Dynamic Frequency Hopping: A Major Boon Towards Performance Improvisation of a GSM Mobile Network

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***Abstract*—: The primary problem in today's cellular network is to raise bandwidth efficiency of cellular system and handle blocking in the call between the subscribers. This will be done by improving the performance of system and reducing the interference to allow the users to achieve higher data rate. This designed system shows how to increase bandwidth efficiency and enhancement blocking probability in cellular system by using techniques of Dynamic Frequency Hopping where data transmission of the wireless regional area network system are performed in parallel with spectrum sensing without any interruption. This leads to an enhancement in performance of system and diminish the interference allowing the users to attain higher data rate.**

***Keywords*— Congestion control techniques, Outage probability, Propagation model, Bandwidth efficiency, Cellular system**

I. Introduction

While the demand for cellular services continues to increase, radio resources remain scarce. As a result, network operators have to competently manage these resources in order to increase the efficiency of their Wireless Cellular Networks and meet the Quality of Service of different users. Ever increasing data traffic and limited capacity causes congestion in present cellular network. Congestion can severely degrade the performance of cellular network and affect the satisfaction of the users and the obtained revenues. It is also projected that congestion will occur in peak usage hours. By congestion, we mean that in some cells, there will be no more capacity left. In a congested cell, there will be no more available data channels for use by additional mobile hosts (MH's) in the cell. However, that control channels for signaling may still be accessible by all MH's in a congested cell.

Several congestion control techniques have been proposed to combat impairments in hastily varying radio channels and to gain high bandwidth efficiencies in cellular network. Some of those techniques are channel coding and interleaving, adaptive modulation, transmitter/ receiver antenna diversity, spectrum spreading, and dynamic channel allocation (DCA). Interleaving is a way to arrange data in a non contiguous way to increase performance. It is generally deployed to disperse burst errors when the received signal level fades and thereby reduce the concentration of errors that are applied to the channel decoder for correction. Channel code is used to protect data sent over it for storage and retrieval even in the presence of noise. Adaptive modulation system improve rate of transmission and bit error rates by exploring the channel information that is present at the transmitter. It exhibit great performance enhancements compared to systems that do not exploit channel knowledge at the transmitter. Antenna diversity is a method of improving the reliability of message signal by using two or more communication channels with different characteristics. Spread spectrum is a means of transmission in which signal occupies a bandwidth in excess of the minimum necessary to send the information. These techniques are used for a variety of reasons including the establishment of secure communications increasing resistance to natural interference, noise and jamming to prevent detection and limit to power flux density. By dynamic channel allocation we allocate bandwidth and communication channels to base station, access points and terminal equipments.

This work utilizes an array of techniques, with a modernization in the frequency-hopping domain where transmitting radio signals rapidly exchange a carrier among many frequency channels. In this paper we discuss the outcome of the GSM with frequency hopping, without frequency hopping and with dynamic frequency hopping. Frequency hopping has been utilized in GSM for ameliorating system capacity. GSM employ random or cyclical frequency hopping. Random frequency hopping , in blend of channel coding and interleaving, provides the benefits of frequency diversity and interference averaging Capacity improvements acquired by random frequency hopping in GSM are in the range of thirty to hundred percentage. Latest theoretical and simulation studies shows that substantial performance improvements can be obtained by enchanting advantage of the frequency hopping and dynamic frequency hopping. The key concept of DFH is to alter or build frequency hopping imitates based on interference dimensions and calculations, in order to avoid dominant interferers. Direct implementation of DFH involves rapid signal quality and path loss measurements, significant and interference avoidance techniques and synchronization between base stations. However, network-assisted resource allocation simplifies DFH deployment significantly and thereby makes it feasible.

II. Dynamic Frequency Hopping

Frequency hopping can introduce frequency diversity and interference diversity. It can be an effective technique for combating Rayleigh fading, reducing interleaving depth and associated delay, and enabling efficient frequency reuse in a multiple access communication system. The use of frequency hopping is the most important in GSM cellular. It includes randomly or cyclically frequency hopping which is suitable for providing robust communications links in frequency selective and interference limited channels. Random Frequency Hopping is the most ubiquitous frequency hopping technique in GSM system.

For generic cellular systems, where frequency reuse of one is used, shows that implementing interference avoidance on top of frequency hopping can result in considerable capacity improvements. This frequency hopping concept is called Dynamic Frequency hopping. The main idea of Dynamic Frequency Hopping incorporates a non-traditional Dynamic Channel Allocation (DCA) scheme with slow frequency hopping. The objective is to achieve capacity gains through interference avoidance that are larger than those provided by conventional frequency hopping, while retaining interference averaging characteristics of conventional frequency hopping to provide robustness to rapid changes in interference.

The idea behind this technique is to adjust or create frequency hopping patterns based on interference measurements. DFH uses slow frequency hopping and adaptively modifies the utilized frequency hoping pattern based on rapid frequency quality measurements. This technique combines traditional frequency hopping with DCA, where a channel is one frequency in a frequency hop pattern. The incessant modification of frequency hop patterns based on measurements represents an application of DCA to slow frequency hopping. However, only a few subsets of frequencies in the whole frequency hoping pattern are replaced by a better quality subset makes this a non-traditional DCA scheme. The modifications are based on rapid interference measurements and calculations of the quality of frequencies used in a system by all mobiles and base stations. The target of these modifications is tracking the dynamic behavior of the channel quality as well as of interference, and with the help of this information avoiding dominant interferers.

Frequency hop pattern modifications can also be based on the fixed wireless network calculating interference levels based on knowledge of path losses and channel occupancy, which we refer to as network-assisted resource management of the DFH based system. DFH requires continuous estimation and measurement of the interference at every frequency for every single hop of a pattern. At each hopping instant, the base station or the mobile terminal measures the quality of each frequency, filters the measurement to average out the instantaneous Rayleigh fading effects, and then sends the data using the best frequencies chosen according to some quality criterion. The most complex form of DFH is, relying on the measurement-based approach, requires substantial amounts of signaling overhead for communicating from a base station to its mobiles what frequency hop patterns need to be used in the ensuing time period. Reduced complexity schemes have been also proposed, which reduce measurement requirements and signaling overhead. For the sake of minimizing system instability and complexity, the number of hopping frequencies that change at every hop can be limited. There three methods are acknowledged for DFH pattern modification:

1. *Full-Replacement DFH:* It assumes altering all current frequencies of poor quality after each physical layer frame.

2. *Worst Dwell DFH:* There only one frequency (the lowest quality one) in a frequency-hop pattern is changed.

3. *Threshold (SIR) Based DFH:* - There a subset of currently used frequencies is changed.

Here, in this paper DFH based received power (Pr) is projected as one method of DFH and introduces an additional method to DFH techniques. In this proposed technique DFH based Pr , has minor complexity from another methods of DFH. In this technique a subset of presently used frequencies is altered. With this technique, the pattern change is done sparingly. In every frame, Pr is measured on the six used frequencies and the current hopping pattern is changed if the measured Pr does not attain the required threshold on at least one of them. Only the frequencies in deprived conditions are altered. Any frequency that meets the threshold can be used as a substitute, and there is thus no need to scan all feasible frequencies.

III. CALCULATION OF BLOCKING PROBABILITY

Blocking probability is the theoretical and statistical probability that a call connection cannot be established due to insufficient transmission resources or network resource congestion, calculated and sampled during busy hour. It is defined as the probability when the signal-to-interference ratio (SIR) plus noise ratio is less than a specified threshold. In this paper, the blocking probability is defined as the probability that a call is blocked and is a measure of the Grade of Service (GOS) and referred to as a lost call or failed call attempts.

We know that, traffic intensity is a measure of the average occupancy of a server or resource during a specified period of time, normally measured during busy hour. The traffic intensity offered by each user is equal to the call request rate combined with call holding time. That is, each user generates a traffic intensity of E Erlangs given by

$$E_u = \lambda T \quad \text{………..} (1)$$

where T is the average duration of a call and λ is the average number of call requests per unit time.

T is also known as " Mean Holding Time " For a system containing NU number of users and an unspecified number of channels, the total offered traffic intensity E, is given as

$$E = N_U E_u \quad \text{………} (2)$$

In addition, in a trunked system of C channel, if the traffic is evenly distributed among the channels, then the traffic intensity per channel is

$$E_{ch} = \frac{N_u E_u}{C} \quad \text{………}(3)$$

which is carried by the trunked system. The trunked system is typically a multiplex computer controlled system which uses a few channels and can have virtually unlimited simultaneous A Party to B Party connections.

The carried traffic becomes restricted due to the limited number of channels. The maximum possible carried traffic is the total and combined offered capacity of channels C, measured in Erlangs. Traffic can be assumed to be uniform for macro cells for theoretical purpose and for calculations. The new arrival call process is modeled as an independent Poisson process with a certain mean arrival rate. The new call durations are independent exponential arbitrary variables with a certain mean. The Erlang B Table is used to determine the probability when a call is really blocked and is measured of the GOS for trunking system, while discounting queuing for blocked calls.

$$P = \frac{\frac{E^C}{C!}}{\sum_{x=0}^{C} \frac{E^x}{x!}} = GOS \quad \text{………}(4)$$

IV. THE PROPAGATION MODEL

The propagation model is an empirical mathematical formulation for the characterization of radio wave propagation as a function of multiple random effects like frequency, distance and other conditions, attributed due to unpredictable change in the radio channel. The wide-area mean of the received power from a specified user is effectively described by a deterministic dependence of the received power on the distance between transmitter and receiver. The model is created with the goal of formalizing the way radio waves are propagated from one place to another, to predict the path loss along a link or effective coverage area of the transmitter. So, it predicts the average signal strength and its variability at a given distance from the transmitter. There are essentially three types of propagation model free space model, two way ground reflection model and shadowing model.

Free space radio wave propagation is the most basic model which assumes the ideal propagation that there is only one clear line of sight path between the transmitter and receiver. There radio waves originate from a point source of radio energy, dispersing in all directions in a straight line, filling the entire circular volume of space with radio energy that varies in strength with a 1/d2 rule, where d is the distance from the radio source. However, real world radio propagation rarely follows this simple model because of reasons like reflection, diffraction, scattering etc, radio channels change in a non-chronological way. Considerating these effects, following propagation model is used in this paper

$$P_r\ P_t \frac{G_r G_t}{P_L} X_\sigma \qquad \text{……………….(5)}$$

where

Pr : Received power

Pt : Transmit power

Gr : Antenna gain of the receiver.

Gt : Antenna gain of the transmitter.

PL : Average path loss which can be defined as

$$P_L = \left(\frac{4\pi f d_0}{v}\right)^2 \left(\frac{d_{tr}}{d_0}\right)^n \qquad \text{……….(6)}$$

Where

f : Carrier frequency

do : Close–in reference distance

v : Speed of light

dtr : Distance between the transmitter and the receiver antennas

n : Propagation exponent

Xσ : Log-normally distributed random variable with 0 dB mean, and σ dB standard deviation

This model represents the communication range as a circle around the transmitter. If a receiver is within the circle, it receives all packets otherwise it losses all packets.

V. Bandwidth Efficiency

With the exponential growth in wireless communication system worldwide , the radio spectrum available for the system has increasingly become more scare than past , with increased demand of frequency allocation of new entrants as well as by existing mobile operators , in order to withstand the ever increasing traffic , being generated by ever growing subscriber base. Bandwidth efficiency therefore becomes a major point of concerns while designing & redesigning a typical wireless voice and data communications system.

Technically, It refers to the information rate that can be transmitted over a given bandwidth in a specific communication system. It is a measure of how efficiently a limited frequency spectrum is utilized by the physical layer protocol and sometimes by the media access control. The efficient use of spectrum is achieved by the isolation obtained from antenna diversity, geographical shaping, time division etc.

However, though frequency reuse technique suggestively enable efficient use of the limited available spectrum, it also simultaneously rope in unavoidable co-channel interference (crosstalk from two different radio transmitters using the same frequency), which ultimately determines the bit error rates (BER's) available to each user. Thus, there need to bring in a balance between the system bandwidth efficiency, measured in [b/s] / [Hz m] or Erlangs / [Hz m], and the communication link quality, measured in terms of the BER provided to the users. Another way to increase bandwidth efficiency is the use of multi-level modulation, such as quadrature amplitude modulation (M-QAM). M-QAM conveys two analog message signals or two digital bit streams, by changing the amplitudes of two carrier waves, using the amplitude shift keying, and digital modulation scheme. It increases link bandwidth efficiency, which is the net bit rate or maximum throughput divided by bandwidth in Hz of a communication channel or a data link. It is measured in [b/s] / Hz, by sending multiple bits per symbol and is used to analyze the efficiency of a digital modulation method.

The bandwidth efficiency (BE) is measured in channels/km2/MHz and expressed as

$$BE = \frac{B_t/B_{ch}}{B_t N_c A_c} = \frac{1}{B_{ch} N_c A_c} \qquad \text{……….(7)}$$

where

Bt = Total bandwidth of the system available for voice channels (transmit or receive), in MHz

Bch = Bandwidth per voice channel in MHz

Nc = Number of cells per cluster

Ac = Area per cell in square kilometers

The definite number of users that can be supported, can be figured out, based on the offered Load (Lo) by each user and the number of channels per cell .

$$BE\ \frac{N_c \times B_t}{L_o} \qquad \text{……...(8)}$$

VI. Simulation Model

We use Matrix laboratory (MATLAB) program for designing model which helps to solve mathematical equations. Once the variables are entered to simulation program to complete environment of cellular design, the present model calculates the number of cells in cluster, number of channels in cell and number of users in system as proportional to area and desire environment design. The goal of this work is to design and implement software systems that increase bandwidth efficiency, by design optimum environment and using dynamic frequency hopping (DFH) technique, besides managing and controlling all the operations performance in a cellular network with high quality agreement with mobile system criteria. Following is the simulation flowcharts for DFH :

Now we calculate number of cells in each cluster (K). We know that, the frequencies allocated to the service are re-used in a regular pattern of areas, called cells, each covered by one base station. A typical group of cell location is characterized by a set of vector, values, band etc. A grouping of points in this multidimensional attribute space is referred as a cluster. Two locations belong to the same cluster if their attributes are similar. Depends on the type of region, there is a specified radius for each cell. The area of one cell is determined to find the number of cells in cluster as

$$K = \frac{\text{Total area}}{\text{Area of one cell}} \qquad \text{…………(9)}$$

The program calculates the cells number does compares results with standard values. If the calculated value is not loosely matched to the standard values, the program calculates new value of cells number after radius is increased and comparison is repeated. The process of calculation and comparison is repeated to reach optimum value of (K).

After this we calculate the Transmitted Power and height of transmitter antenna. By considering propagation model, the program calculates the transmitted power which is expressed as

$$P_t = \frac{P_r (4\pi . d_{tr})^2}{G_t G_r (\gamma)^2} \qquad \text{………………...(10)}$$

The received power in equation is standard value which makes handoff threshold at borders cell reached to optimum value. This ensures handoff threshold besides best radio coverage for all cell Regions and avoid call drops. Depends on received power at weak point received in cell and received power at borders cell and antenna height of mobile unit ,and transmitter power as calculated above (eq.10), it is possible to find height of transmitter antenna(ht)as

………. (11)

Finally, we calculate the number of channels for one cell (C). The number of channels per cell is derived based on mobile telephone switching center capability of processing and management of frequency (channels).The program of distributing the channels number to equal cells number is the first step, but in peak hour's state it depends on complex style for cells distribution. The number of channel per cell is a function of the total number of channel available, amount of available spectrum divided by channel bandwidth and the desired carrier to interference ratio. The formula for this factor is

………….. (12)

VII. Simulation Results

We compare threshold value of -117dB (-110 dB Ideal value; -7dB as tolerance), with the calculated value of received power (Pr). If the calculated value of Pr is greater than the threshold value, then the program takes next value from matrix for comparison with standard value, to be near ending of the matrix. But when Pr is less than the threshold the program blocks the frequency which generates Pr , hence new frequency is selected and the Pr is compared with threshold.

For systems using any kind of dynamic frequency hopping (DFH), the blocking probability is a bit different and given as follows; Mobile station (Ms) receives its signal over 96 time slots. Each six time slots make a frame, so a mobile station is monitored over 16 (96/6) time frames. The analyzed parameter, blocking probability, is the ratio of the number of the frames the (Ms) is in over the whole number of frames which is 16. The mobile station is considered to experience blockage in certain frame if in all the six time slots of that frame its (Pr) is less than the threshold value of (-117dB). Hence blocking probability takes values between 0% and 2%, which is the result of the robustness of frequency hopping systems against interference. Following figure 1 illustrates the sequence of frame and time slots.

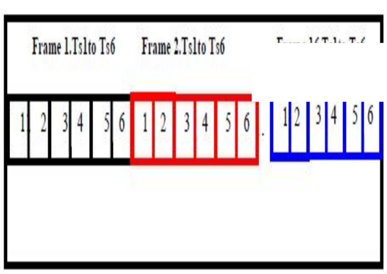

Fig 1 : Ms is monitored over 96time slots for FH system

It is enough for a frame to have at least one time slot with Pr above the threshold. A further performance criterion is simulated for systems which utilize variations of frequency hopping (FH). Figure 2 shows the ratio of weak frequency hops over the whole (FH) pattern of a user. If a hop has a Pr less than (-117dB), it is considered to be weak frequency hops.

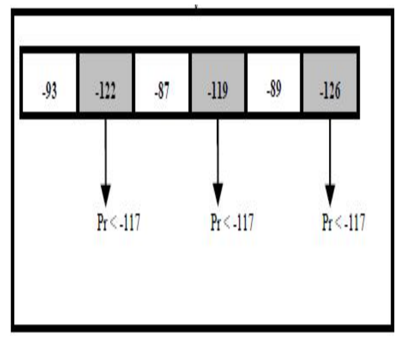

Fig 2: Weak frequency hops ratio

VIII. Call Blocking Probability

For a cellular network, the performance of call blocking probability is calculated using Erlang-B formula (equation 4). Call Blocking Probability is drawn versus the Carried Traffic (A) as shown in Figure (3). This figure presents a comparison of blocking probabilities in GSM systems with FH (FH), without FH (NFH) and with DFH (DFH).

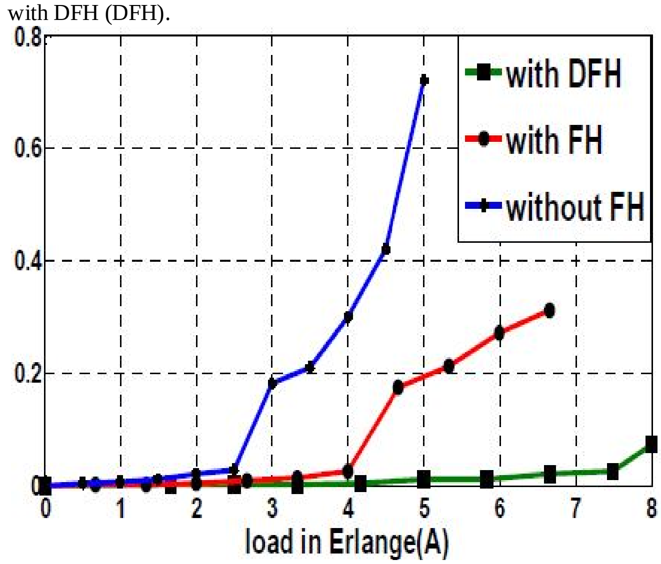

Fig 3 : Relation between blocking probability with the load in Erlang

From the above graph it can be easily concluded that the blocking probability of GSM-NFH at Load 1 is 0.0061 while the Blocking Probability of GSM-FH at the same load (load = 1) is equal to 0.002, and is less than GSM-NFH. Furthermore, the blocking probability is reduced significantly by applying DFH. With increased traffic load (load 3) , GSM-NFH reaches to blocking probability of 0.18, whereas blocking probability for GSM-FH is around 0.01 and for GSM-DFH , it is still 0.0 .

It is also evident that with increase in traffic load, the blocking probability for GSM-NFH increases exponentially, and for GSM-FM, it increases linearly till a threshold afterwards it increases exponentially. For GSM-DFH the blocking probability is (0) until loading (4), hence in GSM-DFH there is no user-perceived outage until a significant traffic loading of 4 and onwards.

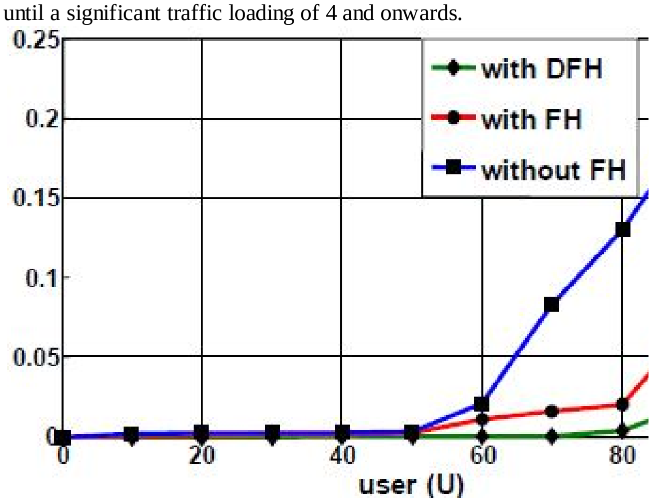

Fig 4: Relationship between blocking probability and user

From the Figure (4), it can be observed that with increase in the number of users the blocking probability almost follow the same pattern. This is because ultimately the users contribute towards traffic, which is explained in Figure (3) .

The blocking probability for GSM-NFH at User 60 is comparatively high (0.021) while with same count of users (60) , the blocking probability for a GSM-FH is 0.011 and is a bit less than GSM-NFH As such , the blocking probability is very low in DFH.

If we compare between the systems for a loading of 60 user ar users, GSM-NFH has a blocking probability of (0.083), where probability decreases to (0.016) for FH and (0.0) for DFH loading increases, blocking probability for GSM increases very while for FH this increase is considerably slow. For DFH blocking probability is (0) until users number (70), for DFH fro to (80). While improving the performance of a particular user assigned low-interference channel might have a severe interfe impact on another user though, in which case it would nc assigned to that second user. Typically for low users, both GSM and GSM-DFH perform very well.

IX. BANDWIDTH EFFICIENCY

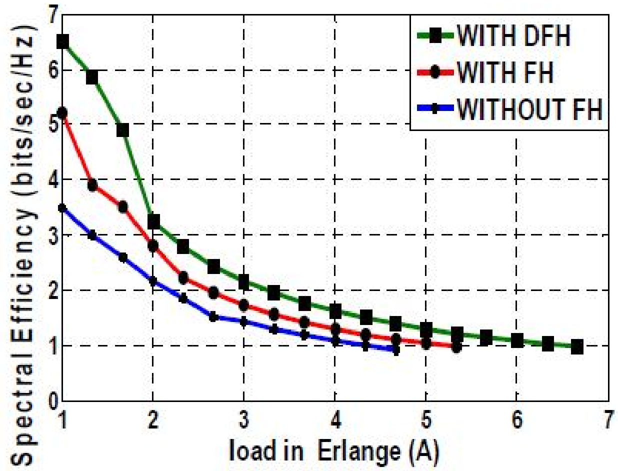

Fig 5: Relationship between bandwidth efficiency and load

Better traffic control and potentially increase the bandwidth efficiency due to reduced signaling traffic because the reduced co-channel & adjacent channel interference enable the users to have high call success rate and normal release of calls as shown in Figure 5. It presents the performances of GSM system, without FH (NFH), with FH, and with DFH. The performance of the GSM-DFH which is sidered as most adaptable system is almost the same as that of GSM-FH system. Another important result of Figure (5) is the improvement in the average user bandwidth efficiency and hence pitching-in the high data rate coverage. Although for low loading the difference in bandwidth efficiency is not much for load = 1, GSM-NFH (3.5 b/s/Hz), with FH (5.2 b/s/Hz), with DFH (6.5 b/s/Hz), and the results show that with the help of the relays better with heavy traffic for load = (2.15), GSM (NFH) (2.3 b/s/Hz), FH (2.8 b/s/Hz), DFH (3.2 b/s/Hz). At loading = 4, the bandwidth efficiency for DFH is higher than that of GSM NFH (1.1), and GSM FH (1.3). Following fig (6) shows the performance of bandwidth efficiency with reuse distance (radius (m)).

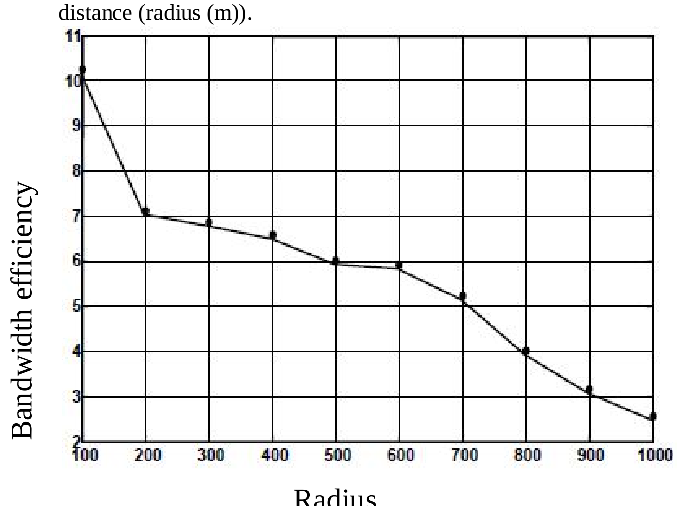

Fig 6 : Relationship between bandwidth efficiency and radius

The bandwidth efficiency is generally decreased by the increased reuse distance. From most appropriate value of bandwidth efficiency, the best possible value for reuse distance can be identified, and from the best possible reuse distance, the minimum value of interference can be calculated. From results shown in Figure (7) it is seen that the bandwidth efficiency increases, when the number of cell per cluster is decreasing. Actually, with less cells per cluster, the traffic load becomes less and since the number of user are less, it enables to increased bandwidth efficiency. The appropriate value of the number of cell in cluster causes reduces interference, since the reduced interference could allow the users to achieve higher call success rates.

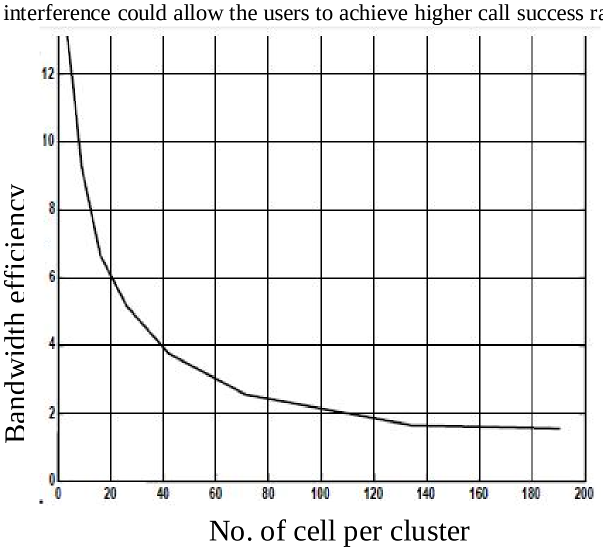

Fig 7: Relationship between bandwidth efficiency and no. of cells per cluster

X. RECEIVED POWER:

A. Received Power with Distance with FH :

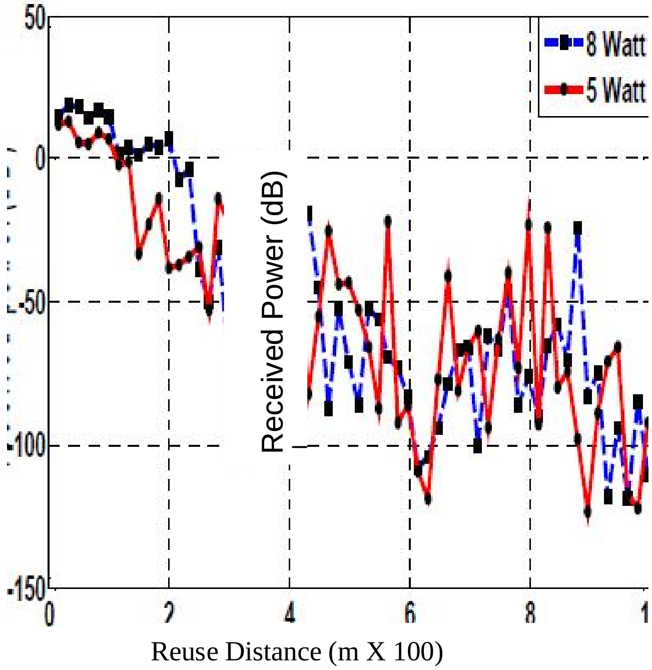

Fig 8 : Received power in dB depends on the transmitted power with reuse distance using FH techniques

The results shown in Figure (8) are obtained in a typical network of GSM with frequency hopping. In Figure (8) the transmitted power is (8 watts) the received signal power is good 0 to 240m. After 240m the level signal drops because of noise effect and losses due to environment, primarily physical obstruction, and vegetation, clutter, scattering & fading, to mention few reasons. At distance 930m the buzzing on call under threshold value is (-117 dB), the signal power records (-118dB). In 970m buzzing happens on call under threshold. In (5 watt) the signal power is good 0 to 130m. After 130m the level signal drops because of noise effect and losses of environment. At distance 630m the buzzing on call under threshold value is (-117 dB), the signal power records (-118dB). At 900m and 980m buzzing happens on call under threshold. The average drop call is decreasing because the information signals distribution is on six slots. When the noise has an effect on any slot the information is transmitted through another slot in TRX (Trans-receiver or simply called as transmitter).

B. Received Power with Distance in GSM without FH (NFH) :

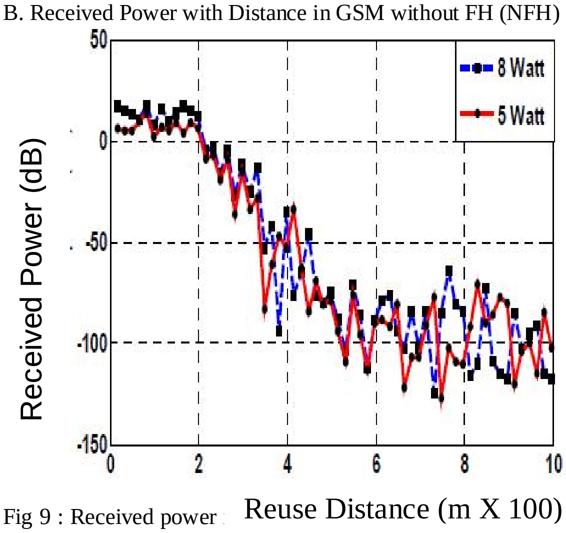

Fig 9 : Received power with reuse distance without using FH tech.

Received Power (dB)

Figure (9) shows the relation received power with distance in GSM. For transmitter power of 8 watt we have seen the received power is good at distance 0 to 200m. After 200m the received power decreases without call falling even at 730m , the call falls under threshold received power (-117 dB). The signal is decreased after 200m duo to the log normal noise effect and losses of environment. At 900m and 1000 m the call falls, the received power is (-118 dB) because effect of noise. In GSM-NFH the one carrier frequency carries information signal, any effect noise on the signal causes drop in level of signal under threshold. In transmitter power (5 watt) we have seen the received power is good at distance 0 to 200m. After 200m the received power is decreasing without call falling even at 670m the call falls under threshold received power (-117 dB). The signal is decreased after 200m due to the log normal noise effect. At 750m and 920m the call falls, the received power is (-118dB) because of effect noise.

C. Received Power with Distance with DFH :

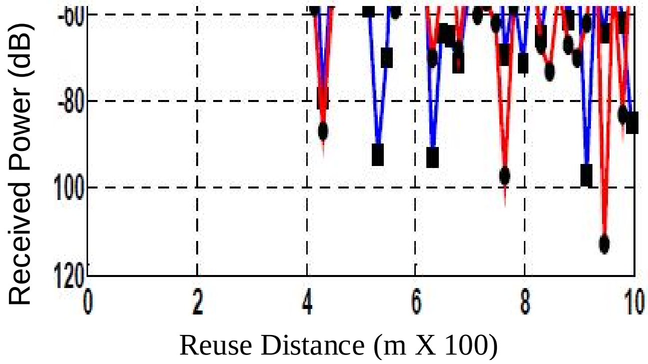

Fig 10 : Received power in dB depends on the transmitted power with reuse distance with DFH tech.

Figure (10) shows improvement in received power, we observe the received power does no exceed threshold level; it causes modification to any poor frequency by using new frequency at the same band before the call drops under threshold. In (8 watt) the received power is good 0 to 300m, after 300m the power drops under (-5dB), it causes noise effect and losses. We see after 300m the received power drops to (-20dB) at 350m, at 360m the power becomes (-45dB), remaining in swing case. In (5watt) Pr is good 0 to 200m, after 200m the signal is down – up without exceeding threshold (-117dB), even reaching (-117 dB) at 950m, causes path losses and noise effect occur.

XI. Ratio of Weak Frequency

A. Ratio of Weak Frequency Hops (with FH)

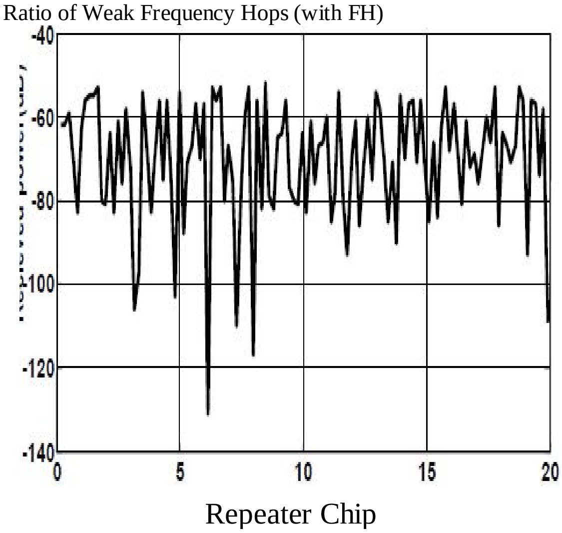

Fig 11. Relationship between received power in db and repeater c with FH

Figure (11) below illustrates the effect of using frequency hoppi chip (six slots) at the same environment. The user is stopping at same place (without change place or position), the chip is changed about 20m times, and we see the one call is dropped after sixth repeater. The value of (Pr) call is dropped to (-131dB), the frequency hopping technique avoids multi path or any other effects, because the information signal distribution is on sixth slot.

B. Ratio of Weak Frequency without FH

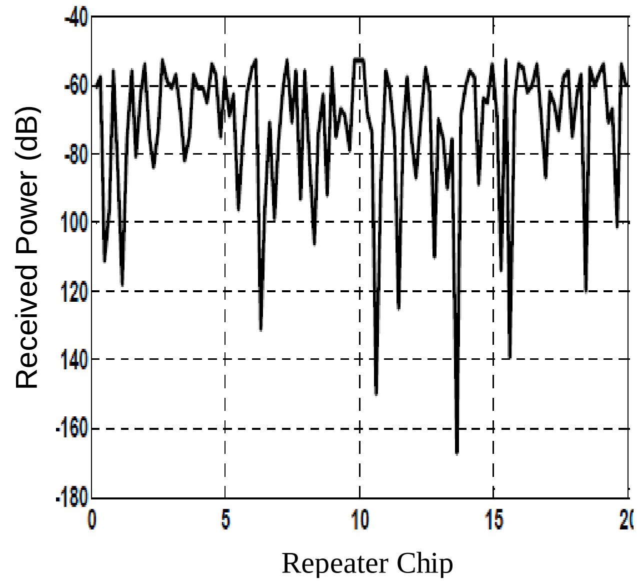

Fig 12. Relationship between received power in db and repeater chip without FH

Figure (12) shows the continuous call in the same place at the graph we observe dropping of the call at 7 times. The user is stopping at the same place (without moving). The call continues at the same environment about (20 times) and the number of fall of the call is observed. In GSM the information signal is carried over one carrier frequency, the first case is more exposed to noise effect and path losses, multi path. We see after first repeater appears first call falls, the value of Pr is (-118 dB), second call in sixth repeater the value is (-131dB), in tenth repeater the third call drop in value is (-150dB) and with eleventh repeaters the fourth call drop in value is (-125dB), other call drops in thirteen repeater the fifth fall in value is (-167dB) and fifteenth repeater the sixth call drops in value is (-139 dB) and eighteenth repeater the seventh call falls in value to (-120 dB).

C. Ratio of Weak Frequency Hops (with DFH)

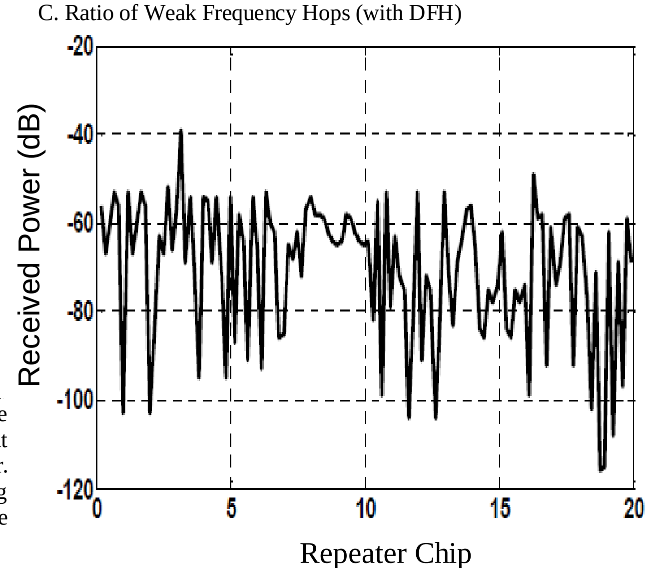

Fig 13. Relationship between received power in db and repeater chip with DFH

In Figure (13), it is clearly seen there is no drop in call due to using the (DFH) which increases the bandwidth efficiency and improves the blocking probability. The automatic modification replaces any weak frequency without drop in call, the distance between user and base station is about 300m in design. The improvement is made clear by using (DFH).

XII. CONCLUSION

The proposed system underscores the capability to reduce blocking probability & enable the mobile network to retain the strength of received signal power by end user.

As such, this paper devices a unique method that avoid or minimize any degradation on received signal power. The network performance is significantly improved by deploying DFH and it leads to reduced blocking probability quotient, major increase in bandwidth efficiency, optimum utilization of hardware & signaling resources, and end-user satisfaction

The comparative result of Bandwidth Efficiency is highest with DFH (6.5 b/s/Hz), while it is considerably good in FH (5.2 b/s/Hz) and average in NFH (3.5 b/s/Hz). Hence DFH leads to an overall improvement in system performance and reduces co-channel and adjacent channel interference , thus enable the end-users to experience better network offerings and very good call success rate as well as other paging based services like SMS , MMS , Data usage , etc . Blocking probability is reduced because of better handling of any drop in received signal level for call. While comparing all three techniques, the blocking probability increases very slowly with increasing the number of users in DFH, while in FH the blocking increases slowly at the beginning, but later gain momentum. In case of NFH, blocking probability increases very fast with increasing the number of users. The received power method gives better performance than other methods of DFH, because the speed of DFH/Pr process is faster than that of the other two methods by factor T/6 (where T is the processing time). Also The technique of DFH track the received signal level for initiating the handover process as and when required, in order to avoid possible call drop due to weakening of received signal. The network with least blocking probability is considered as best.

XIII. REFERENCES

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