Volume 3, Issue 8, August 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Minimization of Call Blocking Probabolity by Cell-Splitting Technique with the Help of Location Manager

Debabrata Sarddar , Ranjan Kumar Mondal
Department of Computer Science & Engineering,
University of Kalyani, Kalyani-741235, India

Uttam Kumar Kundu
Bengal College of Polytechnic,
Bidhan Nagar, Durgapur, India

Abstract: With higher requirement for communications and tremendous growth of mobile subscribers, maximizing bandwidth utilization in cell overlapping systems has been attracting much attention. This work develops an efficient channel allocation scheme based on cell splitting using location manager Technique. Besides, in order to improve the performance of channel allocation, it is preferred to allocate more channels to smaller cells (microcell) under a fixed channel capacity in an overlapping system. It also went further to show that increase in channel capacity directly reduces call blocking probability. The results are simulated and shown using Mat lab.

Key Words: Frequency reuse, cell splitting, channel, location manager.

I Introduction

For last few years handoff becomes a burning issue in wireless communication. Every base station has a limited channels (numbered 1 to 14) are spaced by 5MHz with a bandwidth of 22MHz, 11MHz above and below the centre of the channel. In addition there is a guard band of 1MHz at the base to accommodate out-of-band emissions below 2.4GHz. Thus a transmitter set at channel one transmits signal from 2.401GHz to 2.423GHz and so on to give the standard channel frequency distribution. Many dynamic allocations of channel have been proposed by different authors and all these mechanisms will improve the performance of wireless network. However for practical reason channel allocation is done in a static manner.

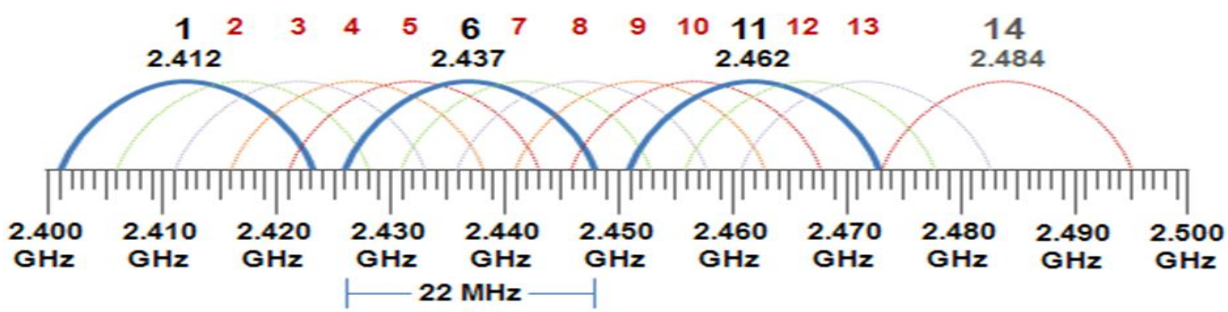

Figure1.Channel distribution

Channel allocation refers to division of a given radio spectrum into a set of disjoint channels, which can be used simultaneously while minimizing interference in adjacent channels by good channel separation. There are three ways in which channel allocation is mainly done. They are:

A) Fixed Channel Allocation scheme
B) Dynamic Channel Allocation scheme
C) Hybrid Channel Allocation scheme

Fixed *Channel* Allocation: Here, a set of channels is permanently allocated to each cell of the system. It has certain advantages like maximum channel reusability, low computational effort required and low call setup delay. It performs better under heavy traffic. However, it has low flexibility in channel assignment and high forced call termination probability.

In Fixed Channel Allocation or Fixed Channel Assignment (FCA) each cell is given a predetermined set of frequency channels. FCA requires manual frequency planning, which is an arduous task in TDMA and FDMA based systems, since such systems are highly sensitive to co-channel interference from nearby cells that are reusing the same channel. Another drawback with TDMA and FDMA systems with FCA is that the number of channels in the cell remains constant irrespective of the number of customers in that cell. This result in traffic congestion and some calls being lost when traffic gets heavy in some cells, and idle capacity in other cells. If FCA is combined with conventional FDMA and perhaps or TDMA, a fixed number of voice channels can be transferred over the cell. A new call can only be connected by an unused channel. If all the channels are occupied than the new call is blocked in this system. There are however several dynamic radio-resource management schemes that can be combined with FCA. A simple form is traffic-adaptive handover threshold, implying that calls from cell phones situated in the overlap between two adjacent cells can be forced to make handover to the cell with lowest load for the moment. If FCA is combined with spread spectrum, the maximum number of channels is not fixed in theory, but in practice a maximum limit is applied, since too many calls would cause too high co-channel interference level, causing the quality to be problematic.

Dynamic Channel Allocation*:*

Here, all free channels are allocated to a central pool. As new calls arrive in the system, channels are allocated dynamically to complete these calls. When the call is completed, the channel currently being used is returned to the central pool. A more efficient way of channel allocation would be Dynamic Channel Allocation or Dynamic Channel Assignment (DCA) in which voice channel are not allocated to cell permanently, instead for every call request base station request channel from MSC. The channel is allocated following an algorithm which accounts likelihood of future blocking within the cell. It requires the MSC to collect real time data on channel occupancy, traffic distribution and Radio Signal Strength Indications (RSSI). DCA schemes are suggested for TDMA/FDMA based cellular systems such as GSM, but are currently not used in any products.

DCA and DFS eliminate the tedious manual frequency planning work. DCA also handles bursty cell traffic and utilizes the cellular radio resources more efficiently. DCA allows the number of channels in a cell to vary with the traffic load, hence increasing channel capacity with little costs. Dynamic Channel Allocation may be of two types:

i. Centralized Dynamic Channel Allocation:

Here, the first free channel that satisfies the reuse distance is selected. For a given reuse distance, all the cells that satisfy minimum reuse distance are termed co-channel cells. When a cell needs to support a new call, a free channel is selected so as to maximize the number of members in the co-channel set.

ii. ***Distributed Dynamic Channel Allocation:***

They are primarily based on three factors: co-channel distance, signal strength measurement and signal-to-noise interference ratio.

Hybrid Channel Allocation:

Each cell is exclusively allotted a fixed number of channels. Thus a proper channel distribution is required to perform the handoff successfully.

Hybrid Channel Allocation schemes are a combination of fixed and Dynamic Channel Allocation schemes, with the traffic channels divided into fixed and dynamic sets. This means that each cell is given a fixed number of channels that is exclusively used by the cell. A request for a channel from the dynamic set is initiated only when a cell has exhausted using all channels in the fixed set. A channel from the dynamic set can be selected by employing any of the Dynamic Channel Allocation schemes.

A Handoff:

When a MS moves out of reach of its current AP it must be reconnected to a new AP to continue its operation. The search for a new AP and subsequent registration under it constitute the handoff process which takes enough time (called handoff latency) to interfere with proper functioning of many applications

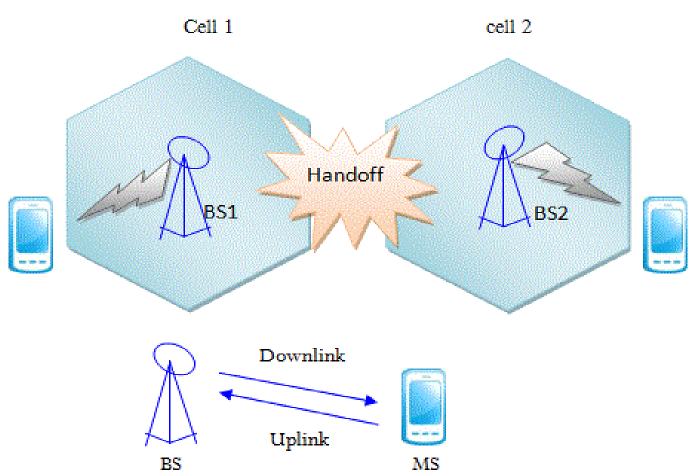

Figure 2: Handoff process

Three strategies have been proposed to detect the need for hand off[1]:

Mobile-controlled-handoff (MCHO): The mobile station (MS) continuously monitors the signals of the surrounding base stations (BS) and initiates the hand off process when some handoff criteria are met. In mobile-controlled handoff, each MS is completely in control of the handoff process. This type of handoff has a short reaction time (on the order of 0.1 second). MS measures the signal strengths from surrounding BSs and interference levels on all channels. A handoff can be initiated if the signal strength of the serving BS is lower than that of another BS by a certain threshold. Network-controlled-handoff (NCHO): The surrounding BSs measure the signal from the MS and the network initiates the handoff process when some handoff criteria are met. In a network-controlled handoff protocol, the network makes a handoff decision based on the measurements of the MSs at a number of BSs. In general, the handoff transmission, channel switching, and network switching) takes 100–200 ms. Information about the signal quality for all users is available at a single point in the network that facilitates appropriate resource allocation. Network-controlled handoff is used in first-generation analog systems such as AMPS (advanced mobile phone system), TACS (total access communication system), and NMT (advanced mobile phone system).

Mobile-assisted-handoff (MAHO): The network asks the MS to measure the signal from the surrounding BSs. The network makes the handoff decision based on reports from the MS. In a mobile-assisted handoff process, the MS makes measurements and the network makes the decision. In the circuit-switched GSM (global system mobile), the BS controller (BSC) is in charge of the radio interface management. This mainly means allocation and release of radio channels and handoff management. The handoff time between handoff decision and execution in such a circuit-switched GSM is approximately 1 second.

Handoff can be of many types:

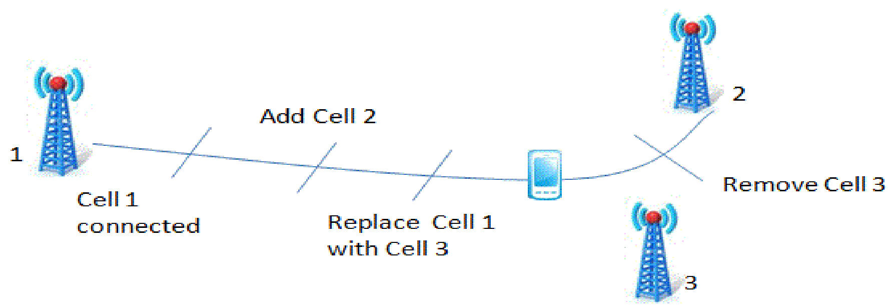

Figure 3: Soft handover scenario.

Hard handoff:

Hard handover means that all the old radio links in the UE are removed before the new radio links are established. Hard handover can be seamless or non-seamless. Seamless hard handover means that the handover is not perceptible to the user. In practice a handover that requires a change of the carrier frequency (inter-frequency handover) is always performed as hard handover.

Soft handoff:

Soft handover means that the radio links are added and removed in a way that the UE always keeps at least one radio link to the UTRAN. Soft handover is performed by means of macro diversity, which refers to the condition that several radio links are active at the same time. Normally soft handover can be used when cells operated on the same frequency are changed.

Softer handoff:

Softer handover is a special case of soft handover where the radio links that are added and removed belong to the same Node B (i.e. the site of co-located base stations from which several sector-cells are served). In softer handover, macro diversity with maximum ratio combining can be performed in the Node B, whereas generally in soft handover on the downlink, macro diversity with selection combining is applied.

The rest of the paper is organized as follow:

In the second section we have described the related works. In the third section we have described the details of proposed method. The simulation results of related cell splitting technique using location manager method in section four. In the next section we conclude the whole paper and finally a future work is mention regarding this paper in section six.

II Related Works:

The MS downloads from the server the data which not only contains the neighbor of the AP on which it is presently operating, but also the channels used by the neighboring APs. However the MS must wait for min channel time or max channel time as the MS does not know how many APs would respond to the probe request. So here we use unicast instead of broadcast which selects the potential APs to which the call may be handed off and scans only the channels associated with those APs. Selective channel probing with the help of unicast instead of broadcast brilliantly reduces the handoff delay by a massive percentage when compared with selective scanning or basic active scanning. Moreover, it was also stated that the MS has to wait for only the 'round trip time' (rtt) for scanning each channel instead of the min channel time or the max channel time. We know that IEEE uses 11 out of the 14 possible channels, out of which 1, 6 and 11 are mutually non-overlapping. When the MS responds to handoff, according to the pre-scanning mechanism of NG, it first looks for the potential AP and then scans the channels 1, 6 and 11 if present. If this fails, it will start scanning the other channels. As proposed in [3], the expected scanning delay using selective scanning is $t = N' \times \tau + \alpha$,

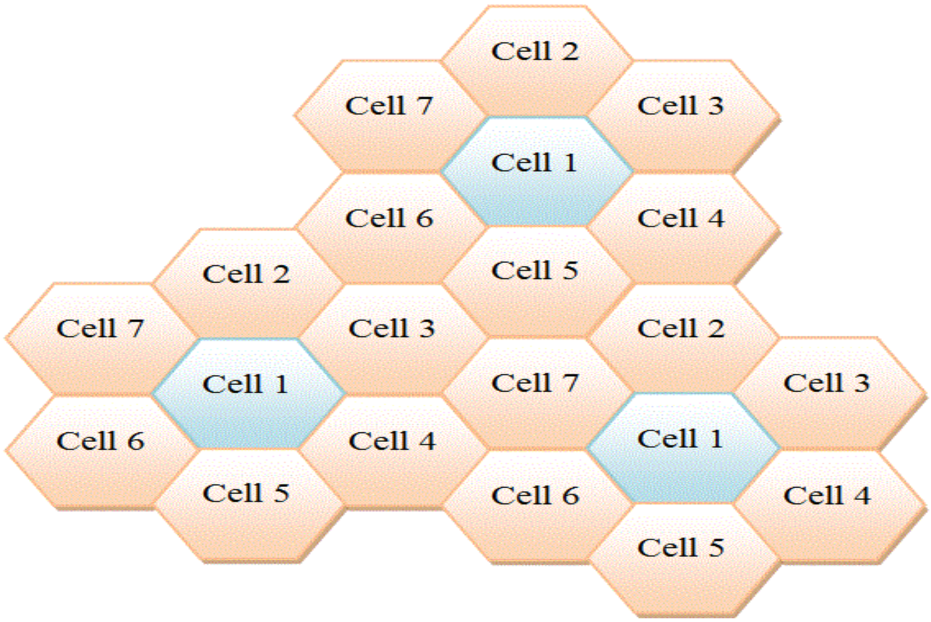

Figure 4: Diagram Representing cells that can use the same frequency channel.

Where 't' is the scanning delay, N' is the number of channels scanned, 'τ' is the round trip time and α is the message processing time. 'τ' is the summation of the time taken for the Probe Request to be sent to the selected APs and for the Probe Response to be received, which, in our case, is nothing but the Min Channel Time, which has been estimated to be around 3-7 ms.

Frequency reuse

The increased capacity in a cellular network, comparing to a network with a single transmitter, comes from the fact that the same radio frequency can be reused in a different area for a completely different transmission. If there is a single plain transmitter, only one transmission can be used on any given frequency. Unfortunately, there is inevitably some level of interference from the signal from the other cells which use the same frequency. This means that, in a standard FDMA system, there must be at least a one cell gap between cells which reuse the same frequency. The frequency reuse factor is the rate at which the same frequency can be used in the network. It is 1/n where n is the number of cells which cannot use a frequency for transmission. Code division multiple access based systems use a wider frequency band to achieve the same rate of transmission as FDMA, but this is compensated for by the ability to use a frequency reuse factor of 1. In other words, every cell uses the same frequency and the different systems are separated by codes rather than frequencies.

Frequency Division Multiple Access

Frequency Division Multiple Access or FDMA is a channel access method used in multiple access protocols as a channelization protocol. FDMA gives users an individual allocation of one or several frequency bands, or channels. It is particularly commonplace in satellite communication. FDMA, like other Multiple Access systems, coordinates access between multiple users. Alternatives include TDMA, CDMA, or SDMA. These protocols are utilized differently, at different levels of the theoretical OSI model. Each user transmits and receives at different frequencies as each user gets a unique frequency slot FDMA is distinct from frequency division duplexing (FDD). While FDMA allows multiple users simultaneous access to a transmission system, FDD refers to how the radio channel is shared between the uplink and downlink (for instance, the traffic going back and forth between a mobile phone and a mobile phone base station).

FDMA also supports demand assignment in addition to fixed assignment. Demand assignment allows all users apparently continuous access of the radio spectrum by assigning carrier frequencies on a temporary basis using a statistical assignment process.

There are two main techniques:

Multi-channel per-carrier (MCPC)

Single-channel per-carrier (SCPC)

Time division multiple access

Time division multiple access (TDMA) is a channel access method for shared medium networks. It allows several users to share the same frequency channel by dividing the signal into different time slots. The users transmit in rapid succession, one after the other, each using its own time slot. This allows multiple stations to share the same transmission medium (e.g. radio frequency channel) while using only a part of its channel capacity.

TDMA is a type of Time-division multiplexing, with the special point that instead of having one transmitter connected to one receiver, there are multiple transmitters. In the case of the uplink from a mobile phone to a base station this becomes particularly difficult because the mobile phone can move around and vary the timing advance required to make its transmission match the gap in transmission from its peers.

Space-Division Multiple Access (SDMA) is a channel access method based on creating parallel spatial pipes next to higher capacity pipes through spatial multiplexing and/or diversity, by which it is able to offer superior performance in radio multiple access communication systems. In traditional mobile cellular network systems, the base station has no information on the position of the mobile units within the cell and radiates the signal in all directions within the cell in order to provide radio coverage. These results in wasting power on transmissions when there are no mobile units to reach, in addition to causing interference for adjacent cells using the same frequency, so called co-channel cells. Likewise, in reception, the antenna receives signals coming from all directions including noise and interference signals. By using smart antenna technology and differing spatial locations of mobile units within the cell, space-division multiple access techniques offer attractive performance enhancements. The radiation pattern of the base station, both in transmission and reception, is adapted to each user to obtain highest gain in the direction of that user. This is often done using phased array techniques.

In GSM cellular networks, the base station is aware of the mobile phone's position by use of a technique called "timing advance" (TA). The Base Transceiver Station (BTS) can determine how distant the Mobile Station (MS) is by interpreting the reported TA. This information, along with other parameters, can then be used to power down the BTS or MS, if a power control feature is implemented in the network. The power control in either BTS or MS is implemented in most modern networks, especially on the MS, as this ensures a better battery life for the MS and thus a better user experience (in that the need to charge the battery becomes less frequent). This is why it may actually be safer to have a BTS close to you as your MS will be powered down as much as possible.

Advanced Mobile Phone System (AMPS) was an analog mobile phone system standard developed by Bell Labs, and officially introduced in the Americas in 1983, Israel in 1986, and Australia in 1987. It was the primary analog mobile phone system in North America (and other locales) through the 1980s and into the 2000s. As of February 18, 2008, carriers in the United States were no longer required to support AMPS and companies such as AT&T and Verizon have discontinued this service permanently. AMPS was discontinued in Australia in September 2000.

III. Proposed work:

As the demand for wireless service increases, the number of channels assigned to a cell eventually becomes insufficient to support the required number of users. In our proposed work increasing channel capacity using cell splitting. If we make a simplistic assumption that MS uniformly distributed in each cell, we can also say that the probability a channel being available in a new cell area depends on the number of channel per unit area. It can easily observe that the number of channels-area increase if the number of channel allocated per cell area increased. The radio resource and hence the number of assigned channel are limited and may not be change to be extent. However, the cell coverage area could be decreased for given number of channels per cells. This leads to smaller cell size and availability of free channel increase and then we allocate free channel using location manager based on call coverage area, duration etc.

III.1 Cell Splitting:

Cell splitting is the process of subdividing a congested cell into smaller cells, each with its own base station and a corresponding reduction in antenna height and transmitter power. Cell splitting increases the capacity of a cellular system since it increases the number of times that channels are reused. By defining new cells which have a smaller radius than the original cells and by installing these smaller cells (called microcells) between the existing cells, capacity increases due to the additional number of channels per unit area [8]. The consequence of the cell splitting is that the frequency assignment has to be done again, which affects the neighboring cells. It also increases the handoff rate because the cells are now smaller and a mobile is likely to cross cell boundaries more often compared with the case when the cells are big. Because of altered signaling conditions, this also affects the traffic in control channels [9].A typical example of cell splitting is shown in Figure 5. Here, it is assumed that the cell cluster is congested and as a result, the call blocking probability has risen above an acceptable level. Imagine if every cell in the cluster was reduced in such a way that the radius, R of every cell was cut in half, (R/2). In order to cover the entire service area with smaller cells, approximately four times as many cells would be required. The increased number of cells would increase the number of clusters over the coverage region, which in turn would increase the number of channels, and thus capacity, in the coverage area. In the example shown in Figure5, the smaller cells were added in such a way as to preserve the frequency reuse plan of the system. In this case, the radius of each new microcell is half that of the original cell.

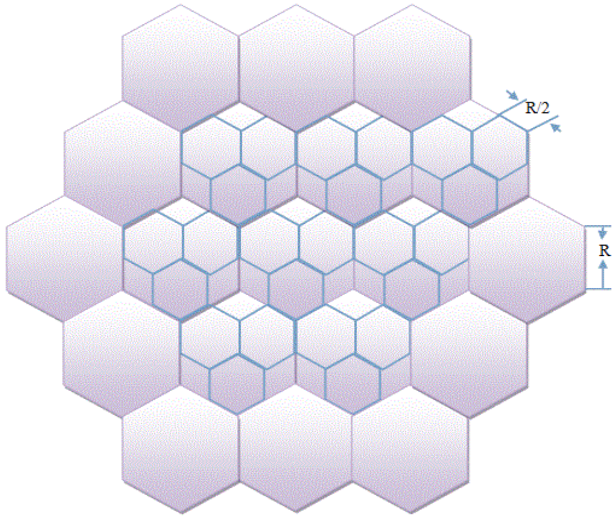

Figure 5: structure of microcell.

Each cell in a cluster is split into approximately four smaller cells by reducing R by half.

For the new cells to be smaller in size, the transmit power of these cells must be reduced. The transmit power of the new cells with radius half that of the original cells can be found by examining the received power, Pr, at the new and old cell boundaries and setting them equal to each other. This is necessary to ensure that the frequency reuse plan for the new microcells behaves exactly as for the original cells. For Figure 2, Pr[old cell]Pt1 (1) and P[new cell]Pt2 (2) where Pt1 and Pt2 are the transmit powers of the larger and smaller cell base stations, respectively, and *n* is the path loss exponent. If we take *n* = 4 and set the received powers equal (that is, assume perfect power control) to each other, then Pt2=Pt1/16 (3) In other words, the transmit power must be reduced by 12 dB in order to fill in the original coverage area with microcells, while maintaining the *S*/*I* requirement [2].

III.2 Algorithm:

1. Location manager is activated.
2. After the call setup start scanning.

IF it find free channel allocation channel corresponding cell Handoff complete.

ELSE

Stop scanning go to Location manager and find the free channel Using location Manager Based on call duration, Signal Strength, Coverage area etc.

Find free channel and allocated the channel.

3. Stop.

Flowchart:

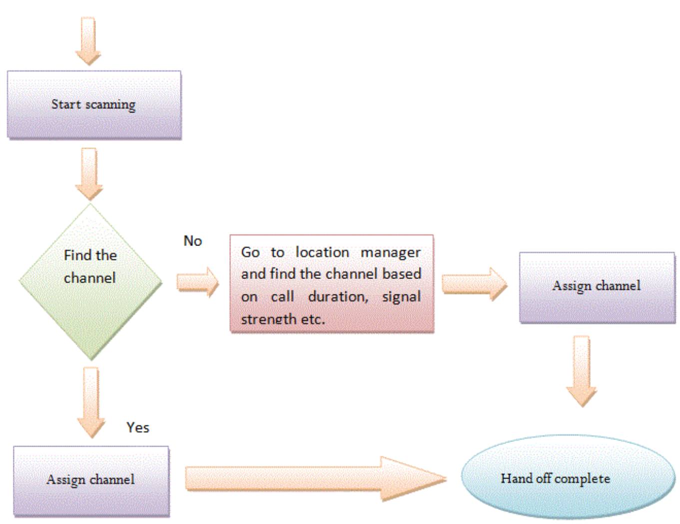

Figure 6:

IV. Simulation Result:

S/no	Parameter	value
1	Cluster(k)	7
2	Total traffic Load	500
3	Signal to interference ratio(s/i)	18.99db

Table 1

The probability that a new call is blocked given by the Erlang B formula was evaluated for different value of channels in ascending order using Matlab. The corresponding values of call blocking probabilities are tabulated against the number of channels as shown below in table 2.

Sl no	Blocking probability	No of channel
1	0.9601	20
2	0.9002	30
3	0.8603	70
4	0.8054	100

Table2

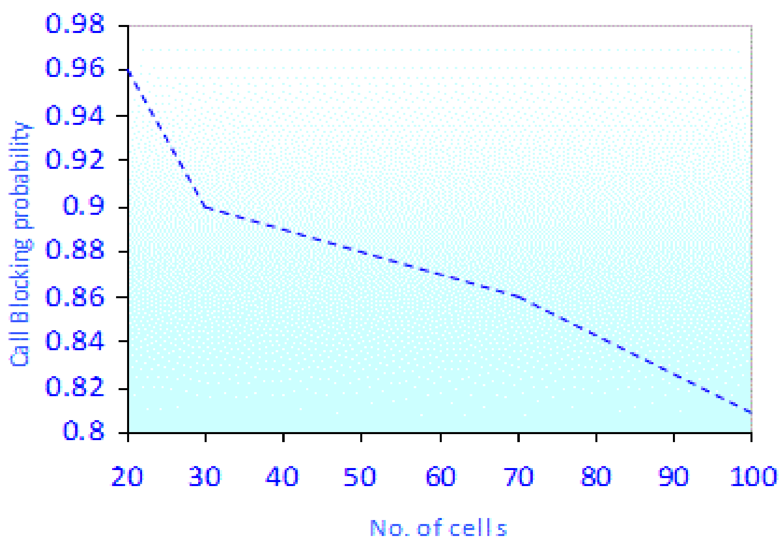

Figure7: Graph of blocking probability against no of channel.

The probability that a new call is blocked represented as Pr[blocked] is plotted against channel capacity in Figure7. The result shows that as the channel capacity increases, the call blocking probability Pr[blocked] reduces until a point when it becomes constant. Figure 4 proves that more calls is allowed in the system as the channel capacity increases.

V. Conclusion:

In conclusion, the capacity of a cellular communication system can be increased using cell splitting. The increment in channel capacity after cell splitting helps to reduce the call blocking probability. The results show that when properly and orderly carried out, the cell splitting technique has the capability of increasing the capacity of a congested cellular system.

VI. Future Works:

In our future work, we will try to find how to increase the channel capacity using genetic algorithm based approach.

REFERENCES

[1]. HSooKimet.al.*'Selective Channel Scanning for Fast Handoff in Wireless LAN Using Neighborgraph'* Japan,July2004.InternationalTechnicalConferenceonCircuits/SystemsComputersandCommunication.

[2]. CShengLiet.al.'*A Neighbor Caching Mechanism for Handoff in IEEE802.11Wireless networks*'Springer 20 March 2008,DOI10.1007/s11227-008-0175-3.

[3]. Minho Shin, Arunesh Mitra and William A. Arbaugh. *'Improving the latency of 802.11 handoffs using neighbour graphs. In Mobisys'* proceedings of the 2nd international conference on mobile systems, applications and services,pages 70-83, New York,USA,2004. ACM press.

[4]. Chung-Sheng Li et.al. *'A neighbor caching mechanism for handoff in IEEE 802.11 Wireless networks.'* Springer 20 March 2008,DOI 10.1007/s11227-008-0175-3.

[5]. Kazunori O. and Fumito K., *"On Dynamic Channel Assignment in Cellular Mobile Radio Systems"*, IEEE International Symposium on Circuits and Systems, 1991, 2:938-941.

[6]. Scott Jordan and Asad Khan, *"Optimal Dynamic Allocation in Cellular Systems"*, IEEE Transactions on Vehicular Technology, 42 (2), 1994, pp. 689-697.

[7] Chao-Wen Lin, *'Scheduling in a Multi-Sector Wireless Cell'*, University of Waterloo, Ontario, Canada, 2009.

[8]. Sara Bavarian, *'Symbol by Symbol Soft-input Soft-output Multiuser Detection for Frequency Selective MIMO Channels'*, Simon Fraser University fall, 2008.

[9]. D. Grace, C. Spillard, and T.C. Tozer, *"High Altitude Platform Resource ManagementStrategies with improved Connection AdmissionControl"*, Wireless Personal Mobile Conference -Japan, September 2003.

[10] *"Displacement of a High Altitude Platform on Cellular Interference and Handover"*, Submitted to IEEE Transactions on WirelessCommunications, May 2003.

[11] J. Thornton, D. Grace, M. H. Capstick, T. C.Tozer, *"Optimising an Array of Antennas for Cellular Coverage from a High AltitudePlatform"*, IEEE Transactions on WirelessCommunications, vol. 2, no. 3, May 2003.

[12] D. Everitt, *"Traffic Capacity of Cellular Mobile Communications Systems"*, Comp. NetworksISDN Sys., vol. 20, 1990, pp. 447-454.

[13]. T. Fujii, *"Selective Handover for Traffic Balancein Mobile Communications"*, Proc. IEEE /Supercomm / ICC' 92, vol. 4 1992, pp. 212.3.1-212.3.7

[14] V. H. Mac Donald, *'The Cellular Concept'*, The Bell Technical Journal, Vol. 58, No. 1, January 2008.

[15] Nasıf Ekiz, Tara Salih, Sibel Küçüköner, and Kemal Fidanboylu, *'An Overview of Handoff Techniques in Cellular Networks'*, World Academy of Science, Engineering and Technology , 2005.

AUTHORS PROFILE:

Mr **Debabrata Sarddar,** Assistant Professor in the Department of Computer Science and Engineering, University of Kalyani, Kalyani,Nadia, West Bengal, INDIA. He has done PhD at Jadavpur University. He completed his M.Tech in Computer Science & Engineering from DAVV, Indore in 2006, and his B.E in Computer Science & Engineering from NIT, Durgapur in 2001. He has published more than 75 research papers in different journals and conferences. His research interest includes wireless and mobile system, Cloud computing, Satellite communication and WSN.

Ranjan Kumar Mondal received his B.Tech in Computer Science and Engineering from Government College of Engineering and Textile technology, Berhampore, Murshidabad, West Bengal under West Bengal University of Technology. At present, he is studying M.Tech in Computer Science and Engineering from University of Kalyani. His research interest includes wireless and mobile communication systems.

Uttam Kumar kundu Completed his M.Tech in ECE from WBUT in 2010 and B-Tech in E.I.E from JIS College of engineering and technology under West Bengal University of Technology in 2006. His research interest includes wireless communication and satellite communication.

