Methods to improve cell efficiency in wireless communication: A Review

Sapana S. Suryawanshi
Electronics and Telecommunication
SSIET, Maharashtra.
India.

***Abstract*— Now a day, the use of wireless communication is becoming extremely high. Due to this, the number of users in this field goes on increasing rapidly. As the users of wireless communication goes on increasing regularly, this field becomes crowded and there occurs different problems like Call drops, Reduction in cell efficiency with respect to the communication. To avoid these kinds of problems, different methods are used. The paper presents several techniques proposed by some authors to improve Cell efficiency.**

***Keywords*— Frequency Reuse, Cell Capacity, Cell Splitting, Cell Sectoring, Microcell Zone Concept, Range Repeaters.**

I. INTRODUCTION

Communication means exchanging ideas, thoughts, messages, informations etc. either by speech, by writing, signals or by behavior. Communication is the word which is derived from Latin word "communis", which means "to share". For the process of communication there is necessity of sender, message and receiver. There is no need that the receiver is present at the senders end. Also, it's not necessary that the receiver must be aware of the communication process. So, the process of communication occurs in larger distances also. The process completes when the receiver gets or understood the message sent by the sender.

Wireless communication is the fastest increasing part of communication industry. There is large growth over the last decade and there are approximately 2 billion users of wireless communication in world. The wireless communication network is replaced wired communication network in many industries, homes etc.

The concept of mobile or wireless communication was first developed by the Bell Laboratories in 1960s and 1970s.Then in 1970s with the development of highly reliable, small size solid state radio frequency hardware the wireless communication became practically possible. Up to 1980s there is large penetration of mobile in market. However, in the last 10 years the market penetration rate of wireless communication is extremely high.

The wireless communication uses the particular frequency spectrum to work. This range is 800 MHZ to 900 MHZ. If we use wireless communication devices outside this range then that area will becomes so crowded. Therefore, it's necessary to use the available spectrum efficiently. So that to do this task we use different techniques like Frequency Reuse. Also there are different problems occurs while using wireless communication, such as Call Drops problems. These problems occur due to Traffic, coverage area, handoff etc. [6]. To resolve them we may optimize some solutions like Cell Splitting, Cell Sectoring, Microcell zone concept or Use of Repeaters. Whenever we may use these methods, there occurs some changes in the coverage and cell capacity.

A. Frequency Reuse

Any Cellular system consists of mobile station, base station and mobile switching center. Mobile station is the movable station in wireless communication. The base station is a fixed station which provides the signals to the mobile station, Cell is the geographical area covered by the base station. The shape of each cell is hexagonal. The group of cells is known as Cluster. The size of Cluster is denoted by letter 'N'. Frequency Reuse is the technique used in wireless communication between two different cells. When the two different cells uses the same set of frequency, the process is known as "Frequency Reuse". As shown in figure 1 the cells having same colour, uses the same frequencies. Such cells are known as co-channel cells. In wireless communication, frequency reuse is the very important concept. Cell performance is depends on frequency reuse concept.

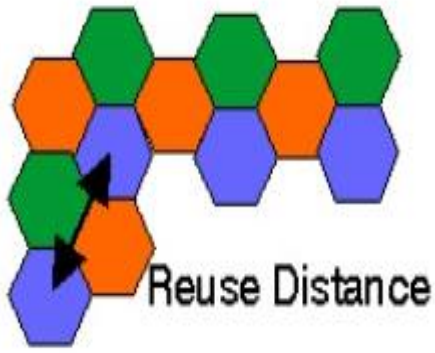


Figure 1. Frequency reuse

II. LITERATURE REVIEW

In [1], the author says about CDMA system and provides for the appropriate way of enhancing the cellular capacity with the enhanced cell capacity will go a long way in giving more mobile users access to network by using available static resource spectrum (channels). The cell sectoring technique utilizes the directional antenna system to decrease the number of interfering users so that co-channel interference which is major factor in CDMA system is drastically reduced for optimum channel usage.

In [2], the author analyze the performance of CDMA system in telecommunication by using cell splitting technique

to divide a large macro cell into micro or pico or femto cells. They have calculated the processing gain, number of users requesting for service within each type of cell, user-transmitted in-band signal power to achieve desired Signal to Noise Ratio, probability that a call attempt fails and also compared the results by simulating their equations using simulation software.

In [3], the author says that in GSM system the main concern is coverage area because of increase in GSM users. The traffic on a network system also increases, which causes problem of allocated spectrum. Also, the problem of inefficient coverage area occurs. Hence, for rise of efficient coverage there are methods like, Cell Splitting and Cell Sectoring technique. The author presents a comparative study on Cell Splitting and Cell Sectoring, so that they found a method to improve cell efficiency.

In [4], the author proposes TDMA based channel allocation in high load environment. They evaluated the efficiency for dropping probability for handoff calls in busy traffic conditions. They applied bandwidth window, in which the bandwidth window changes its size according to change in network traffic conditions. With this solution higher priority handoff call will get requested bandwidth, lower priority handoff call will get minimum bandwidth and probability of dropping of handover calls is reduced to minimum. More number of users can be connected to network and service provider could generate more output.

In [5], the author proposes the solution of reducing call drop in wireless communication by using multiple input and multiple output antenna. Call drop problem in wireless communication directly affects the customer need. The multiple reasons behind the call drop is handoff failure call drops, Link Access Protocol on D-channel call drops and the radio frequency call drops. These are all general type of call drops occurring during the processing of calls in wireless communication. A new approach to solve such problems of call drops has been discussed by using MIMO antenna.

In [6], the author focuses on the details the experiences and technical issues occurred in use of mobile handheld devices.

In [7], the author proposes a use of smart antennas in wireless communication.

III. CELL SPLITTING

Cell Splitting, it is the process in which congested cells are divided into smaller cells [2]. In this process, the bigger cells are divided into the smaller cells. Each smaller cell contains individual antenna. But, the height of the antennas is restricted that is the height of antenna should be small here. Also, the transmitted power is less.

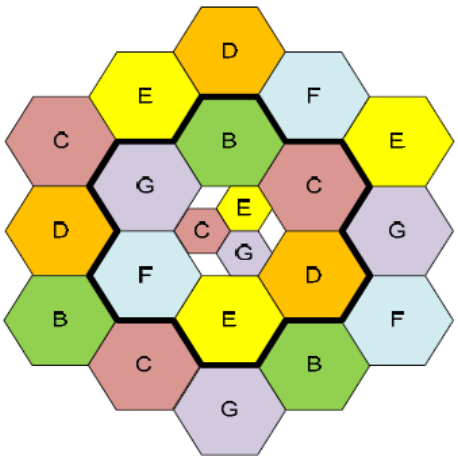


Figure 2. Cell Splitting

Due to cell splitting process, the smaller cells become more in number. As the cell numbers are more, the number of clusters are also in large numbers. As the numbers of clusters are more, then the numbers of channels are also more. Because number of channels per cell are fixed and hence it leads to a more capacity. Depending upon the traffic density, the cells can be splitted. When the traffic density is high, then the splitted cells can be activated. While, when the traffic density is less, then the splitted cells can be deactivated.

IV. CELL SECTORING

Cell Sectoring is another method to improve the efficiency of cell in wireless communication. In Cell Sectoring, the cells are divided into sectors. These sectors are of 60 degree or 120 degree. These 60 degree and 120 degree sectoring are shown in figure [3] and figure [4] respectively. Each sector contains antennas. The omnidirectional antennas that mean the antennas which radiates into all directions. Such type of antennas are not used in Cell Sectoring. The reason behind this is that, if we use omnidirectional antennas, then it will increase the interference. So, instead of using such omnidirectional antennas, only the directional antennas are used in Cell Sectoring. These are the antennas radiates power in specific directions only. So, the co-channel interference is considerably decreased by replacing a single omnidirectional antenna with some directional antennas. In 60 degree sectoring 6 directional antennas are used. 6 antennas covers one cell. While, in 120 degree sectoring 3 directional antennas are used. Here, 3 antennas covers one cell [1].

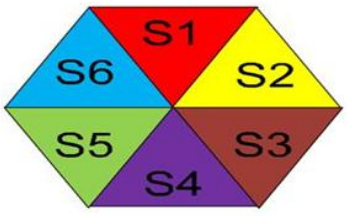


Figure 3. 60 degree Cell Sectoring

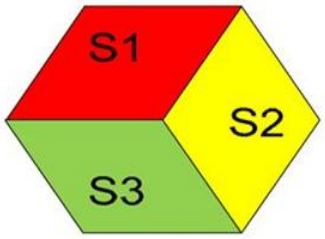
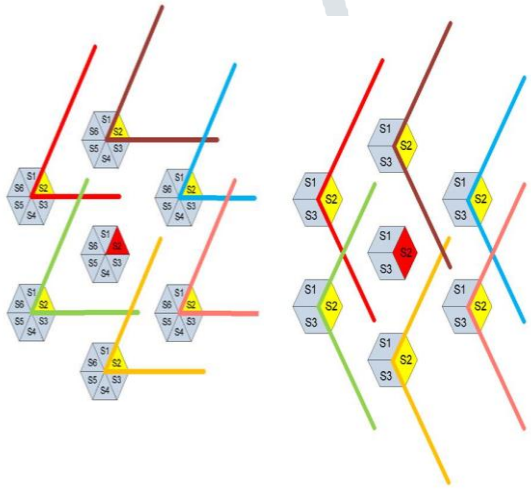


Figure 4. 120 degree Cell Sectoring

While, in Cell Sectoring Handover is more. Because, when mobile moves from one sector to another in the same cell then also Handover takes place [3]. If the bandwidth allocation is not proper then during Handover, there will be more probability of dropping calls [4] [5]. In 120 degree sectoring, maximum 2 cells causes interference. While in case of 60 degree sectoring only one cell is responsible for interference. This is shown in figure 5(a) and figure 5(b).



(a) 120 degree sectoring (b) 60 degree sectoring

Figure 5. Cell Sectoring

As the interference reduces, directly it will improve the cell efficiency of cell.

V. MICROCELL ZONE CONCEPT

This is a new concept called micro cell zone concept which is different from both the Cell Splitting and Cell Sectoring [7]. The problems occurs in Cell Sectoring are avoided in Microcell Zone Concept. Here, the cells are divided into zones. Each zone uses a directional antenna. All three zones uses common base station. A zone selector is used which decides whether the base station is using zone 1, 2 or 3. When mobile goes from one zone to another, it doesn't changes the channel. Only the base station switches the channel to a different zone. So, there is no need of Handoff when mobile travels from one zone to another.

At a time only one zone can be selected by the base station. Hence, it reduces the co-channel interference. Decreased co-channel interference improves the quality of signal and also leads to an increase in cell capacity. It extends the cell boundary to the places which are hard to reach.

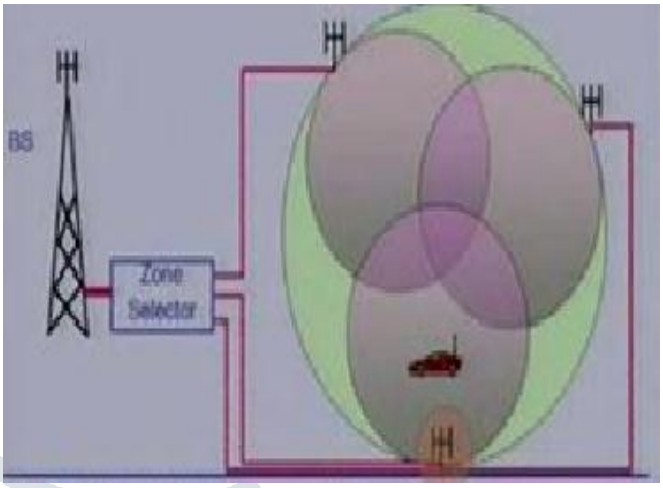


Figure 6. Microcell zone concept

VI. USE OF REPEATERS

In telecommunications, a Repeater is an electronic device that accepts a signal and retransmits it at a higher level or higher power, or onto the other side of an obstruction, so that the signal can cover longer distances. Repeaters can be used for hard-to-reach areas such as within buildings, basements, tunnels, valleys or other secluded areas. Range Repeaters are also called as Range Extenders.

Figure 7(a). Range Repeater

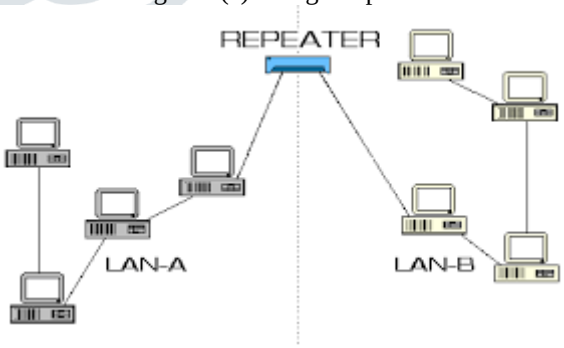


Figure 7(b). Range Repeater

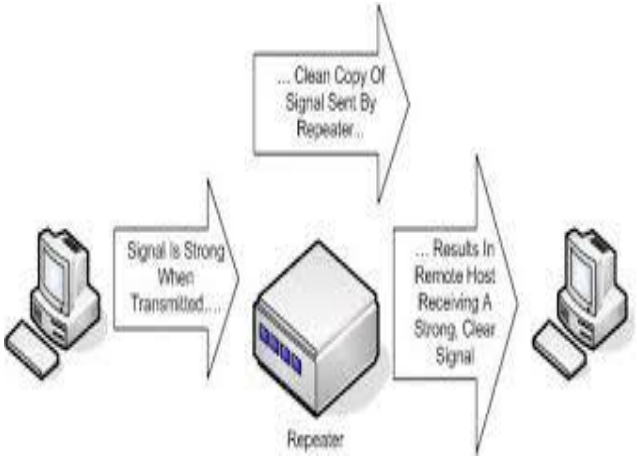


Figure 7(c). Range Repeater

Diagrams of repeaters are shown in figure 7(a), figure 7(b) and figure 7(c). These are actually transmitters which are used to provide coverage to the hard to reach areas. They accept signals from base stations .Then, Repeaters amplifies them and finally, radiates those amplified signals to the hard to cover areas. That means the repeaters are usually used to cover the uncovered areas. Repeaters are nothing but a regeneration of signal to transmit over long distance.

VII. CONCLUSION

In this paper, we discussed a technique called Cell Splitting to increase capacity in which we divide the larger cell into smaller cells. Another technique that was discussed in this paper is Cell Sectoring in which we use effectively directional antennas instead of using omnidirectional antennas. Then the next technique called microcell zoning was discussed which essentially works on the good properties of cell splitting and Cell sectoring. Finally, we discussed the use of repeaters also known as Range Extenders, which covers the areas not covered by base stations. All the methods are mentioned above are used to minimize the call drops. So that the cell capacity can be increases.

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1) Author Details:

Name- Miss. Sapana S. Suryawanshi
Electronics and Telecommunication
SSIET, Maharashtra.
India.