Improvement of Cell Coverage Area And E_c/I_0 of CDMA 2000 1x Network By Smart Antennas

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Abstract: Smart receiving wires are reception apparatus clusters with keen flag handling calculations used to recognize spatial flag mark, for example, the heading of entry of the flag, and utilize it to ascertain bar framing vectors, to track and find the radio wire bar on the portable/target. The utilization of shrewd radio wire frameworks empowers the system administrators to expand the remote system limit, where such systems are required to encounter a gigantic increment in the activity. This is because of the expanded number of clients and the high information rate administrations and applications. Moreover, savvy receiving wire frameworks offer the capability of expanded range proficiency, developed scope of scope and higher rate of recurrence reuse. In this paper, we concentrated the execution examination of CDMA 2000 1X organize which will be utilized for the versatile correspondence. We will assess the attributes of CDMA system utilizing brilliant receiving wire frameworks. The qualities of CDMA system are throughput, cell scope region, span, normal EC/I0, and EC/I0 distinction. The recreation consequences of the above qualities can likewise be watched. In the event that the shrewd radio wire frameworks are utilized for information benefit clients then the execution investigation of CDMA system will stay surprising.

Index Terms: CDMA2000 1x SYSTEMS, BEAMFORMING, SMART ANTENNA SYSTEMS, TBA, SBA, DOA

I. INTRODUCTION

The recent 3D generation (3G) mobile radio communication systems are proposed to provide high-speed multimedia data services as well as voice services. The ever-increasing demand for high-speed multimedia data services motivates the need for reducing the interference from other users to increase the capacity of the mobile radio communication systems [2]. The new techniques are also necessary for improving the spectrum efficiency without increasing the radio frequency (RF) spectrum. The smart antenna systems are interference limited systems. Interference significantly by using a narrow antenna beam. These systems are intended to form an antenna beam that should be in the direction of a desired user by tracking the main beam direction. These antenna systems, therefore, can minimize the interference from other users. This reduced interference leads to an increase in the cell coverage and system capacity because the values of E_c/I_0 and E_b/N_0 are improved [3]. The increased EC/I0, leads to the extension of the cell coverage. The improvement of E_b/N_0 on both the forward and reverse links leads to an increase in service qualities, e.g. voice call quality, multimedia data throughput and so forth. This also reduces the power consumption of a mobile station [2]. The signal degradation due to multi path fading can be reduced with the help of smart antenna systems. There are two approaches to implementing smart antenna systems. The first one is the tracking beam array (TBA) method and the second one is the switched beam array (SBA) method[2] In this paper, we study the performance analysis of smart antenna systems using TBA approach of implementation CDMA mobile communication systems are interference limited systems. Interference degrades the system parameters such as E_c /I_0 and E_b/N_0. Smart antenna systems can reduce same and other cell interference by using a narrow antenna beam [1].

II. BACKGROUND

A. Smart antenna frameworks:

Brilliant or versatile receiving wire clusters comprise of a variety of radio wire components with flag preparing capacity that streamlines the radiation and gathering of a coveted flag, powerfully. Savvy receiving wires can put nulls toward interferers by means of versatile refreshing of weights connected to every radio wire component. They in this manner offset the greater part of the co-divert obstruction bringing about better nature
B. CDMA frameworks:

CDMA is a technique in which clients involve a similar time and recurrence designations, and are channelized by exceptional allotted codes. The signs are isolated at the beneficiary by utilizing a correlator that acknowledges just flag vitality from the coveted channel. Undesired signs contribute just to the commotion. Significant properties of CDMA versatile System are gives wide territory, high limit, and cell portable correspondence.

III. SYSTEM SIMULATION RESULTS

A. THROUGHPUT:

We develop the received $\frac{E_b}{N_0}$ model of the supplemental channel SCH for the CDMA 2000 1X data service on the forward link. This is used to calculate the data throughput on the physical air link. The $\frac{E_b}{N_0}$ can be calculated with the help of below equation.

$$\frac{E_b}{N_0} = \frac{\xi_{SCH} p_{tx} L_{0,k} W}{I_{SC} + I_{OC} + N_0 W \cdot R_d}$$

Where $\xi_{SCH}$ is the supplemental channel power portion of $p_{tx}$. W is the channel bandwidth and $R_d$ denotes the information data rate. The number of supplemental channels. In this case, the interference $I_{SC}$ and $I_{OC}$ can be expressed as follows:

$$I_{SC} = \alpha p_{tx} L_{0,k} (\xi_{OH} + G_{SA}(1 - (\xi_{OH} + \xi_{SCH}))$$

$$I_{OC} = \sum_{i=1}^{M} p_{tx} L_{i,k} (\xi_{OH} + G_{SA}(1 - (\xi_{OH} + \xi_{SCH})))$$

Where $\alpha$ is the orthogonality factor between traffic channels and $\xi_{SCH}$ can be expressed as in the equation.

$$\xi_{SCH} = \frac{P_{SCH}}{P_{tx}}$$

The maximum data requested by user is assumed 153.6 kbps; distance between each base station is 3.8 km. We get improvements of air link throughput when narrow antenna beam is used, by entering number of voice users and data users, the throughput will be expressed as shown below equation.

Throughput = $R_{data} \times (1 - FER)$

The interference is the sum of the supplemental channel powers from other users and the overhead channel power. We have developed the data throughput on the air link by using the results of the link level simulation that shows the variation of frame error rate (FER) with respect to the $\frac{E_b}{N_0}$. $R_{max}$ is the maximum data rate requested by the user. Thus, the simulation result for the throughput will be given as shown in the below figure.

B. CALCULATION OF AVERAGE $\frac{E_c}{I_0}$, $\frac{E_c}{I_0}$ DIFFERENCE USING SMART ANTENNAS:

The interference from other users in the CDMA system can be reduced if smart antenna systems are used. We assumed that the smart antenna systems are used to transmit traffic channel signals only on the forward and reverse link. The below figure shows the desired signal and interference signals from other users on the forward link in the case of using a smart antenna.

Fig.1. Throughput Result

Fig.2. A desired signal and interference signals from other users on the forward link.

We develop the Ec/I0 model of the $k^{th}$ mobile station in the $0^{th}$ base station, $BS_o$ when considering the effect of the smart antenna system.
where $p_{tx}^i$ is the total transmit power of the $i$th base station $L_{0,k}$ is the path loss from the BS $i$ to the MS $o,k$. $N_0W$ is the background thermal noise power and $M$ is the number of base stations used in the simulation. $\xi_p$ denotes the pilot channel power portion of $p_{tx}^i$ and $\xi_{off}$ denotes the overhead channel power portion of $p_{tx}^i$. These can be expressed as

$$\xi_p = \frac{P_{\text{PILOT}}}{P_{tx}^i} + \frac{P_{\text{SYNC}}}{P_{tx}^i} + \frac{P_{\text{PAGING}}}{P_{tx}^i} + \frac{P_{Q-PAGING}}{P_{tx}^i}$$

$P_{tx}^i = P_{\text{PILOT}} + P_{\text{SYNC}} + P_{\text{PAGING}} + P_{\text{Q-PAGING}}$

$N_0 = 0$

Where $P_{\text{PILOT}}$ is the pilot channel power, $P_{\text{SYNC}}$ is the synchronization channel power, $P_{\text{PAGING}}$ and $P_{\text{Q-PAGING}}$ are the paging and quick paging channel powers, respectively. $P_{\text{FCH}}$ and $P_{\text{SCCH}}$ are the fundamental and supplemental channel powers, respectively in the CDMA2000 1X network. $N_v$ and $N_d$ are the numbers of voice and data users. The subscript J denotes the number of supplemental channels used for data service and the parameters $v_v$ and $v_D$ are the voice and data activity factors, respectively [1].

The interference caused by other users traffic channel signals can be reduced by using the smart antennas with narrow beam width, as compared to the sectored antenna systems. Here are the simulation results for Average $E_c / I_0$ and $E_c / I_0$ difference [2].

C. SIMULATION FOR COVERAGE AREA

In this simulation, it was shown that the cell coverage ratio for the voice and data service case increases slightly in proportion to the number of increased users, when compared to the voice service case only [4]. Cell coverage increases by using Smart antenna to form narrow beam towards the desired user. Forward cell coverage increases for 10 users but decrease rapidly as number of user’s increases [4].

D. SIMULATION RESULT FOR RADIUS OF SMART ANTENNA SYSTEM

As the coverage area of the CDMA network increases with the help of the smart antenna systems, the radius of the cellular mobile network is also increases [5]. In the case of voice service only, the forward cell coverage increases remarkably when 10 users exist in a sector but we can see that the ratio decreases very rapidly when increasing the number of users per sector. On the other hand, the ratio of the voice and data services case increases slightly as the number of users increased, i.e. the variation of the ratio is not so sensitive as that for
the voice service case [5]. The simulation result of coverage radius in the CDMA 2000 1X using smart antenna system will be shown in the below figure.

Figure: 6. Cell coverage Radius Result

IV. SIMULATOR DESCRIPTION
In order analyzed the system performance of the system, we will considered three important smart antenna patterns. They are:

i. $30^\circ$ smart antenna pattern
ii. $60^\circ$ smart antenna pattern
iii. $120^\circ$ sectored antenna pattern

To have maximum gain for the desired user, we use these sectored antenna patterns. The $30^\circ$ smart antenna pattern simulation will be Obtained by assuming 3 dB bandwidth is 300. The $60^\circ$ smart antenna pattern simulation will be obtained by assuming 6 dB bandwidth is 600. The $120^\circ$ sectored antenna pattern is used for the transmission of overhead channel signal and also in traditional 3 sectored cellular systems. We observe all these 3 smart antenna patterns for the CDMA network using smart antenna systems which can be used for the effective mobile communication.

V. CONCLUSION
The average $E_c/I_0$ of the cell resulting from the simulation was evaluated. The simulation results show that the $E_c/I_0$ increased by using smart antenna to from a narrow beam width. The increased amount of $E_c/I_0$ is much larger in the case of voice and data services than that of the voice services case only.

It was shown that the cell coverage area and radius is a function of antenna type and beam width. In this simulation, it was shown that the cell coverage ratio for voice and data service case increases slightly in proportion to the number of increased users, when compared to the voice service case only.

The average values of the increased amount of $E_c/I_0$ for the smart antenna and sectored antenna case are evaluated. It was shown that the $E_c/I_0$ increment is more than 2 dB when a $30^\circ$ smart antenna is used. Also evaluated the average data throughput on wireless radio link; i.e. the air throughput. It was shown that the air throughput increased slightly when narrow antenna beam is used.

Smart Antennas for Future Wireless Systems provides key technology and latest developments in the smart antenna improves cell coverage, throughput, reduces co-channel and inter channel interference. It reviews the advancements in the field of smart antenna technologies has potential to impact wireless communications in terms of high performance benefits. We observe different characteristics of CDMA network like Throughput, $E_c/I_0$ average and difference, cell coverage area and radius using smart antenna systems.

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