network traffic. But as with the 2G system, its capacity is also limited by airborne spectrum resources. We note that, in theory, under the same conditions, CDMA does not have greater spectrum utilization than FDMA or TDMA. Therefore, in order to truly reflect the advantages of 3G systems in business capabilities, we must use new technology to improve the spectrum utilization quality, smart antenna technology is now considered to be able to achieve this goal one of the most effective way. It can effectively mitigate the contradiction between the capacity of the 3G system and the interference in the network by increasing the capability of the system SDMA (space division multiple access), which greatly improves the system's ability to utilize the wireless radio spectrum resources.

China's TD-SCDMA standard, as air interface using TDD duplex mode, the communication of the uplink and downlink channels using the same frequency, so a very short time slot interval, the cross between the uplink and downlink channels are strong. It is easier to adjust the transmission characteristics of the downlink channel according to the reception of the uplink channel. Therefore, TD-SCDMA

becomes one of the most convenient technologies for using the smart antenna in the 3G standard, and has been standardized, and the smart antenna as one of its key technologies.

4.3 TD-SCDMA of the third generation mobile communication system

TD-SCDMA (Time Division-Synchronous CDMA) means time-division synchronous code division multiple access, CDMA, TDMA, FDMA and SDMA multiple access methods in one, using a smart antenna, software radio, joint detection, relay switching, Packet switching high-speed data transmission and a series of high-tech, with high spectral efficiency, the system capacity, suitable for data services, low system cost, in line with the development of mobile technology and other prominent advantages. Especially for high-density, high-volume voice, data and multimedia services for urban densely populated areas. The system can be operated separately or in conjunction with other wireless access technologies.

4.3.1 Technical Overview

Its goal is to build an advanced mobile communication system with high spectral efficiency and high economic efficiency. One of its basic technical characteristics is in the TDD mode, the use of periodic repetitive time frame transmission of basic TDMA burst mode of operation (and GSM the same), by synchronizing the transmission direction, on the same carrier. Alternately uplink and downlink transmission. The advantage of this scheme is that the location of the transition point between the uplink and the downlink can be arbitrarily adjusted due to the difference in the service. When symmetrical transmission is performed, symmetrical station-for-point position can be used. When asymmetric service transmission is carried out, it can be selected within the range of asymmetric switching point. In this way, for both of these services, TDD mode can provide the best spectrum utilization and best service capacity.

In addition, for different nature of the business, TD-SCDMA can be based on the use of each burst CDMA and multi-user detection technology for multi-user transmission to improve the rate of 8 ~ 384kb / s voice and multimedia services, to spread the signal to provide high-speed data transmission, such as mobile Internet high-speed data services. The service mode conversion in the base station transceiver station (BTS) and the user terminal (UE) is realized by digital signal processing software (DSP-SW). This method laid the foundation for the realization of software radio.

Overall, TD-SCDMA wireless transmission program is FDMA, TDMA and CDMA. Three basic transmission mode of flexible combination. This combination is first through the multi-user detection technology makes TD-SCDMA transmission capacity increased significantly, while the transmission capacity of the further growth is achieved through the use of smart antenna technology. The orientation of the smart antenna reduces inter-cell interference, making it possible to multiplex denser spectrum. In addition, in order to reduce the operator's investment, the wireless transmission mode design goal is to improve the data throughput of each cell, and the other is to reduce the number of small base stations have been high transceiver efficiency. TD-SCDMA in the realization of this goal is also more ideal.

4.3.2 System structure

TD-SCDMA system design set FDMA, TDMA, CDMA and SDMA technology as a whole, and consider the current China and the world in most countries widely used GSM second generation mobile communication objective reality, he can smoothly transition from GSM to 3G system The TD-SCDMA system function modules include: client equipment (UE), base station (BTS), base station controller (BSC) and core network. At the beginning of the network, the system's IP service was accessed through the GPRS Gateway Support Node (GGSN) to the X.25 packet switch. The voice and ISDN services used the original GSM mobile switch. Based on IP-based 3G core network is completed, it transit to a complete TD-SCDMA third generation mobile communication system.

Key Technologies

(1) Smart antenna

The smart antenna of the TD-SCDMA system consists of a concentric array of 8 antenna elements with a diameter of 25 cm. Compared with the omni-directional antenna, it can get 8dB gain. With the use of smart antenna, the application of beamforming technology significantly improve the base station's receiver sensitivity and transmit power, greatly reducing the interference within the system and the interference between adjacent cells, so that the system capacity expansion more than 1 times. At the same time, the number of base stations required for high-density urban and suburban areas can also be reduced. The increase in antenna gain also reduces the linear output power of the high-frequency amplifier (HPA), thereby significantly reducing operating costs.

(2) Integrated use of multiple access mode

TD-SCDMA uses all access technologies in the second generation and third generation mobile communications, including TDMA, CDMA and SDMA, the most important part of which is SDMA. SDMA can be used in the frequency domain, outside the time domain to increase capacity and improve performance, SDMA key technology is the use of multi-antenna spatial parameters to estimate the downlink signal space synthesis. In addition, CDMA and SDMA technology also play a complementary role, especially when several mobile users

rely on very close and make SDMA cannot be separated, CDMA can easily play a separation role and SDMA itself but also minimize the interference of CDMA users. Another important role of SDMA technology is to roughly estimate the distance and orientation of each user. It can be applied to the positioning of third-generation mobile communication users, and can provide reference information for the handover.

(3) Channel allocation

TD-SCDMA system uses RNC centralized control of the dynamic channel allocation (DCA) technology, in a certain area, a number of residential area of the available channel resources together, unified management by the RNC, according to the cell call blocking rate, the candidate channel use frequency, channel. And then the distance and many other factors, the channel is dynamically assigned to the call user. This can improve system capacity, reduce interference, and make more efficient use of channel resources.

(4) Multi-user detection

Multi-user detection mainly refers to the use of multiple user symbols, time, signal amplitude and phase information to jointly detect a single user's signal, and to better receive results. The goal of best multiuser detection is to find the largest input sequence in the output sequence. For the synchronization system, it is necessary to find out the largest input sequence of the function, so that the combined detection of the spectrum utilization and the base station and the user terminal power control part of the more simple, it is worth mentioning that in different smart antenna case, through Joint detection can be in the existing GSM infrastructure, through the C = 3 cellular re-multiplexing mode so that TD-SCDMA can be 1.6MHZ low carrier frequency band.

(5) Synchronous CDMA

Synchronous CDMA means that the signals sent by the terminals at the uplink are fully synchronized at the base station demodulator and do not generate multiple access interference to each other, improving the capacity and spectrum utilization of the TD-SCDMA system.

(6) Software radio

The basic principle of software radio is to broadband A / D and D / A converter as close as possible to the antenna, so as to replace the hardware to implement the signal processing software. The advantage of using software radio is that, based on the same hardware environment, different software can be used to achieve different functions.

4.4 Application of Smart Antenna in TD-SCDMA System

The high efficiency of the TD-SCDMA (Time Division Synchronous Code Division Multiple Access) smart antenna is obtained based on the symmetry of the uplink and downlink wireless paths (the same wireless environment and transmission conditions). In addition, the smart antenna can reduce inter-cell interference, but also reduce the interference within the district. These features of the smart antenna can significantly improve the spectral efficiency of mobile communication systems.

The smart antenna of the TD-SCDMA system consists of a concentric array of 8 antenna elements with a diameter of 25 cm. Compared with the omni-directional antenna, it can get a higher gain. The principle is to make a group of antennas and the corresponding transceiver in a certain way to arrange and encourage the use of wave interference principle can produce a strong direction of the radiation pattern, the use of DSP (digital signal processor) so that the main lobe adaptive point to the direction of the mobile station, you can achieve the signal to keep the load ratio, reduce the transmission power and other purposes. The performance above for smart antennas allows for more intensive frequency reuse, resulting in a significant increase in spectral efficiency

as each user in the district's location is different. This aspect requires that the antenna has a multi-directional, on the other hand requires that in each independent direction, the system can track individual users. The above requirements can be achieved by controlling the direction of the user by the DSP. Each user's tracking is measured by the angle of arrival. In the TD-SCDMA system, since the length of the radio subframe is 5 ms, it can be measured at least 200 times per second, and the uplink and downlink transmission of each user takes place in the same direction. Through the orientation and tracking of the smart antenna, the performance is the best.

A further advantage of TD-SCDMA in TDD (Time Division Duplex) mode is that the transmission and reception of user signals occur at exactly the same frequency. So the transmission conditions in both the upstream and downstream directions are the same or symmetrical, so that the smart antenna can minimize inter-cell interference, so as to obtain the best system performance.

5 Conclusions

The rapid development of mobile communication users, the trend from narrowband voice communication to broadband high-speed data communication, way to improve the network capacity in a certain spectrum of resources to become network construction, are become the future 3G network construction focus. Simply relying on increasing the base station (using microcells to increase the frequency of reuse), both in terms of cost and performance are no longer the best option. In this case, the introduction of smart antenna technology, by increasing the system in the spatial resolution, from a higher level to improve the system for the wireless spectrum utilization. As with all other

advanced technologies, the development of smart antenna technology is a gradual process that accompanies algorithmic research and hardware upgrades. Due to its important role in understanding, in recent years the world carry out a large number of research and experimental work, and achieved fruitful results, It has basically started the actual application phase, the actual use of the various problems are gradually solved. At present, China is on the next generation of mobile communication system, the practical application of large-scale research and testing, smart antenna technology will undoubtedly become one of the hot spots of discussion, hope this article can provide helps to relevant work and researchers.

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