A

DISSERTATION REPORT

ON

ANALYSIS OF THE IMPACTS OF UPLINK CO-CHANNEL INTERFERENCE ON CELL COVERAGE IN AN IEEE 802.16m SYSTEM

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by

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Certificate

This is to certify that the dissertation report entitled **Analysis of the Impact of Uplink Co-channel Interference on Cell Coverage in an 802.16m System** submitted by **Richa Verma (2017PEC5466)**, in the partial fulfilment of the Degree Master of Technology in **Electronics and Communication** of Malaviya National Institute of Technology, is the work completed by her under our supervision, and approved for submission during academic session 2018-2019.

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CANDIDATE'S DECLARATION

I, **RICHA VERMA,** hereby declare that the dissertation report entitled "**ANALYSIS OF THE IMPACT OF UPLINK CO-CHANNEL INTERFERENCE ON CELL COVERAGE IN AN 802.16m",** being submitted by me towards the partial fulfilment of the requirement of **Masters Of Technology In The Field Of Electronics And Communication From Malaviya National Institute Of Technology , Jaipur.** It is record of the work carried out by me under the supervision of **Prof R.P.YADAV** and has not been submitted anywhere else.

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ABSTRACT

In this thesis, after a brief introduction about cellular communication and the different IEEE 802.16 standards, an accurate explanation of WiMAX and its technical aspects is included. In the end, it's doable to look at the various applications enforced with WiMAX and a quick comparison with alternative wireless technologies method is developed for estimating the impacts of transmission co-channel interference on coverage in Associate in Nursing IEEE 802.16m system. The method is based on the signal to interference-plus-noise ratio requirement, which requires each mobile user to transmit enough power to satisfy minimum SINR. The effects of shadow weakening and user random locations area unit are taken into consideration for the calculations of average interference power. In addition, the iterative effect of interference under the power control mechanism is derived. The simulation results indicate that CCI can cause a significant reduction in cell coverage, particularly when mobile users use a large number of sub channels for high-speed data transmissions. A method is developed for estimating the impacts of uplink co-channel interference (CCI) on coverage in an IEEE 802.16m system. The method is based on the signal-to interference plus-noise ratio (SINR) requirement, which requires each mobile user to transmit enough power to satisfy a minimum SINR. The effects of shadow fading and user random locations are taken into account for the calculations of average interference power. In addition, the iterative effect of interference under power control mechanism is derived. The simulation results indicate that CCI can cause significant reduction in cell coverage, particularly when mobile users use a large amount of sub channels for high speed data transmissions.

List of Abbreviations

3G	Third Generation
BPSK	Binary Phase Shift Keying
BSC	Base Station Controller
CDMA	Code Division Multiple Access
CQI	Channel Quality Indicator
DL	Downlink
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
GPRS	GSM Packet Radio Services
GSM	Global system for mobile communications
FDMA	Frequency Division Multiple Access
FFR	Fractional Frequency reuse
IFFT	Inverse Fast Fourier Transform
IP	Internet Protocol
LOS	Line Of Sight
LTE	Long Term Evolution
MAC	Media Access Control
MIMO	Multiple Input Multiple Output
MS	Mobile station
OFDM	Orthogonal Frequency Division Multiplexing
NAP	NETWORK ACCESS PROVIDER
NLOS	Non-Line-of-Sight
OFDMA	Orthogonal Frequency Division Multiplexing
QAM	Quadrate Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
SINR	Signal Interference Noise Ration

List of Symbol’s

Mw	Miliwatt
F	Frequency
KHz	Kilohertz
Mbps	Megabits per second
M	Number of sub channels
μ	Path loss exponent
dB	Decibel

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CHAPTER 1

BACKGROUND AND MOTIVATION

1.1 Introduction

The potential to converse with people on the move has evolved substantially since Marconi first illustrated the potential of radio and provide continuous communication with English Channel sailing vessels. That was in 1897, and individuals around the globe have enthusiastically embraced fresh wireless communications techniques and facilities. The mobile radio in particular over the previous ten years that was in 1897, and since then, people across the region have fully embraced different wireless communications methods and services, The mobile communications market has risen by light years, driven by advances in digital and RF modules, modern large-scale integration of components and other miniaturization innovations which make portable radio appliances lighter, faster and more durable. Digital switching technologies have enabled to deploy accessible, simple-to-use wireless transmission infrastructures on a massive scale.

1.2 Literature Review

The literature survey about co channel interference, impact on system performance and mitigation technique in cellular communication by various researchers in previous years is given below,

A.F.Naguib et al. [1998] in this research work a new scheme is proposed by which interference is effectually suppressed from other co-channel users by allotting each user with diversity benefit with a productive effect of suppression and ML decoding scheme for space-time block codes. They considered a system with K synchronous co-channel users, each is equipped with N transmit antennas and uses the STBC. Utilizing the temporal and spatial structure of these codes, developed STBC while suppressing interference and interference suppression techniques could not be properly applied to increase the capacity, data rate in wireless application MMSE interference suppression technique, Limitations those techniques not maintained the decoding simplicity of the [1].

Ling Li et.al[2001] introduced a novel method with STBC to collectively estimate the multipath channel, consistently demodulate data symbols and, meanwhile, reduce radio interference, the intended system was easy to execute and able to alleviate disturbance of various origins, including inter-symbol interference (ISI), co-channel interference (CCI)And another, but a joint channel prediction and interference termination system for wireless cellular systems which use both transmit diversity and receive diversity was not easy to adopt and could not manage interference from various sources when devices with only two broadcasting antennas were investigated.[2].

H.Arslan G.E. Bottomley R. Ramesh et al. [2005] evaluated that filter-based methodology, multi-user-based techniques were generally more vulnerable to model flaws. This implies that a lot of survilliance should be made on channel estimation in multi-user detection. In impact, channel estimation appears to be the bottleneck, especially in asynchronous I networks with frequency because the mobile terminal generally has only one receiver antenna. But estimating channels in asynchronous network with various interferes is particularly hard. Because of this, decoupling linear CCI cancelation nonlinear equalization (cases B and C) is an acceptable [3].

Kapil Gulati et al. [2009] throughout this article the problem of statistical-physical modeling of co-channel interference, Statistical modeling of interference was a useful tool for examining the probability of interference in wireless networks and building intervention-aware transceivers. Limitations of the solar background noise current in the devices involved wideband and emissions of broadband interference. Intervention-aware transceivers. Interference is not well modeled by the Gaussian distribution, especially at elevated interference amplitudes decompose far too quickly to model the impulsive nature of co-channel interference accurately [4].

Rong-Teret et al. [2010] examines the effect of femtocell interference on established fractional frequency (FFR) macro cells. Rather than using complex and difficult transmitting methods by organizing numerous base stations (BSs), this paper will adapt, FFR pattern to prohibit interference with both the femtocell, based on a density and situation of the femtocell. Simulation results show that the proposed femtocell BS implementation can potentially reduce downlink interference to microcellular networks but a module that could become the Femtocell interface [5].

Eneh Nijsu Yogesh et al. [2011]. In this document is being used to discover a theoretical peak for cell size decrease in portable communication schemes resulting from coordinated mathematical modeling. The information capacity approach is used for the assessment. The effective interference cells of the co-channel are seeking attention. Co-channel interference cells in the microwave frequencies above 2 GHz [6].

Sonia Gupta et al. [2014] in this document, the relationship between the probabilities of free receipt of interference Demonstrate the partnership between the possibility of interference-free reception, defense ratio and coverage spectrum for dissimilar fading allocation of received signal like Rayleigh, Weibull and Nakagami distribution.in this job only one sided and two sided case where the mobile is not on line joining T1 to T2. 2. Also here we have considered that the interferer and desired signal following similar channel ought to a situation could also be focused in different manner and can be worked in future [7].

Hossien B.et al. [2016] recommends a restrictive field of vision angular diversity receiver (CFOV-ADR) to completely eliminate CCI from neighboring antennas and decrease ISI from multipath reflections. The goal is to efficiently distinguish LOS signals from neighboring antennas to be obtained by various PDs of the suggested FOV-ADR by maximizing the FOV angle of PDs. That is to achieve uncorrelated LOSS and poor non line of vision correlation (NLOS) achieve meters of channel The primary issue with the transmitters outlined in this document is the shape of the necessary optical components, although there are alternative concentrators that have battery size versus gain features. Another feasible strategy would be to use a single lens-based imaging receiver instead of a set of distinct non-imaging concentrators [8].

Neha Belwal et al. [2018] in this research three different channels Rayleigh, Rican and AWGN channel are evaluated. Observed that AWGN is the simplest radio environment channel that operates on Time-of-Flight and is based on wireless communication system or a limited positioning system and the impact of ACI and CCI are studied and BER has been investigated and compared for three different channels using a QAM modulation technique [9].

1.3 Objective Of Present Work

IEEE 802.16 m scheme recognized as mobile WiMAX, here is observational way for calculating the decrease in cell coverage owing to uplink CCI. Our technique is implemented on the insistence of the signal-to-interference-plus-noise proportion and uses energy control to keep the obtained signal power At least SINR. For the calculation of median interference strength, the impacts of shadow fading and customer random places are taken into consideration. Furthermore, the probability of service outage and cell coverage are obtained by considering the constraints of the processing energy of the handset. We investigate the relationship between cell utilization and the Amount of sub-channels used by smartphone consumers in the presence of CCI. To evaluate how sectorization impacts the ability of the wimax cellular network, which relies on energy per bit noise spectral density proportion, external cell interference factor, smooth transfer factor, sound interaction factor and also processing performance to evaluate how sectorization impacts cellular network coverage, which depends on information prices for propagation setting such as urban dense and metropolitan case.

CHAPTER 2

EVOLUTION OF MOBILE RADIO COMMUNICATION

2.1 First-Generation (1G)

In Laboratories of bell established a cellular or wireless communication in 1964 in which early wireless media focused only on voice. At first, Bell Labs created analog systems called HCMTS in the era 1964–1974. For both the signaling and voice channels, the HCMTS used frequency modulation approx. bandwidth of 29 kHz. The speech FM modulation indices are 4 which are the proportion between the frequency (12 kHz) and the frequency of the voice (3 kHz). There are 10 kbps signal rates. New handoff characteristics have also been moved. There was no conventional mobile wireless system organization at the moment. The first generation cellular system was developed by AT&T as its norm for HCMTS1. Subsequently, EIA was calledIS-3, EIA was merged with TIA, which then was called TIA-EIA. Advanced mobile phone services [1], the new system name, was developed and used to supply energy by analog AMPS devices. Analog AMT systems have been developed and were applied in form of car phones. Each cell has a coverage of approximately 8 miles. AMPS system features: FDMA analog circuit technology and operating frequency band between 800-900 MHz, AMPS system limitation is less traffic efficiency, independent transfer of long range installer time and frequent call falls Inefficient use of bandwidth and low battery life Poor voice quality and big telephone size permission customers to make voice calls only in one nation.

2.2 Second Generation (2G)

In 1983, Europe began developing GSM [6−9] and then changed the initial the worldwide mobile device system name. Global system mobile communication was first implemented in Germany in 1991, and is a digital TDMA scheme. It was the world's first digital phone device. The CDMA might have a capability 10 times higher than Amps in 1989; the system of Qualcomm could have CDMA technical problems and problems of spectrum. In 1989, in 1900 MHz PCN later adopted the GSM system by the UK, the band licensed by the Personal Communications Networks. The 900-MHz TACS band spectrum has also been moved to GSM. GSM had the information transmission upgrade known as the General Packet Radio Service in 2000 and was able to use any amount of time slots for sending information among the eight complete slots. The data rate is between 14.4 and 64 kbps. The information rate of communication can be up to 500 kbps from EDGE (Enhanced information rates for GSM Evolution), which modulations are altered from (Gaussian minimum shift key keying) on 8 PSK. The 12.5 kHz offset the 25-kHz channel and thus the amount of channels in the scheme increased. The PDC (Personal Digital Cellular) has been created by Japan. Second generation system features: It was an 800 MHz and 1.5 GHz TDA mobile system that supported information, voice, fax, SMS, and WAP services first on a commercially operated digital mobile scheme. 2 G limits are that the low data speed range provided for the whole call session was from 9.5 kbps to 29 kbps In Circuit-switched system. Bandwidth and resource use are reduced. Too many GSM, CDMA, PDC and PHS norms worldwide [8].

2.3 Interim Generation (2.5G)

The need for more data transmission throughput Web browsing and e-mail rates have resulted 2.5 G evolution, which is between the two generations. Mobile technology using GPRS promotes. The protocol of wireless access by which the websites of a cell phone can be viewed by mobile phones.

2.4 Third Generation (3G)

Japan became the first nation to nationally implement the IMT-2000 3 G Network the IMT-2000 Network 3 G system on a national basis, and the transformation to 3 G was completed by Japan in 2006, for the development of 3 G cellular networks, for live video and for concurrent information and voice transmission. The 3 G technology has added 2.5 G telephones to multimedia. 3 G works in the 1710–2170 MHz frequency band and offers elevated rates of transmission between 348 Kbps for stationary or mobile users in moving vehicles up to 2 Mbps. 3 G systems aim at ensuring a guaranteed quality of service to communicate globally, and at all times through any medium. For instance 3 g mobile universal systems (UMTS) and mobile global telecom are 2 000 MHz (I MMT-2000). 3g-generation features, UMTS are intended for various cars, 384 kbps are intended for pedestrian use, and 2 Mbps are intended for indoor and stationary use. UMTS will integrate into a service, 3 G system drawback: high bandwidth requirement High-specific licensing fees 3 G telephone spent and large size 3 G phones Lack of network coverage. [11] Services provided by a variety of mobile communication technologies such as mobile and cell phone.

The transmission rate of 4 G mobile communications will be up to 20 Mbps higher than 3G.4 G technology, which will offer universally very smooth global roaming with lower expenses. 4 G is ready to supply 100 Mbps worldwide to a roaming moving device, and a fixed device with up to 1 Gaps. 4 G takes almost the ideal wireless Internetworking in the world into consideration with expected features, 4 G enables perfect video conferencing, streaming images and much more. On cellphones, 4 G, variable transmission factor orthogonal division of frequency code multiplexing multiple access codes spreading variable code division. The following modulation methods should be used. The main advantage of i4 g technology is that the packet switching is primarily based so that there are low latency issues [14].

2.6 Fifth Generation (5G)

5th generation is Hundred times faster than 4th generation, very low latency, able to fix bandwidth issues used technologies are given as Ulsi technology Parallel processing Artificial intelligence software and also includes robotics neural network.

2.7 Summary

A key input to mobile communication growth is the emergence of the cellular idea. The cover region of a specific site is seen as a cell. The devices are called "cellular," because big regions were divided into smaller regions or "cells." Each cell is assigned a different set of frequencies within the clusters. A low energy transmitter and receiver are provided for each cell.

.

Technology	Various Technology				
	1G	2G	2.5G	3G	4G
Design Begin	1970	1980	1985	1990	2000
Implementation	1984	1991	1999	2002	2012-2015
Service	Analog Voice	DIGITAL VOICE	HIGH CAPACITY PACKETS	HIGH CAPACITY BROADBAND DATA	HIGHER CAPACITY IP MULTIMEDIA
Multiple Access	FDMA	TDMA, CDMA	TDMA, CDMA	CDMA	OFDMA
Standards	AMPS, NMT	CDMAGS M, PDC	GPRS, EDGE	WCDMA	SINGLE STANDARD
Bandwidth	1.9Kbps	14.4kbps	384kbps	2mbps	200mbps
Core Network	PSTN	PSTN	PSTN, PACKET NETWORK	PACKET NETWORK	INTERNET

Table 2.1 History of 1G, 2G, 3G, and 4G technologies

2.8 Cellular System

In reaction to standard mobile radio services, the cellular idea was created. High-power transmitters were used for very big areas of the prior mobile communication scheme. Inadequate use of radio spectrum assigned. If a customer leaves the coverage region, a separate frequency channel should reset the call.

2.8.1 Cell Shapes

The square, the circle and the triangle standard hexagon regular are only certain cell patterns that can be repeated over a plane. For the reasons it gives the best approach to the circular omnidirectional radio models obtained in reality, the regular hexagon is preferred by system developers. It is cheaper to use because a hexagonal design needs fewer cells and therefore less stations. It combines the geometry of the overlapping circles with a simple practical realization. The hexagon has the greatest surface area for a certain distance between the middle of a polygon and its greatest point's perimeter. Hexagons are usually used for geometry and calculation purposes to depict the cells.

2.9 Introduction to Cellular Concept

In light of the constraints of standard mobile radio services, the cellular idea was created. High-power transmitters have been used to cover very high coverage of the former mobile communications systems. Inefficient radio spectrum utilization. When a user leaves the coverage, a distinct frequency channel needs to be restarted.

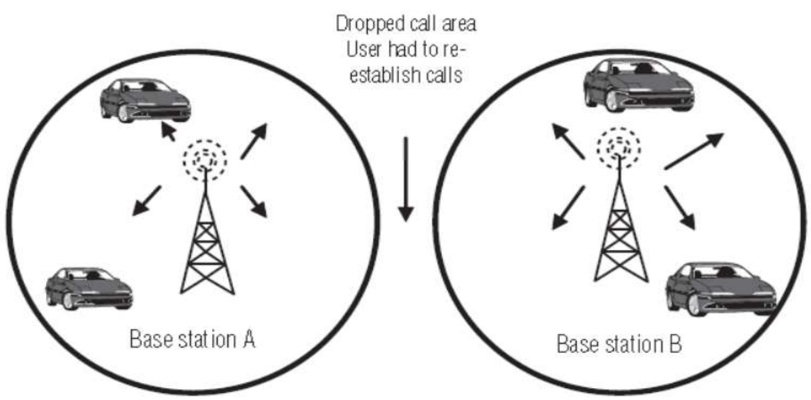

FIG 2.1 Conventional mobile radio services

The size the cellular system mostly depend how energy the centralized BS could transmit and obtain at the start there was no handoffs. The calls had to be ire-established for users who came off the spectrum of one scheme (Fig 2.1)These systems capability was very restricted because portable systems only had a tiny amount of radio channels. Consequently, they had to discover a way to reuse radio stations to conduct more than one discussion. Repeating a number of concurrent discussions with the radio frequencies in a specified geographical region. Frequency reuse is the fundamental method of the wireless communication.

2.10 Frequency Reuse Concept

The key idea of the cellular radio scheme is frequency reuse. In this systems, customers can simultaneously use the same frequency channel at separate geographic places or cells. The reuse scheme of frequencies can dramatically improve the effectiveness of the sample but severe interference may happen, then it is possible that system is not correctly constructed. Interference owing to the prevalent application of the as it is channel, is called co channel interference and is our principal problem in the frequency reuse notion.

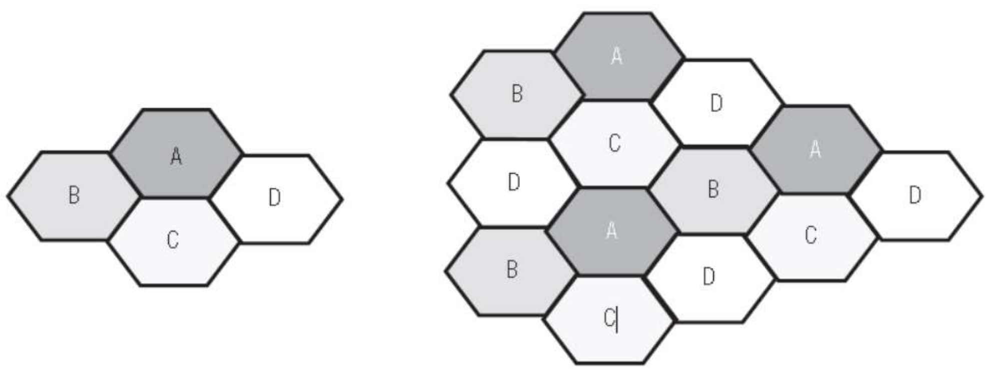

Fig 2.2 Cluster Size N=4

Reusable frequency in the time domain outcomes in distinct time slots (TDM) occupying the same frequency. In frequency domain reuse in a spatial domain, the same frequency in the same classifications may be allocated to two distinct geographical fields, like AM or FM radio stations in separate towns with the same frequency. The system is used in mobile applications in the same frequency, constantly in the same particular region in one system. The system consists of many co-channel cells. The complete allocation of frequency spectrum is split into the pattern for K frequency reuse.

2.10.1 Frequency Reuse Distance

Much of the variables will influence the minimum distance allowing for re-use of the same frequency, for example, many co-channel cells near center cell, geographical contour type of landscape, the height of the tower and power from each cell site. The frequency of reuse range D from

$$D = \sqrt{3K}\, R \qquad (2.1)$$

Cellular system capacity and frequency reuse for

Size of Cluster is N

Each cell allocated in a group of no of channels given K

No. of Duplex channels for use in a cluster is given S

If each cell is allocated a set of k channels ($k < S$) then the total number of radio channels can be given by

$$S = K \times N \qquad (2.2)$$

The number of channels in each cluster is same. If a cluster is replicated M times within the system, then the total number of duplex channels, C, which is a measure of capacity of the cellular system is given by

$$C = K \times N \times M \qquad (2.3)$$

The capacity of a cellular system is directly proportional to the number of times a cluster is replicated in a fixed area.

For the same cell size at a given area, N decreases ⇒ M increases ⇒ C increases.

2.11 Tradeoff of Frequency Reuse

The frequency reuse idea contributes to an overwhelmingly large cellular architecture in the geographical zone and to the amount of subscribers the system can serve. Two parameters are of significance when configuring a cellular design. The first is cellular radius and the second is the size of the cluster, and as demand rises it is not enough to provide a amount of channels per cell. Different methods to expand this section's system ability begin with a summary of the design compromises in which these parameters are crucial. We will therefore concentrate on expanding the system. Cell fractionation, sectoration, repeater and zone microcells are the technique are applicable cell coverage and ability in wireless communication systems.

2.11.1 Splitting of Cells

Cell division is the method of separating a bigger cell in to micro or Pico cells with their own BS each and the antenna height and transmitter energy correspondingly reduced. The fresh cells will have a narrower radius than the initial cells and will be installed between the current cells.

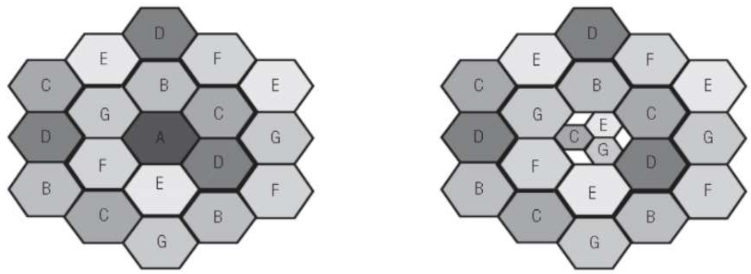

Fig 2.3 cell splitting

Benefits are increased capacity owing to the extra amount of channels per unit region. Reduced transmitted energy the battery life of these mobile phones is increased because new towers are very expensive and are required to be constructed.

2.11.2 Sectoring

A mobile region has the same covering space in the segmentation, but rather than one omnidirectional antenna that transmits three or six directional antennas in every direction, each with beam widths of approximately 120 ° or 60 °. The channels assigned to a given cell are split between distinct industries when this technique is used. Channels which are allotted to a given industry is always in the same direction in the various cells.

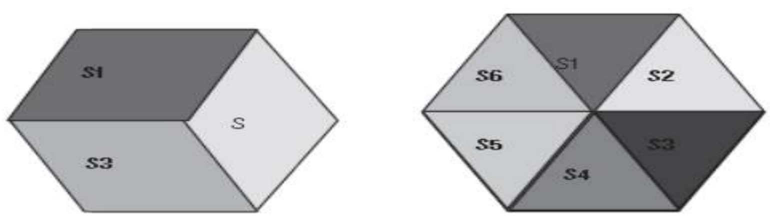

Fig 2.4 cell sectoring

Advantages are Increased CIR ratio, coordination of channel to avoid co channel interference is easier in sectorization in comparison of splitting of cells and Limitations are more handoff increase the complexity of the system.

2.11.3 Range Extension by the Use of Repeaters

Repeaters are used in mobile communication systems to broaden the reception variety of the receptor. Repeaters are of a bidirectional nature and send signals to a service BS concurrently and obtain them. The repeater amplifies and retransmits BS signals to the particular covers area when it receives signals from BS in the future. Advantages are used when the repeater is difficult to achieve the recipient set for the transmitted signal. Repeaters are commonly used to cover houses, which traditionally have little coverage. Limiters add no ability to the scheme; only improve the reach of a BS or MS in' shadowed' regions.

2.11.4 Microcell Zone Concept

The idea for the microcell area is implemented, resulting in an enhanced ability without any declining truck effectiveness resulting from the sectoring and from the distribution by various microcells of the same radio equipment. As a result, the cluster size is reduced and the system capability is therefore increased. The microcell coverage area method generally applied, in order to increase the ability of cellular communication devices. This reduces interference and increases ability. There is no transfer when the mobile unit moves between the microcells because hand off are reduced (also composed of decreases in cell volume) because the microcells with in cell are operating at equal frequency. The area device is tiny in size. The site equipment on the side of a construction or on a pole can be installed as tiny.

The use of Pico cell site by wireless carriers is based on the willingness to provide coverage and ability for a certain region or application. A Pico cell is a tiny cellular base cell. The service region in which more Pico cells can cover the same region as a microcell in principle. In comparison to a microcell site, the Pico cell is a spot coverage and low capacity. Typically, Pico cell sites have a single omnipotent, just like microcells. The Pico cell has less energy and hence a coverage than a microcell.

2.12 Channel Assignment Strategies

The channel assignment approach has an impact on system efficiency, especially on by which method calls are handled when a cell-to-cell any user is handed over. "A predetermined set of speech channels is allocated to every cell in set channel assignment strategy. Any call attempt in the cellular region made by the not utilized cell channels. If all cellular channels are allotted, the call is outranged and the service is not provided to the subscriber. This debt approach uses a cell to borrow channels from a nearby cell if they are already occupying all its own channels. The

Mobile Switching Center monitors this type of borrowing process and makes sure that a channel is not loaned in a cell in any way, as a dynamic channel assignment strategy-speech channels are not continuously assigned to separate regions. Rather, every call application requested by the serving base station reduces the probability of blocking from the MSC Dynamic channel allocation, increasing the system's ability to trunk.

2.13 Handoff

When a phone moves into another cell in a debate, the MSC had done mutually transfers calls to a new channel of the new base station. For the transference method, a new basic station as well as a new base station involves assignment of voice and control signals.

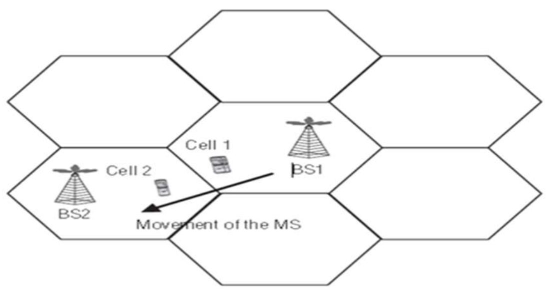

Fig 2.5 handoff between cell1 and cell 2

Soft handovers called pre-break handoffs and are applied on CDMA schemes, because K= 1 is performed in CDMA when mobile devices enter the nearby cell. It's known as a brake before making hard hand off. Intracellular handoff purposes can be a sector to sector handoff, Inter-cell handoff from an adjacent cell into a fresh region.

CHAPTER 3
INTERFERENCE AND SYSTEM CAPACITY

3.1 Merits of Digital System

The signals in the analog system are continuous waveform of the message on the transmitted media. Amplitude, Phase and frequency of the sine carrier may be changed continually according to the voice or the message.

The signals transmitted are discreet on time, amplitude, phase or frequency in digital transmission systems or a combination of two parameters. The noise created by the discrete levels of digital communication should be managed by a sufficient number of digits assigning for each sample to convert from analog to digital form, and sufficient samples are required to apply the Nyquist rate to sampling for an analog waveform. The conversion of message signals into digital form is beneficial due to the stiffness of the digital signal. The main benefits for digital transmission are this method, called regeneration. Besides the cost-benefit, electricity utilization is reduced and digital machinery is commonly slower and compact. More benefits in the application of digital technology exist in mobile cellular systems [6].

3.2 Interference

Interference in cellular radio systems is the significant limiting factor inefficiency. Interference is something, which alters, modifies or interrupts a signal on a channel between a source and a receiver. To telecommunications interference is nothing. Point-to-point communication has restricted noise, while mobile radio environments are interfering with a small number of transmitters as well as receivers [6].

3.2.1 Sources of Interference

A further mobile in that same cell is a call in a nearby area. A base station in the same frequency band no non-cellular scheme that draws energy into the mobile frequency band. The other base station Interference in voice channels creates cross-talks in Voice channels, in which subscribers receive an unwanted transmission interference in the background and in control channels: this interference contributes to the failure and blocking of calls as both a result of digital signal mistakes. Interferences on voice channels cause interaction in the background of Voice channels, where user hear interference from the unwanted transmission and the Control Channels, leading to missed and blocked calls due to digital signal mistakes. This interference creates interference. CCI and ACI are two main kinds of system-generated cellular interference. [6]

3.3 Co - Channel Interference

Interference with the channel has been crosstalk from the same frequency from two distinct transmitters. Spectrum is indeed a precious resource separated into non-overlap able, cell-assigned, spectrum bands. A CCI is caused by phenomenon of frequency reuse of mobile-cellular networks. To add to the signal meant from the cell, signals from undesirable transmitters (far away) on the same frequency (co-channel signals) reach the recipient and result in a decline in recipient results. Here is also no interference from co-channel in CDMA so interference from the code channel in the traffic channels. Power control is a rather critical element in decreasing the interference of a code channel [7].

3.3.1 Co-Channel Interference Areas In A System

Amount of CCI and grade of coverage affects the voice quality of received signal. Co-channel interference can be measured by selecting any channel to find CCI area through receiver (because all channels have same interference) interference in co channels and or interference in inter channels can be denoted by the carrier to interference ratio or simply signal to interference ratio. If signal to interference ratio is greater than 18 dB throughout the cells than the system is designed for capacity properly. If it is less than 18 dB than it leads to the presence co channel interference. The presence of co channel interference is also considered if C/N ratio is greater than 18 dB For both of these values less than 18 dB and for both of these values to be equal we get the clear indication of problem in coverage area. If for a given area C/N and C/I are less than 18 decibels than also coverage problem takes place. Also for C/N greater than C/I coverage problem occurs.

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3.4 Estimation of co-channel interference level

CCI is the factor which limits the extent for reduction in cluster size. Because to reduce the frequency reuse ratio cluster size must be reduced.

$$q = D/R = \sqrt{3N} \qquad (1.4)$$

Where

Q denotes frequency reuse factor.

R denotes radius of the cell.

D denotes the distance of reuse.

N denotes the size of cluster or number of cells.

If we increases the frequency reuse factor than spatial separation between the cells of co channel increases. This operation leads to the decrease in co channel interference (CCI). If we decrease the q, than value of N also decreases which leads to the increase of number of replicas (duplicates) inside a cluster. Due to this capacity of channel increases, but with a compromise of increase in co channel interference.

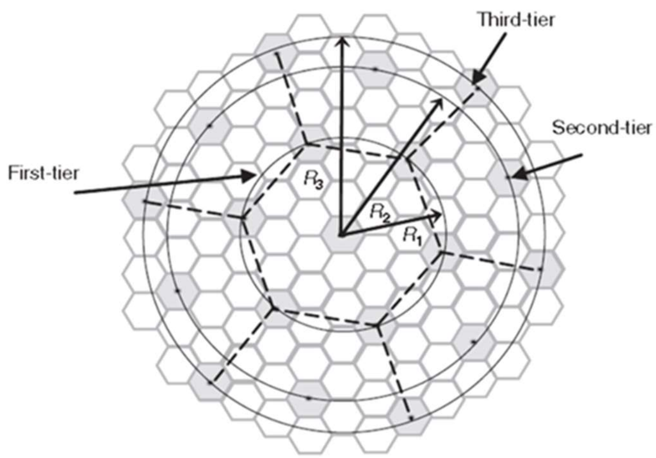

Fig 3.1 cci in first second and third tier

From the given geometry it is concluded that the radius of third tier is twice of the side of hexagonal. That is given by: R3=2D. by assuming the path loss exponent of four that is γ=4 than interference from 2nd tier is given by the following expression.

$$\frac{C}{I} = 10\,\mathrm{LOG}\; 1/6\left(\sqrt{3D}/R\right)\text{^}4 \qquad (1.5)$$

The mesured interference of second tier is of 9.54 decibles below the level of interference of first tier. Similarly by applying the same procedures we get that measures interference of third tier is 12 decibles less than or below than the level of first tier. And also this method is applicable for the higher calculations.

3.5 Co-Channel Interference Models

CCI designs are basically utilized for the calculation of interference in between the communication systems those are either co situated or simply located in adjacent areas. The quality of speech which is experienced by the receivers is totally affected by S/I (signal to cochannel interference) protection ratio those are observed by the different modulation techniques used. Generally this ratio that is signal to cochannel interference is defined by the capabilty of system which rejects the CCI i.e. co channel interference. In mobile radio systems of cellular networks the CCI (co channel intereference) and the noise of system is the limiting factor in performance and efficiency. It is due to noise power of system is lesser than unwanted signal power.

$$\alpha = \frac{S}{I+Ns} \qquad (1.6)$$

$$\alpha = \frac{S}{I} \quad I \gg Ns \qquad (1.7)$$

Where, S is considered as the power of desired signal.

I = CCI signal power

And Ns = total noise power in the system.

3.5.1 Co channel interference model

Classification of cochannel interference models is primarily based on two categories. The first type of category is based on geographical phenomenon, in which models are designed by analyzing the locations of transmitters and receivers in a relative geographical area by assuming the possible interferers which causes problem in cellular system network. The second type of category is based on statistical analysis where shadowinf and fadings includes static fashion too. Point must be noted that both of these categories are based on general assumptions only.

A regular hexagonal cell shapes are considered for cellular land mobile radio systems. Omni directional antennas are employed in the base areas those are located at the cell centres. The median value of signal power for long term is inversely propotional to the power of distance and it gradually decreases with the radial distance from the base stations. In both of the categories only CCI is considered. From base station antennas having large number of frequency channels the inter modulation products are not produced. The channel combiner which is connected to the antenna is assumed to be well matched to each of the channel load impedance.

Different kinds of modulatory techniques may retain the long and short-term stability of the frequency. Signal quality improvements are presumed to be similarly relevant for all devices, for instance, diversity signal receipt, pre-emphasis de-emphasis, Automatic frequency and gain control and thus not included as models. And the effect of applying such techniques is given by the protection ratio.

The interference with co-channels is independent of the real transmission capacity for basic stations. This is because it is supposed to be approximately identical in size of all cells in a specified cellular system. The interferences from base stations to mobile stations are probably the worst. The fact is that the energy radiation from portable stations is much smaller than that of the base radiated stations and thus is ignorable. The models may be adjusted for devices working in frequency bands other than the 900/1000 MHz frequency range to which they are tailored provided that the propagation circumstances are taken into consideration.

3.5.2 General Features Of The Geographical Models

The geographic model has one interferer, six interferer, and many interferers. The models are built with regard to mobile terminal, based on the relative geographic places of the interfering and service stations. The number of active interferors in the co-channel systems taken into account in this model. The models in this category represent a loss of signal paths caused by space and the loss of spread over a "flat earth." The design in this category do not represent any further fading and/or shadowing signal loss. However, after they are fully developed, these impacts can be added by amending the models.

3.5.3 General Features Of The Statistical Models

Amplitude of the signal obtained is nearly slowly varying after the Rayleigh distribution (fading). Signal mean variability is log-normal (shadowing) distribution. The average signal is an inverse of the distance from the transmitter to the receiver. With fading and shadowing, interfering with the co-channel can happen everywhere, even near the serving station. There are three types belonging to the statistical category: fading, shading, and statistical models fading and shadowing.

3.6 Reduction Of Co-Channel Interference

Reduction in CCI is one of the main problems in mobile cell systems. Some techniques which can be used are regarded to increase the distance between the two co-chaannel cells. Use of a tilted pattern antenna by using adaptive antenna filters to reduce the interference. Using directional antennas at base station. The base station minimize the antenna height at the base station.For the entire removal of intervening co channel signals, weighting can be used. The BS is capable to predict the channels between every mobile device and every antenna element.

The solution of systems of simultanatic equations, this is necessary that the number of elements is at least equalises to number of mobiles. In practical cases, the optimal weights in the presence of noise should be estimated so that the interferer is not completely removed. Weights instead have been selected to maximize the SINR ratio.

Use of a successful frequency management chart In order to assign frequency channels to the specific mobile unit, certain channels are loud, few may be silent and few may also be susceptible to channel interference. These factors should be regarded in the allocation of frequency channels. This design instrument is intended to contain the results of signal requirements. Omni-directional antennas using the umbrella pattern or downwards tilting are used to confine the energy within a tiny area. This can be used since it is more essential to reduce interference than to reduce radio coverage.n, in some instances it may be more efficient to reduce transmitted energy rather than decreasing antenna height[3].

3.7 Non Co Channel Interference

There are two types of non co channel interference Adjacent-channel interference and Near-end to far-end ratio interference in cellular communication.

3.7.1 Adjacent Channel Interference

The ACI can be classified as an interference in-band or outside-band. This word is used in band when it drops within the bandwidth of the required signal at the center of the interfering signal bandwidth. This word is used if the center of the interfering signal stream is beyond the range of the required signal. The required signal and an adjacent signal can be partly related to its fades in the mobile radio setting. In comparison to CCI, ACI is constantly lower in terms of its impacts at the same rate of interference energy. ACI can be removed based upon a channel assignment, filter properties, reducing the interference from close to far-end ratio and maintaining frequency separation as wide as possible between each channel, thus preventing the use of neighboring channels in nearby cell sites, etc. ACI can be eliminated. ACI contains next channel interference and neighboring channel interference (more than one channel away from the working channel). The frequency assignment can be decreased.

3.7.2 Next-Channel Interference

For any specific mobile units, the interference from the next channel influencing them must originate in several cell sites and not be triggered by transmeters on the prevalent website. This is because every channel combiner on the cellular site must combine the channels chosen, usually the 21 (630 kHz) channels or the required channel at least 10. The next-channel interference from other cell sites will be reached by the mobile device without a correct system design. In addition, a portable device which initiates a call on a control channel in a cell with the next control channel on another cell site may cause interference. The receiving end is utilized by techniques for the next-channel interference decrease. Filters with a sharp failure pitch may assist decrease all ACI, including interference from the next channel.

3.7.3 Neighbouring-Channel Interference

Another sort of ACI unique to the mobile radio scheme is the neighboring channel interference. The channels that are several channels away from the required channel are responsible for the assignment of a fixed number of channels to each cell site. For a Multischannel Combo all channels are simultaneously transferred on a cell-site antenna to decrease intermodulation products, sufficient quantity of band isolation is needed between channels. Instead of one antenna on the cell site, evolving techniques focus on the use of various antennas, assuming band separation needs can be addressed.The anotor sort of ACI triggered by the transmitting channels is the transmitting and receiving channel interference. The fact is that the transmitting channels are so large that the weak signals from the receiving channels can be masked. The duplexer can be used, but only offers isolation of 30–40 dB per band isolation[7]. In FDMA and TDMA schemes the guard strip of 20 MHz separates both sending and receiving channels.

3.8 Near-End To Far-End Ratio Interference

The distance between MU and Base station transmitter with another transmission system becomes very large then this interference takes place. Very large distence between transmission unit can face this problem, MU is far away from its desired base station transmitter of distance d0, but nearer to undesired MU of distance d1, and d1> d0 is a condition when transmitter transmit signal at the same power and frequency and masked the signals received by the MU from the desired source by the signals received from the undesired source. Additionally,this interference occurs at the base station when signals are received concurrently by two MU's that are at different distances from the base station .The power difference of path loss of receiver side and transmitter side is known as near-end to far-end interference ratio and expressed by path loss ratio at range d1 to the range d0 path loss

(a) In One Cell

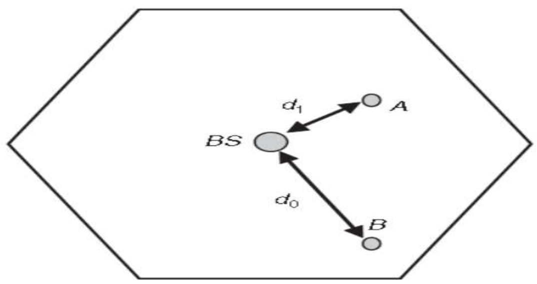

Fig 3.2 near far interference in one cell

When MS, *A* is situated nearer to base station, and concomitantly same time mobile station B is located far away from the same base station mobile station A causes ACI to the base station and mobile station B The C/I at mobile station B is expressed by the following equation.

$$\frac{C}{I} = \left(\frac{d0}{d1}\right)^{\mu} \quad (1.7)$$

μ is the path-loss slope

d0 is the distance from base station to desirable mobile station A

d1 is the distance from base station to undesirable mobile station B

(b) In Cells Of Two Systems

Mobile Operators covers same area and their frequency channels are not coordeinated then ACI occurs. In fig two different mobile radio systems are shown. MS, A is sited at the cell boundaries of system A, but adjacent to BS, B. Additionally,MS B is sited at the cell boundaries of system B, but immediate vicinity to base station A. Closeness results in Interference for BS A and BS B.

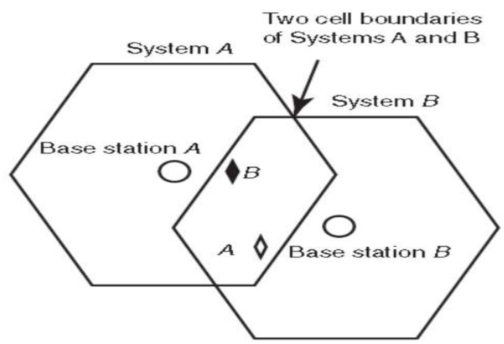

Fig 3.3 Near-far interference in cells of two system

Reomoving method : To get rid off this type of interference the frequency channels of the two systems are properly coordinated and proper distance should be maintained between Base station.

CHAPTER 4

WIMAX AND MITIGATION OF CCI IN WIMAX

4.1 Introduction

IEEE has standardized introduced some standards for wireless network devices. WiMAX is one of them. IEEE 802 is nternational standards designed for different Local Area Networks and other wireless networks such as MAN. Some of most commanly used IEEE 802 standards are as follows:

1. IEEE 802.11 is used for wireless LANs (WLAN)
2. IEEE 802.15 is designed for wireless personal area networks (WPAN)
3. IEEE 802.16 is used for wireless metropolitan area networks (WMAN)
4. IEEE 802.20 for many more wireless networks.

The IEEE 802.16 standard was originally designed for fixed broad-band wireless (FBW) networks. Wireless networks has an advantages of reaching to the places where wired network infrastructure is hard construct. Wireless network has a higher edge of having the low installation cost and easy maintenance over wired channels.

IEEE 802.16 Wireless MAN is having a connection-oriented MAC and PHY is based on non-line of-sight radio operation in 2-11 GHz. For licensed bands, channel bandwidth will be limited to the regulatory provisioned bandwidth divided by any power of 2, no less than 1.25M Hz.

Three technologies have been defined [8].

Single carrier (SC)

Orthogonal frequency division multiplexing (OFDM)

Orthogonal frequency division multiple access (OFDMA)

4.2 Antennas in Wimax

A high capacity of six sector antenna pattern is used to configure a six sector cell here we placed two three sectoring antenna back to back a phase shift of 180 .there are a number of ways that the six sector can be configured all three sector antenna of first pattern can be deployed on one side and the second pattern on other side. Another method where a sector of the first pattern is adjacent to two sectors of the second pattern. The first method yields the best performances improved signal demodulation and lower power performances requirements the way of these sector can be impact the performances of six sector. For high rate data transmission for wireless networks Mobile WiMAX was designed and it was just a start for next generation wireless network. Frequency reuse is one of the solution which helps to increase channel capacity. But frequency reuse usually have a disadvantage that is suffers against inter-cell interference (ICI) at cell boundaries and spectral efficiency decreases too. m-WiMAX is used for real-time applications. At 512kbps data rate m-WiMax provides a real time at the cell boundary by allocating the downlink re-sources to only one user. It is hard for service providers to accept m-WiMax until unless it can improve the spectral efficiency up to a minimum mark specifically at cell boundaries.

CCI is one problem any wireless network which needs to be resolved or the device is of not that much of use. In order to resolve ICI. The cellular structure was initially inspired by the features of signal propagation connected with the distance between the transmitter and the receiver. In those geographically separate fields frequency reusing can be successfully achieved where the signal attenuation results due to distance.Though the target signal cannot be completely protected from ICI. Many methods have been devised to eradicate the ICI problem. An easy strategy is to divide the cells adequately using the same frequency band to keep a minimum signal-to-interference plus noise ratio (SINR) needed throughout the coverage region. This is accomplished using frequency reuse and sectorization [9].

4.3 Radiation Pattern of Wimax Antenna

A high capacity of six sector antenna pattern is used to configure a six sector cell here we placed two three sectoring antenna back to back a phase shift of 180 .there are a number of ways that the six sector can be configured all three sector antenna of first pattern can be deployed on one side and the second pattern on other side. Another method where a sector of the first pattern is adjacent to two sectors of the second pattern. The first method yields the best performances improved signal demodulation and lower power performances requirements .the way of these sector can be impact the performances of six sector [10].

$$A(\theta) = -\min\left[12\left(\frac{\theta}{\theta 3db}\right)^2, Am\right] \qquad 90 \leq \boldsymbol{\theta} \leq 90 \qquad (4.1)$$

Where

θ3db is the 3-db beam width cross ponding to 65degree.

Am is maximum attenuation set to 20 dB,

The antenna gain of base station is assumed to be 15dbi and for mobile station an omnidirectional pattern with an antenna gain of 0 db.

4.4 Analysis of uplink co channel interference in wimax

To design the system model first, we have to consider the cci impact between two channel cells as shown in figure here in each cell, one base station is deployed with 180 degree phase shift and each base station has six sector, now we consider with their base station bs1 and bs2 respectively two cells are using the same set of frequency in this situation they must suffer from cci impact because base station1 can receive co channel signals which are being radiated from ms2 the received interference power at bs1 can be written as

$$I(1) = Pt2\ L1\ Gms1\ A1(\theta 1 - 30°) \quad (4.2)$$

Where

PT2 is transmitted power of MS2

L1 is the path loss between BS1 and MS1

Gms2, Gbs2, Gms1, Gbs1 are the antenna gain

A1 represent the antenna pattern of base station 1 and reference antenna is shifted to 30 degree. In this condition Base station 2 must receive sufficient power from mobile station 2 so we can calculate the received power at base station2 can be written as

$$\mathrm{Pr2} = \mathrm{Pt2\ L2\ Gms2\ Gbs2\ A2(\theta 2 - 30°)} \quad (4.3)$$

If we assume two base station have same antenna gain then interference can be written by following equation

$$\mathrm{I1} = \mathrm{Pr2}\ \left(\frac{\mathrm{L1A1(\theta - 30°)}}{\mathrm{L2A2(\theta - 30°)}}\right) \quad (4.4)$$

Due to shadow fading path loss can be written as $L1 = C1\ (r1^{\mu 1})10^{-\frac{\varepsilon 1}{10}}$ (i)

Now same for mobile station 2 and base station 2 $L2 = C2\ (r2^{\mu 2})10^{-\frac{\varepsilon 2}{10}}$ (ii)

For simplification we consider constant c1= c2 and path loss exponent should be equal ,we know interference power primarily depends user random location and fading effects also, take both as mutually independent then interference power can be calculate as by following equation as

$$E(I1) = Pr2.E[10^{(\varepsilon 2} - \hat{}\varepsilon 1)].E[\left(\frac{r1}{r2}\right)^{\mu}.A1(\theta - 30\circ)/A2(\theta 2 - 30\circ) \quad (4.5)$$

Since $\varepsilon 0$ and $\varepsilon 1$ are two identical and independent random variables with lognormal distribution, their difference is still a lognormal random variable with zero mean and variance $2\sigma 2$. Hence, we can define

$$\mathrm{E(I1)} = \mathrm{Pr2}\,.\,\mathrm{e}^{(.1\,\sigma\,\ln 10)2} \int_0^{r}\int_0^{\frac{\pi}{3}} \left(\frac{r1}{r2}\right) \wedge \mu \;\; \mathrm{A1}(\theta 1 - 30°)/\mathrm{A2}(\theta 2 - 30°\; \mathrm{f}(r2, \theta 2)\mathrm{d}\theta 2\mathrm{d}r2 \quad (4.6)$$

Where R is the radius of BS1. Note that $f(r1, \theta 1)$ is the probability density function for the random location of MS1.If the random location is uniformly distributed over the 60◦sector, then probability density function will be like this

$$\mathrm{f}(r2, \theta 2) = \frac{3r2}{\pi r^2} \quad (4.7)$$

So in short we can write $E[I1] = M12.Pr2$ and same for we can analysis the impact at base station 2 and calculate the expected value of interference power and which can be written as

$$E[I2] = M21.Pr1. \quad (4.8)$$

4.5 Calculation of SINR

An open-loop power control is used in 802.16 m for uplink transmission to meet its target SINR. To preserve their target SINRs, each BS must regulate MS radiation. The open-loop energy control defined in 3GPP can provide a coarse original power setting for the MS at the start of a connection based on transmission parameters such as downlink channel data and interference information obtained from the BS. In this scenario to obtain target SINR, the MS transmit energy is regulated to compensate for the path loss and we can calculate the minimum SINR requirement at base station 1 as

$$\mathrm{SINR1} = \frac{\mathrm{Pr1}}{\mathrm{NF(M12Pr2+NO)}} \qquad (4.9)$$

Where No is the noise power for m number of sub channel receive noise power may be written as

$$\mathrm{No} = -\frac{174\mathrm{dBm}}{\mathrm{hz}} + 10\log_{10}(\mathrm{m}\,.\,\mathrm{BWsubchannel}) \qquad (4.10)$$

Similarly the SIINR requirement at bae station 2 can be written as -

$$\mathrm{SINR2} = \frac{\mathrm{Pr2}}{\mathrm{NF(M21Pr1+NO)}} \qquad (4.11)$$

By solving these upper equation we can have the power at base station1 and power received at bae station 2 are Pr1and Pr2 so there value can be calculated as following equations-

$$\mathrm{Pr1} = \mathrm{SINR1}\,.\,\mathrm{NF.\,N0.}\frac{\mathrm{SINR2.NF.M12+1}}{\mathrm{1-SIN\quad .SINR2.NF^2.M12.M21}} \qquad (4.13)$$

$$\mathrm{Pr2} = \mathrm{SINR2}\,.\,\mathrm{NF.\,N0.}\frac{\mathrm{SINR1.NF.M21+1}}{\mathrm{1-SINR1.SINR2.NF^2.M12.M21}} \qquad (4.14)$$

The given power solutions are feasible if they are positive Therefore, the identical denominator in and must be greater than zero

$$\mathrm{SINR1.\,SINR2.\,NF^2.\,M12.\,M21<1} \qquad (3)$$

Now consider all inner cell uplink cci signals are from another cell at the same time. Let assume there are n+1 number of base stations then the expected power can be received at all base station as

$$\mathrm{E[Ii]} = \sum_{\mathrm{j=1,j\neq i}}^{\mathrm{n}} \mathrm{Mij.\,Prj} \qquad (4.15)$$

For each base station requirement of SINR can be written as

$$\mathrm{SINRi} = \frac{\mathrm{Pr2}}{\mathrm{NF(MijPrj+NO)}} \quad (4.16)$$

The required power level at each bae station can be written as in matrix form

$$\begin{bmatrix} (SINR1.NF)^{-1} & -M12 \; -M13 & -M13 \\ -M21 \; (SINR2.NF)^{-1} & -M23 & -M2n \\ -Mn1 & -Mn2 & (SINR.NF)^{-1} \end{bmatrix} \begin{matrix} [Pr1] \\ [Pr2] \\ [Prn] \end{matrix} = \begin{matrix} N0 \\ N0 \\ N0 \end{matrix}$$

We can easily solve the simultaneous equations by using a numerical method. After the required power levels are obtained, we can then calculate the CCI at each BS from above equations.

4.6 Outage Probability And Cell Coverage

Service outage probability is the probability of failure of a system that means there will be no communication link between the systems, Means no link between base station and mobile station, We can examine the handset power limitation on system performance due to the co channel intereference.then we have to analyses that the MS has enough power to support given SINR requirement .the required transmission power at mobile station can be written as

$$\mathrm{Pt1} = \mathrm{Pr1}/(\mathrm{Lo.Gms1.Gbs1.Aa}(\theta - 30°) \quad (6)$$

There will be no link between mobile station and bae station when the required power is greater than the mobile handset power, we can mathematically express as

$$\mathrm{Poutage} = \mathrm{P(Pto > Pmax)} \quad (7)$$

Where Pmax represent maximum output power supported by mobile hanset.so outage probability can be rewritten as

$$Poutage = 1 - Q(x) = 1 - \frac{1}{\sqrt{2\pi}} e^{\left(-\frac{v^2}{2}\right) dv} \quad (8)$$

Here

$$x = \frac{10}{\sigma}.\left(\frac{\mathrm{Pr1}}{\mathrm{c.\,ra^{-}\mu.}\frac{10^{\varepsilon 1}}{10}\mathrm{.\,Gms1.\,Gbs1.\,Aa(\theta a - 30^{\circ})Pmax}}\right)$$

ra defines the distance between MS and BS. The more distance between user equipment and its base station results increment in outage probability. The coverage area will be maximum for that values of ra when service outage probability is less than the acceptable level which is set to 0.1 for good communication link can be established in this coverage area .therefore the coverage of a call can be mathematically given by

$$\mathrm{Dcovrage} = \max\{\mathrm{ra: Pouatge} \ < \delta\} \tag{9}$$

Where δ is an acceptable level for outage probability.in this study the value of outage probability is taken as 0.1 we will present the results for the reduction in cell coverage caused by CCI.

CHAPTER 5
RESEARCH METHODOLOGY

The objective of this project is to evaluate the performance of Wimax System in terms of outage probability vs distance between Ms and Bs and frequency reuse analysis. For this purpose we have used Matrix Laboratory (MATLAB) as a research tool.

5.1 Methodology used for the performance analysis of wimax Systems

5.1.1 MATLAB As A Tool

MATLAB combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly. It allows an effective numerical computing environment with multiple data. It offers an optimized platform for solving scientific problems. MATLAB is basically a Matrix based language which is great at solving mathematical problems.

5.1.2 Procedure To Plot Results

Select the required parameters like number of subcarriers, duration of CP, symbol duration, channel, and modulation technique. After selecting these write a code according to wimax sectoring and cci cancellation Procedure and after simulating that results are obtained which are reflected in the form of graphs. Matlab is a great software in handling up of large data as compared to other similar tools. We can have fine graphs by using MATLAB.

MATLAB by default provides the output values at every sample points taken within the iteration in tabular format while similar thing cannot be readily find into other tool.

CHAPTER 6

SIMULATION RESULTS AND ANALYSIS

6.1 Numerical Result

A complete amount of base stations are put in seven clusters for six sectors, each having seven cells. Each unit has six areas and is installed in a 5R range hexagonal grid and installed in a 5R range hexagonal grid. Now we have to pay very close attention to the effects of the co-channel interferences on victim base station1 for assessment.

In this studies the propagation model of hata is used for calculation

$$Pathloss(dB) = 36.1 + 36(d) + 26\left(\frac{f}{2}\right) \quad (11)$$

Where d displays the range in meter and f is the frequency in ghz.in this survey, the transmission frequency f is set to 3.6 GHz.

6.2 Parameter Taken in Numerical Integration

Cell geometry	hexagonal	sectored
band of frequency	3.6	GHz
Sectoral BW	15	MHz/sector
Total sub channel	48	decibel
basestation gain antenna	0.00	decibel
Mobile station gain	6	decibel
Cell radius	250	meter
Standard deviation of fading	8	dB
Thermal noise	174	dBm/hz

MS antenna height	32	meter
Base antenna height	1.5	Meter
IFFT	1024	
Simulation time	100TTL	
Sub carrier spacing	11	kHz
Feedback delay	3	ms
Length of simulation run	100	frames
Simulation run	1000	
Scheduler	opportunistic	
Path loss model	Cost - Hata 231	
BS antenna pattern	30 degree(-3dB)	
Duplex	TDD	
BS EIRP	57	dBm

Table 6.1 parameters

Those are the specifications used it to evaluate the efficiency of distinct transmission techniques that we conduct system level analysis using the snap shot technique of manto Carlo computation. Every user is presumed to remain stationary at their place during each simulation run. This form of simulation classified into quasi-static system tier simulation and is appropriate for resource planning and.And it is appropriate for resource planning and energy control. In addition, HARQ with chase combination structure is added. Frame period is 3ms. The number of computation runs is 1000 and the length for each run is 100 frames.

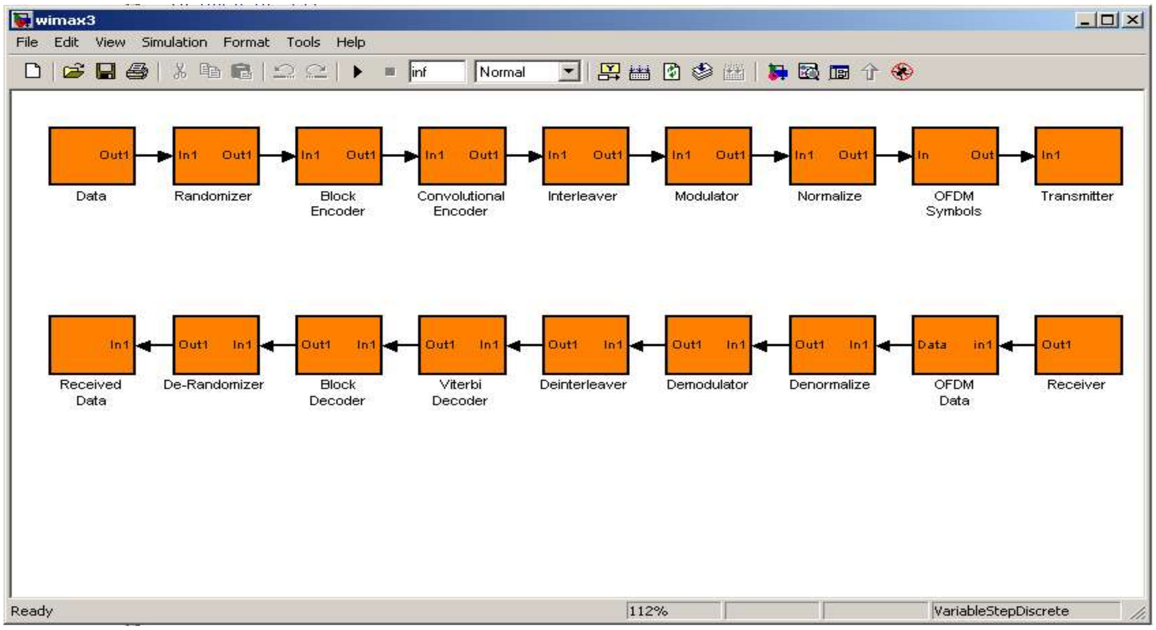

Fig 6.1 Simulink design of wimax

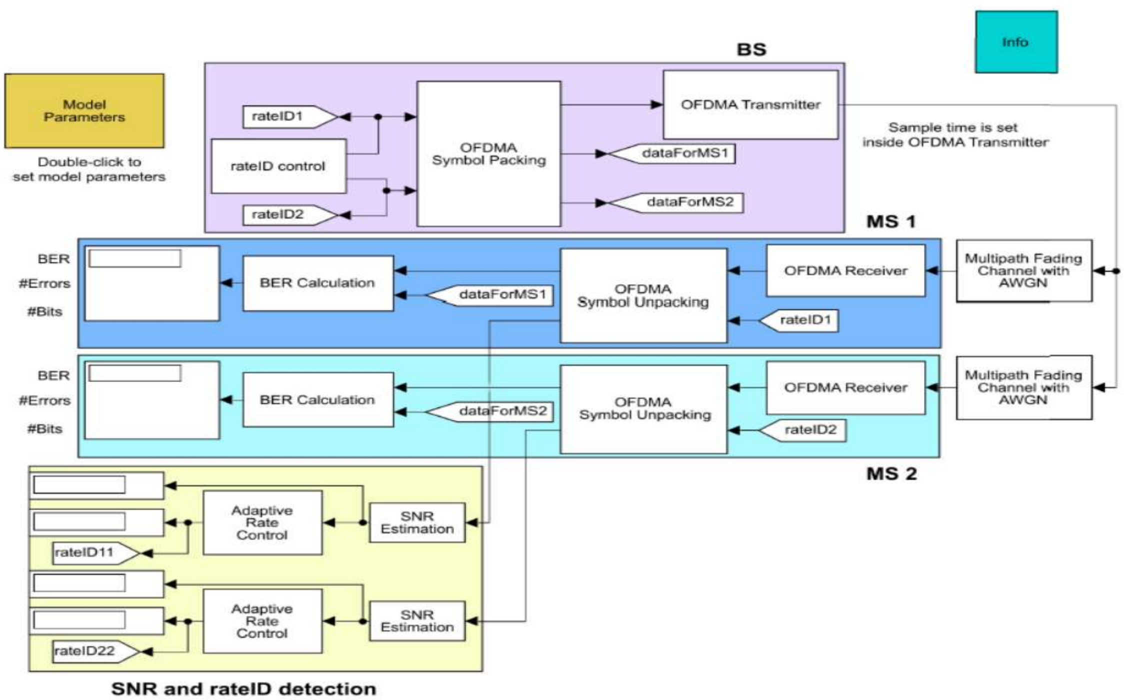

Fig 6.2 Simulink Design of Wimax 802.16m

6.3 Capacity evaluation using sectorization in cells with frequency reuse

Appearance of frequency reuse with sectoring cells the quality of fractional reuse is evaluated with respect to conventional reuse 1 and reuse 3. For FR1 all 48 sub-channels are divided into 3 parts, for reuse 3 all sub-channels are divided into 3 parts with each 16 sub-channels.

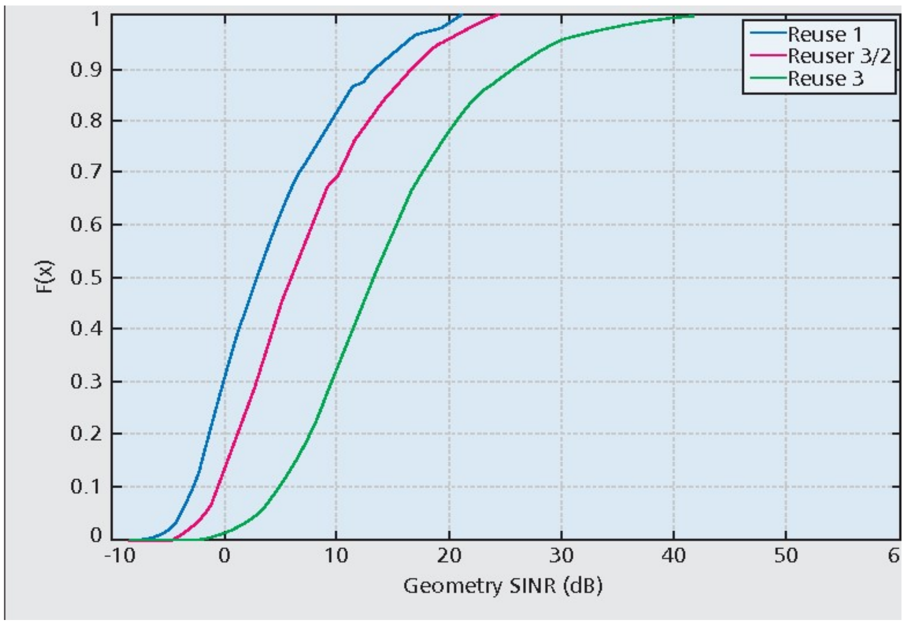

Fig 6.3 sinr distribution with multiple frequency

FR scheme used during 802.16 m, in which practical OFDMA assets are separated in to the three frequency compartments as reuse 1 and smooth reuse 3 All cells distribute with equal strength on the Reuse 1 separation in figure 6.3, while the transmission power on the remaining 3 partitions is based on the primary partition assigned to the transmission cell. The real distribution of energy across the frequency partition. From graph we can say reuse 3 is far better than reuse 1.in reuse 1 all band of frequency used in a cell and again reused in adjacent cell, due to this high interference present in system.in reuse 3 no neighboring cells have the same frequency so we get more SINR in reuse 3 pattern. Result analysis with frequency reuse concept in cell, and comparison of their analysis in terms of SINR and frequency. Here we take reuse one, reuse 2,reuse 3/2 and ffr in analysis.by the graph we can analysis that fractional frequency reuse is far better than reuse1 and reuse 2.

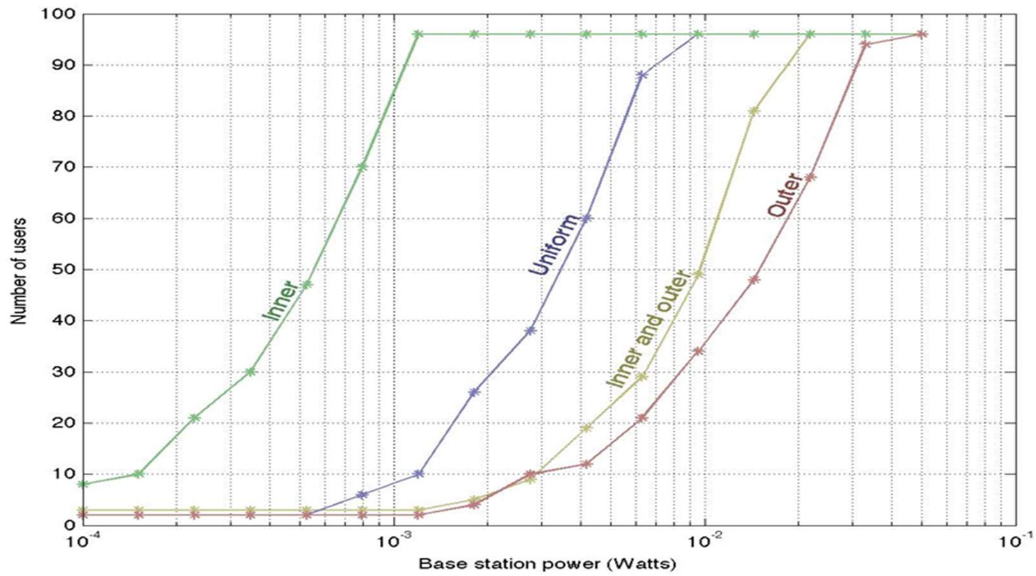

Fig 6.4 CCI analysis in terms of base station power and number of users

Base station energy and comparative amount of customers in the internal and outer cell, the outer cell on its own. Here we have the as a percentage of customers rise as the demand for base station energy rises owing to this cci can have more impact on cell ability and performance.

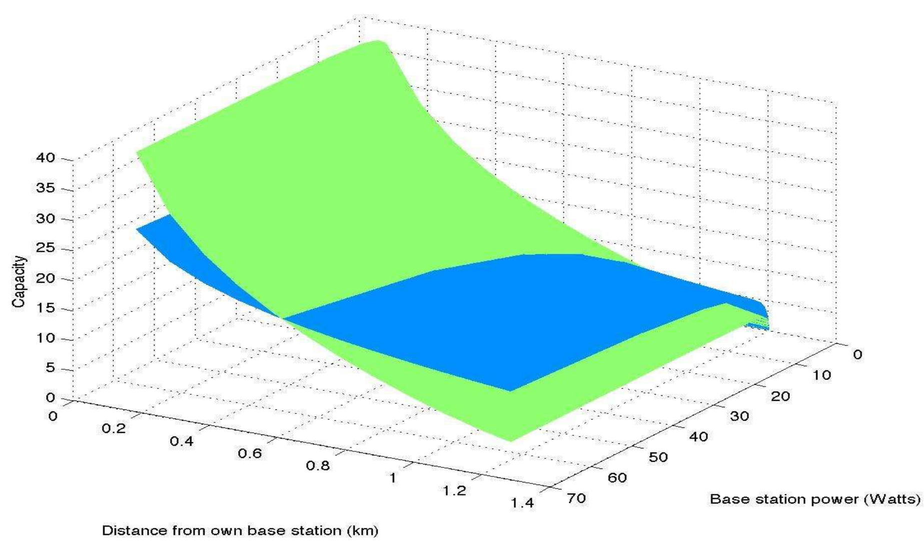

Fig 6.5 Cell Capacity vs Distance graph

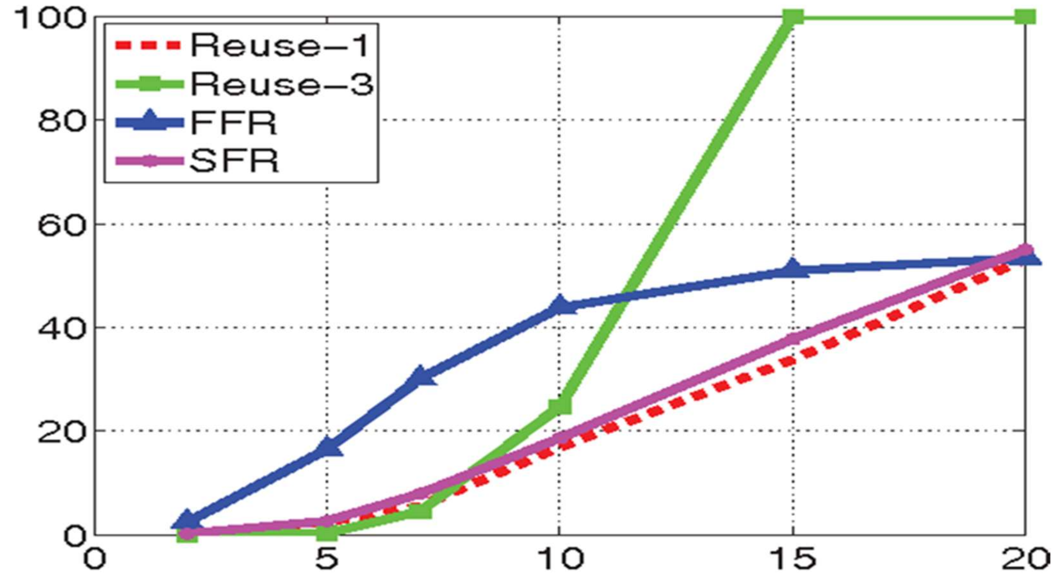

Fig 6.7 Frequency reuse comparison graph

Here median cell throughput for separate frequency distribution systems utilizing analytical and computational techniques. The outcome is computed on the basis of the Shannon equation. We can discover that the actual cell capacity acquired from the analytical technique is lower than that from modeling. With the use of a lower frequency reuse factor, the ICI can be shortened, enhancing the efficiency of the connection.

6.4 Coverage analysis by using sectorization

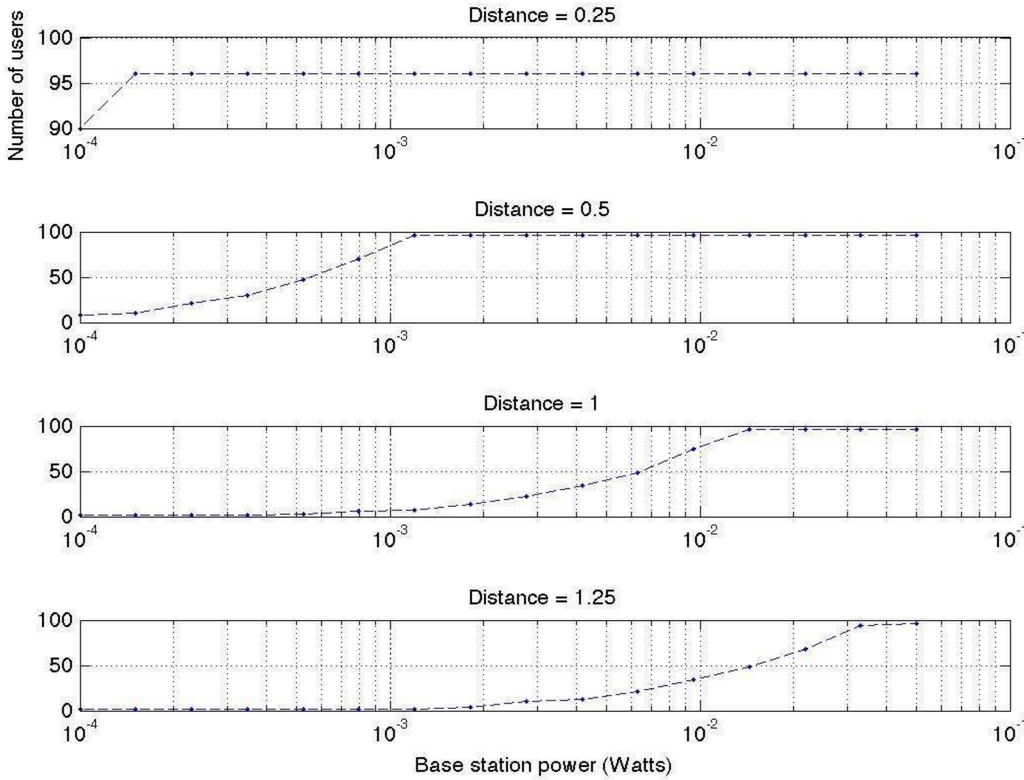

Fig 6.8 base station power and number of users

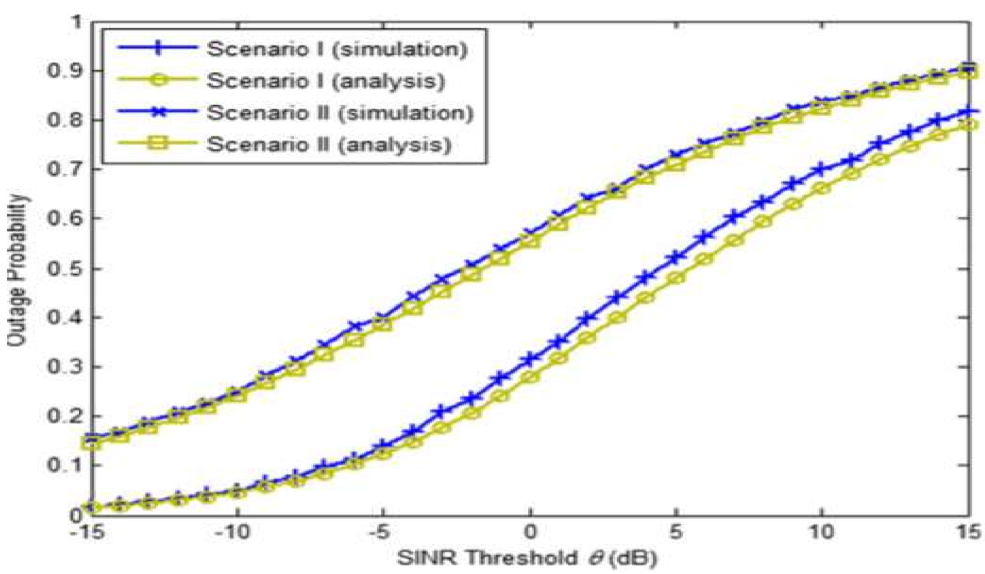

Fig 6.7 CCI impact on outage probability

Fig 6.7Demonstrates the graph of probability and separation among Ms and Bs for distinct SINR demands. The simulation outcome suggests that the cell connectivity of SINR 6 Db is more than about 250 m, and the chance of outage is also at an appropriate stage, but the track quality is not so good. In this situation SINR 11.5 dB, the call quality is excellent, the probability of outage is greater in much less coverage.

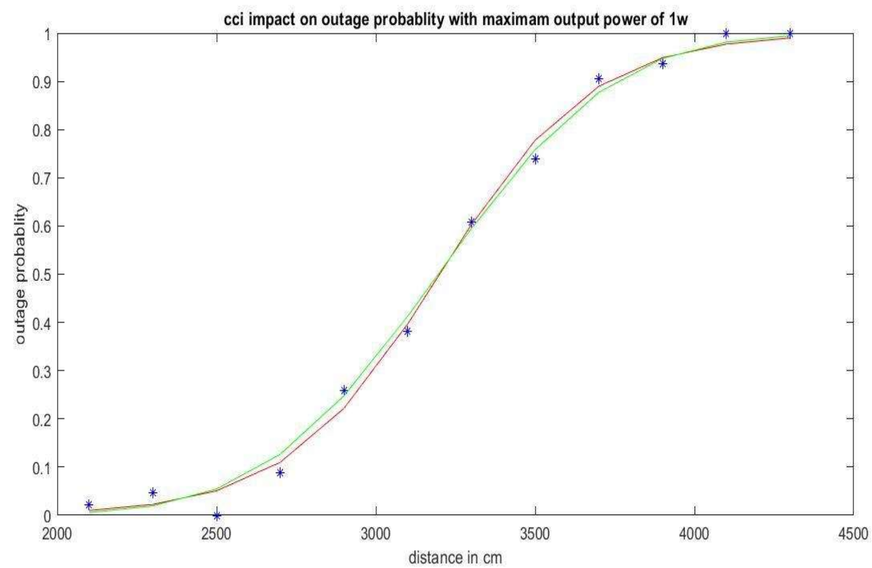

Fig 6.8 outage probability vs distance graph

The outcome demonstrates how each user is allotted with one sub-channel the impact of the handset energy on the likelihood of outage with SINR 6dB. If portable users want to transmit big amounts of information in this scenario they need more sub-channels for their transmission and stronger communication, this will lead to a high traffic scenario and a more severe impact on the likelihood of interruption.

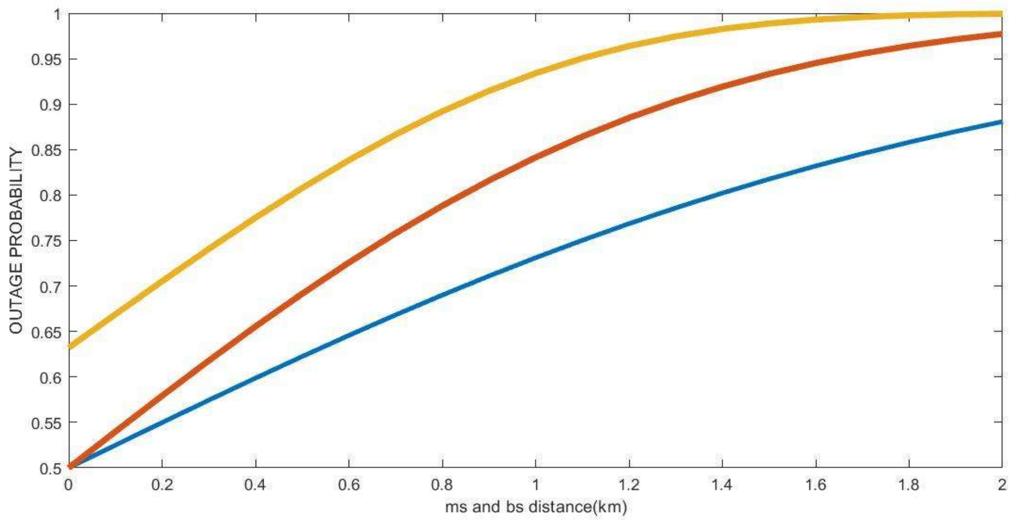

Fig 6.9 Baseline throughput for adaptive modulation scheme

The effect of the subchannel quantity assigned to the mobile client on the probability of outage in the presence of cci shown in the figure 6.9.The probability of power failure is enhanced when more subchannel is radiated by the mobile client.We can realize that the link range is approx.The effect of co-channel interference is minimum for the first 200 meters if the distance larger than the 300 meters has a tremendous effect of co-channel interference and likelihood blackout of the probability will achieve an intolerable amount just because of the sensible distinction exists among the theoretical and simulation outcomes. It is just because of the reality that the simulation model contains an opportunistic planning technique

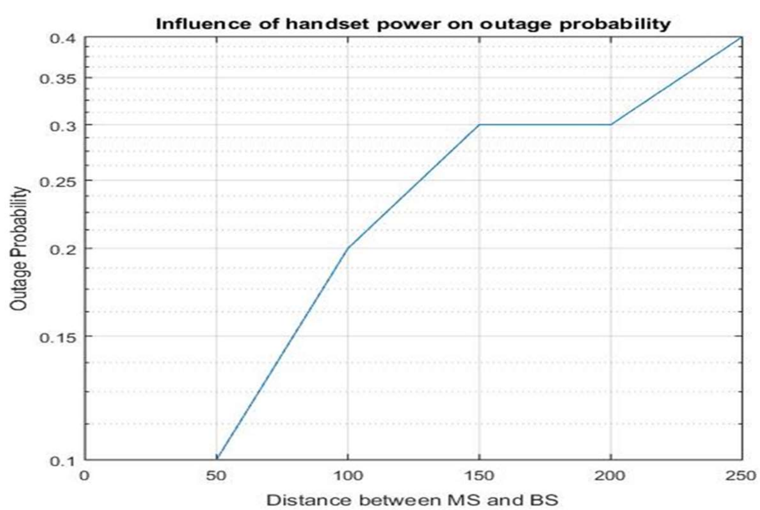

Fig 6.10 influence handset power on outage probability

Power provided by a dc battery for transmission for the uplink to the mobile device, energy will considerably influence the performance of the connection. Due to the limited power supply, dc power supply can not be generally sustain lengthy range or high quality communication. By taking the power level pmax to be equal to 200mw, it shows that devices are maximum affect the service outage probability. It can be concluded that when SINR is 6 dB then the cell coverage is about 130 m for the maximum power of 200mW and it will extend to about 210 meter. Cell coverage is about 240m if supplied by the power of 1 watt.

CHAPTER 7
CONCLUSION AND FUTURE WORK

7.1 Conclusion

CCI reduction in the IEEE 802.16 m scheme. CCI minimization Our model focuses onto the SINR requirements where every BS has the power to maintain the highest SINR possible of its mobile clients. The impacts on shadow loss but also user random locations are taken into account in computations for median interference intensity. Through our scheme, they may evaluate the probability of power failure and cell coverage as a result of CCI. Its simulation results indicate which CCI can lead to a dramatic reduction of cell coverage, in particular, if mobile customers require a large number of sub-channels for fast-speed information transmission. The simulation results also show that mobile customers who want than five substrates should be less than 60 meters of their own BSs.

Given the general restriction of that same available radio spectrum, hostile re-use of 4 G wireless radio is vital. The effect of CCI on system efficiency needs to be properly considered but a sustainable solution found.

7.2 Future Work

In future fifth-generation (5 G) wireless networks, integrated multi-input multiple-output (MIMO) technique will be implemented in such a way that much more difficulties are identified in the effective distribution of high-access density user equipment (UE) to promote their high mobility among distinct micro pico-cells. This issue of interference with the co-channel can be more effective in the cellular communication.

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