CONCEPTUAL ANALYSIS OF FREQUENCY REUSE IN CO-CHANNEL CELLULAR SYSTEM FOR LTE AND HANDOFF TECHNIQUE

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ABSTRACT

All over the globe, wireless communication services have enjoyed dramatic growth over the past twenty five years. Mobile communication is that the booming field within the telecommunications trade. The cellular network is that the most prospering mobile communication system, accustomed transmit each voice and knowledge. In this latter, systematic analysis has been taken by using mathematical term for handoff technique, improved handoff techniques are proposed to support mobile internet and call services with quality of service constraints within 4G wireless systems also taken a systematic literature review (SLR) for the mobile communication of frequency reuse in co-channel cellular system and an active study of frequency reuse approaches in 4G networks and introduces the challenges in implementing them in the mentioned networks.

Index term:- *Mobile Communication, frequency reuse, frequency reuse for LTE, handoff, handoff for 4G .*

I. INTRODUCTION

The term wireless only describe the way of accessing a network or other communication partners i.e., without a wire. The wire is replaced by the transmission of electromagnetic waves through the air. The ability to communicate with people on move has evolved remarkably since Guglielmo Mareconi (G. Mareconi) first demonstrate radio's ability to provide continuous contact with ship selling. It was the first ship to shore communication system and provided information about incoming ships the English Channel.

A cellular radio system provides a wireless association to the general public telephone network for any user location inside the radio vary of the system. The term mobile has historically been wont to classify a radio terminal which will be captive throughout communication. Cellular systems accommodate an outsized range of mobile units over an outsized space inside a restricted frequency spectrum. There are many sorts of radio transmission systems. We tend to take into account solely full duplex systems. These are communication systems that enable coincidental two-way communication. Transmission and reception for a full duplex system are generally on two totally different channels, that the user might perpetually transmit whereas receiving signals from another user. Figure 1 shows a basic cellular system that consists of mobiles, base stations, and a switch center. Every mobile communicates via radio with one or a lot of base stations. A decision from a user are often transferred from one base station to a different throughout the decision. The method of transferring is named football play. Every mobile contains a transceiver (transmitter and

receiver), an antenna, and management electronic equipment. The bottom stations carries with it many transmitters and receivers, which at the same time handle full duplex communications and usually have towers that support many transmission and receiving antennas. The bottom station connects the coincidental mobile calls via telephone lines, microwave links, or fiber-optic cables to the switch center. The switch center coordinates the activity of all of the bottom stations and connects the complete cellular system to the general public telephone network.

The channels used for transmission from the bottom station to the mobiles are referred to as forward or downlink channels, and also the channels used for transmission from the mobiles to the bottom station are referred to as reverse or transmission channels. the two channels to blame for decision initiation and repair request are the forward management channel and reverse management channel.

Once a decision is ongoing, the switch center adjusts the transmitted power of the mobile (this method is named power control1) and changes the channel of the mobile and base station (handoff) to take care of call quality because the mobile moves in and out of vary of a given base station.

In this paper, Section 1st describe the start-up of mobile communication form ship to shore through G. Mareconi after innovation, enhancement with modern world and improvement is discussed in section 2nd as Evolution in mobile communication. Frequency reuse with co-channel methodology is discussed in section 3rd, Handoff technique for improvement of mobile communication is full filled in section 4th and last section 5th are summarized the whole problems and analysis.

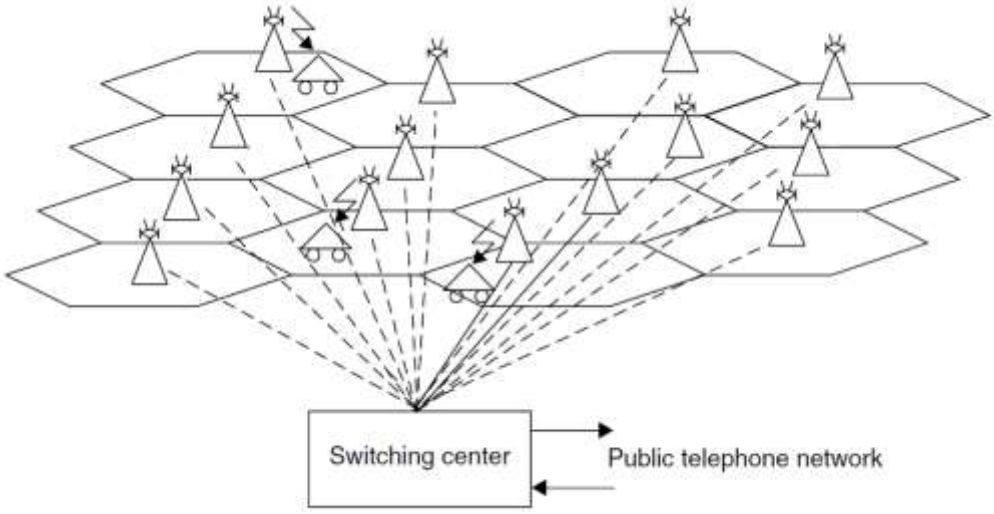

Fig.1. Illustrate the Basic Mobile Communication System

II. EVOLUTION OF MOBILE COMMUNICATION

Transferring data between way areas across the globe perpetually meant a giant challenge within the human history. There was some ways throughout the traditional times and therefore the Middle Ages, like smoke signals, beacons or Colum biform bird posts, however the speed and therefore the dependableness of the data transfer wasn't the foremost satisfactory.

The first huge breakthroughs within the history of worldwide communication was the fast spreading of the electrical telegraph networks ranging from the center of nineteenth century. By 1902, because the results of birth many submarine communication cables, the telegraph system encircled the globe. After that, at the first twentieth century, the telephone began to take the place of the telegraph, and by the top of the century, it's become one in every of the foremost fashionable communication device all round the world.

Beside the continual improvement of cable communication, at the top of the nineteenth century, Mareconi stared to make a radio based mostly wireless telegraphic system that will operate identical as wired telegraphy. On thirteen could 1897, Mareconi transmitted the primary wireless signals over water to Lavernock from Flat Holm, and therefore the regular transatlantic radio-telegraph service was begun on seventeen Gregorian calendar month 1907. Industrial radiotelephone for passengers on ships within the Atlantic was begun in 1929. By this point, radios were little and rugged enough to be put in in cares, and therefore the 1st "land mobile" radio system was place into operation by the city police in 1928. By 1934, there have been 194 municipal police systems and fifty eight state police radio stations serving quite 5000 radio-equipped police cares. The age of mobile radio had begun.

Spectrum that might be exploited for sensible systems was perpetually briefly provide, and mobile communication services were in competition with military and broadcast services for the obtainable channels. As a result, most mobile radio channels were dedicated to emergency and public service uses. Despite these difficulties, associate degree early mobile utility was initiated in 1947, exploitation many channels at thirty five megahertz. Extra channels were before long allotted at a hundred and fifty megahertz, and later at 450 megahertz. Improved filtering and frequency stability allowed these channels to be narrowed, eventually making a complete of quite forty channels for mobile telecom. Early mobile telephone systems resembled broadcast systems, in this powerful transmitters were accustomed cowl a distance of 20-30 miles from a high tower or upside. These systems used analog modulation, and therefore the calls in each directions were placed through a mobile operator.

For the higher utilization of the magnitude relation spectrum, and increasing of the lined areas, cellular networks has been made. In an exceedingly cellular network, every cell uses a distinct set of frequencies from neighboring cells, to avoid interference and supply secured information measure among every cell.

III. FREQUENCY REUSE IN CO-CHANNEL FOR LTE

Most of you would possibly be conversant in the conception of frequency reprocess. We regularly encounter this term in Mobile Computing. Quite easy and straightforward conception, however still it needs an in depth clarification. This can be one in every of the foremost common terms utilized in the globe of Cellular telephone (Wireless Communication). Most cellular systems use frequency reprocess theme to boost capability and coverage. Allow us to perceive what specifically a cell mean and the way they're associated with frequencies.
In a cellular system, every mobile station (MS) is connected with its base station (BS) via a communication system. The bachelor's degree is chargeable for causing the calls to and from the MS that be the coverage space of that bachelor's degree. The coverage space of a base station or a sector of a base station is understood as a cell. Every bachelor's degree consists of variety of frequency channels, which function a link between the MS and also the bachelor's degree. Every time, a decision propagates through a channel that is presently idle and receiving the most effective signal. Because the coverage space of a bachelor's degree is termed as a cell, we will conjointly say that a cell uses the frequency channels for telephone. These cells are typically of polygon shape (this clarification is never within the scope of our discussion here).

- **Cell:**
    1. A cell is basic geographic unit of cellular system. The size of a cell depends on the density of subscribers in area. On the basis of their size cells may be categorized as marcocells, microcells, picocells and femtocells.
    2. Cell wise, one base station provides transmission over a small geographic area, smaller cells use low power transceivers to cover smaller region; hence frequency reuse can be increased without interference.

- **Frequency reuse:**

1. Cellular radio system rely on an intelligent allocation and reuse of a channel throughout a coverage region.
2. Each cellular base station is allocated a group of radio channels to be used within a small geographic area called a cell.
3. Base station in adjacent cells are assigned channel groups which contain completely different channels than neighbor cells.
4. The base station antennas are designed to achieve the desired coverage within the particular cell.
5. By limiting the coverage area to within the boundaries of cell, the same group of channels may be used to cover different cells that are separated from one another by distance larger enough to keep interference levels within tolerable limits. The design process of selecting and allocating channels group for all the cellular base station within a system is called **frequency reuse.**
6. The cellular frequency reuse concept is shown in figure 2. Cells with the same letter use the same set of frequencies. A cell cluster is outlined in bold and replicated over the coverage area.

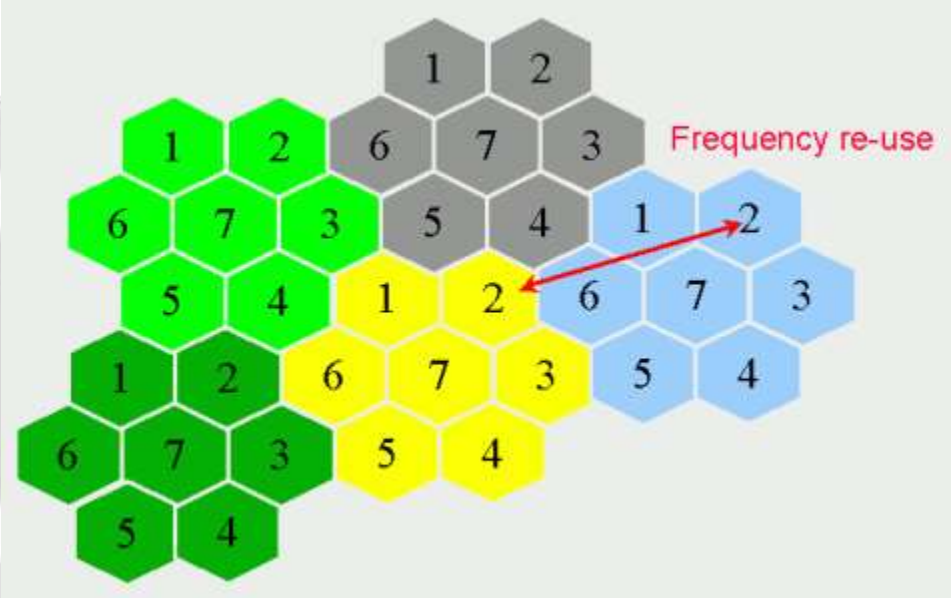

Fig.2. Frequency reuse concept

- **Frequency reuse ratio:**
  Frequency reuse ratio which is also known as distance to reuse or co-channel reuse ratio, defines the geographic distance that is required between cells using identical frequency in order to avoid interference between the ratio transmissions at these cells. It is represented by '*Q'*.

$$\boldsymbol{Q = D/R = \sqrt{(3N)}}$$

Where, *D = Minimum distance between two channel cells.*
R = radius of the co-channel cells.
N= Cluster size.

- **Frequency reuse for LTE**
  Authors in [19] presents an analytical contribution to interference cancellation and estimation of Signal to Interference Noise Ratio (SINR) in LTE network. Fractional frequency reuse scheme is proposed to improve the cell coverage. The authors have used this analytical approach to make a comparison between different levels of reuse, three-cell clusters and implemented Inter-cell Interference Coordination (ICIC)

based on FFR. Analytical results have illustrated that if fractional frequency reuse is used, the interference is smaller than that of Universal Frequency Reuse (UFR) case. By using UFR, the enhancement of system performances can be determined by 10 dB rise of SINR in uplink. Whereas, by using the Fractional Frequency Reus 3 (FFR 3) the interference is lesser comparing to FFR. However the price of using FFR-3 is three time higher spectrum than FFR. While using FFR instead of UFR gives 10 dB enhancement of SINR results in approximately twice larger cell radius. The authors do not study the impact of the areas size of cell center users (CCUs) and cell edge users (CEUs).

A Soft Frequency Reuse (SFR) has been proposed recently by many researchers as a substitute of FFR scheme [19-21] In SFR the whole bandwidth can be reused in each cell in contrast to FFR. In SFR, the whole bandwidth in each cell is sub-divided into two groups as major and minor sub-bands. The major sub-bands can be allocated to the users located in both inner and outer regions of the cells which are orthogonal to each other in neighboring cells. On the other hand, the minor sub-bands have lower transmit power comparing to major sub-band's one and they are utilized only by users in inner cell. A power ratio is introduced as the ratio between major and minor sub-bands transmit powers in [19]. However, in these SFR schemes the allocation of power and spectrum for major and minor sub-carriers are fixed. According to the simulation results in [16] and [17], the SFR scheme proves higher spectrum efficiency than the FFR technique.

The novel methodology of optimized cell geometry constraints which has given more inclusive picture of the situation and has clarified the occurring phenomena has been proposed in [21]. It has focused its study about the comparison between both the SFR and Partial Frequency Reuse (PFR) and have presented the impact on throughput-coverage features of LTE network. Firstly, the throughput features of individual user connection has been presented in simulation results to evaluate the stability and availability of achieved bit rate in different cell areas. Secondly, the characteristics of the network capacity has been shown to evaluate the available capacity in different cell regions. The paper results have given a clear view about different ways of cell division by assigning different frequency bands among them. In addition, the paper might be suitable in designing the LTE network In terms of the throughput for individual connection and the capacity of a cell. Moreover, SFR method provided promising results in terms of capacity maximization. However, some advantages have been perceived for the PFR side as well by taking into consideration of the maximum suitable throughput for individual user connection. The effects of the inappropriate selection of the Central Area of a Cell (RCAC) Radius has been clearly shown which contributed the negative results of the inappropriate bandwidth allocation for both SFR and PER. The analysis of a single user connection throughput and the maximum available cell throughput have been shown the stability of achieved throughput in the cell area and given the information on the overall capacity of a cell respectively. The maximum available throughput has also provided the information about the capacity for both the CAC and Boundary Area of a Cell (BAC). The optimum value of RCAC radius has been selected with the consideration of network design requirements of the selected area.

Cell capacity issues and cell planning for LTE technology to efficiently utilize the bandwidth has been proposed based on SFR in [22]. The authors divided the cell area into two main parts namely the central part and the external part and using different reuse schemes for each part. The SINR and the probability of different transmission modes have been characterized in cell area in reference with SFR. The results proved that, the cell capacity optimization has been carried out by means of extensive numerical results in order to select both the radius of the cell center region and the border-to-center power ratio of SFR.

IV. HANDOFF TECHNIQUE

In 1st generation handoffs, the signal strength measurements are created by base stations and are supervised by MSC.

In second generation, football play call was mobile aided. Each mobile station measures the received power from close base stations and regularly reports the results of the measure for base station.

In Associate in nursing analog system, once a decision has been established, the set-up channel cannot be used once more throughout the amount of the decision. Therefore, football play is often enforced on the voice channel.

However within the digital systems, the worth of implementing football plays depends on the dimensions of the cell and also the handoff is meted out through paging or common management channel. an example, if the radius of the cell is thirty two kilometer (20 mi), the world is 3217 km^2(1256 mi^2). When a decision is initiated during this space, there's a bit likelihood that it'll be born before the decision is terminated as a results of a weak signal at the coverage boundary. Then why trouble to implement the football play feature? Even cell football play might not be required for a 16-km radius and if a decision is born in a very fringe space, the client merely reconnects and redials the decision. Currently daily the dimensions of cells becomes smaller so as to extend capability. Additionally individuals speak longer, therefore the handoffs are terribly essential.

Handover should be performed quickly and with success, however there's a tangle with quicker football play that we have a tendency to lose the advantages that square measure related to signal averaging and physical phenomenon. This was useful in removing unneeded handoffs and ping fetor condition. However, in microcellular systems, the time of football play is crucial and that we might not tolerate the delay that comes with physical phenomenon windows. The football play should be quick. The movement of the mobile station from one cell to a different cell should be detected to initiate a football play. Now, a reliable technique to create this detection and to accommodate the movement of mobile station is to live the received signal strengths from the user and to the bottom stations. So as to avoid the excessive and inaccurate handoffs, associate degree averaging of the received signal levels is performed still as physical phenomenon margin is additionally enforced. The whole football play delay is that the total of the physical phenomenon delay and signal averaging delay and seeks to create this delay tiny. [5] Develops associate degree associate degree lytic approach to pick the physical phenomenon delay and signal averaging time so as to get an optimum tradeoff between those 2 parameters still as a tradeoff between the whole delay time and also the variety of allowable unneeded handoffs. Some vital parameters square measure given mathematical expressions. The chance of associate degree unneeded football play is given as:

$$Pu = [\int_{-\infty}^{\infty} f(x).(\frac{1}{2}\operatorname{erf}(x - \frac{h-\Delta t}{\sigma}))\, dx].[\int_{-\infty}^{\infty} f(x).\left(\frac{1}{2} erf(\, x - h + \Delta l\sigma)\right) dx$$

V. HANDOFF ARCHITECTURE FOR 4G MOBILE COMMUNICATION

An IP-based handoff architecture using mobile IP, as shown in Figure 3, is used. The mobile host has a multi-mode card that can access the 802.11b (such as WLAN) and cellular (such as CDMA2000) network, and its hierarchical foreign agents and multi-path [14] structure follows in Figure 2. For conventional handoff techniques, the criteria that select the initial mode in mobile host are the radio link quality, data rate, service type, speed of mobile host, and capacity of cellular network. If its data rate is low and fast moving, then the mobile host can select the CDMA2000 network. For high data rates, then the WLAN is selected. It also connects the mobile agent (MA) in order to support its mobility management. But for a certain mobile user, we know that the uplink and downlink traffic of service is not balance for accessing internet, normally, user prefer a wider downlink frequency. So our goal is to use combination of cellular network for uplink traffic services and 802.11b network for downlink traffic services to provide an efficient application for mobile user to access wireless mobile internet.[15]

In figure 3, structured mobility anchor point (MAP) can offer seamless mobility node when it moves from MAP2 to MAP3 while communicating with corresponding node (CN) , based on integration of 802.11 and cellular wireless data networks, detailed in [16]. In this approach, different mechanisms and protocols can handle authentication, billing and mobility management in the cellular and 802.11 portions of the network[14- 18]. When a mobile node (MN) enters a new foreign sub-network it first acquires a new physical care-of address (PCoA) by means of address auto-configuration, in which the mobile node uses it as the source address of all datagrams that it sends. When mobile node (MN) arrive in a foreign network, the MN will register a unique virtual care-of address (VCoA) with a home agent (HA) and CN. It is also acquires unique VCoA from each level of the hierarchy. So when MN moves to MAP2 it will acquire VCoA2 from MAP2 and VCoA1 from MAP1. When MAP1 receives a packet addressed to VCoA1, which the VCoA of MN located MAP1, it can determine the next VCoA by looking up the binding between VCoA and the next lower VCoA. After this MAP will tunnel the packet to this VCoA. This continues until the datagram reaches the lowest MAP, which tunnels the packet to the mobile node's PCoA. In figure 2 MAP1 tunnels packet to VCoA2. MAP2 decapsulates the packet, encapsulates it and tunnels it to mobile node's PCoA.[14]

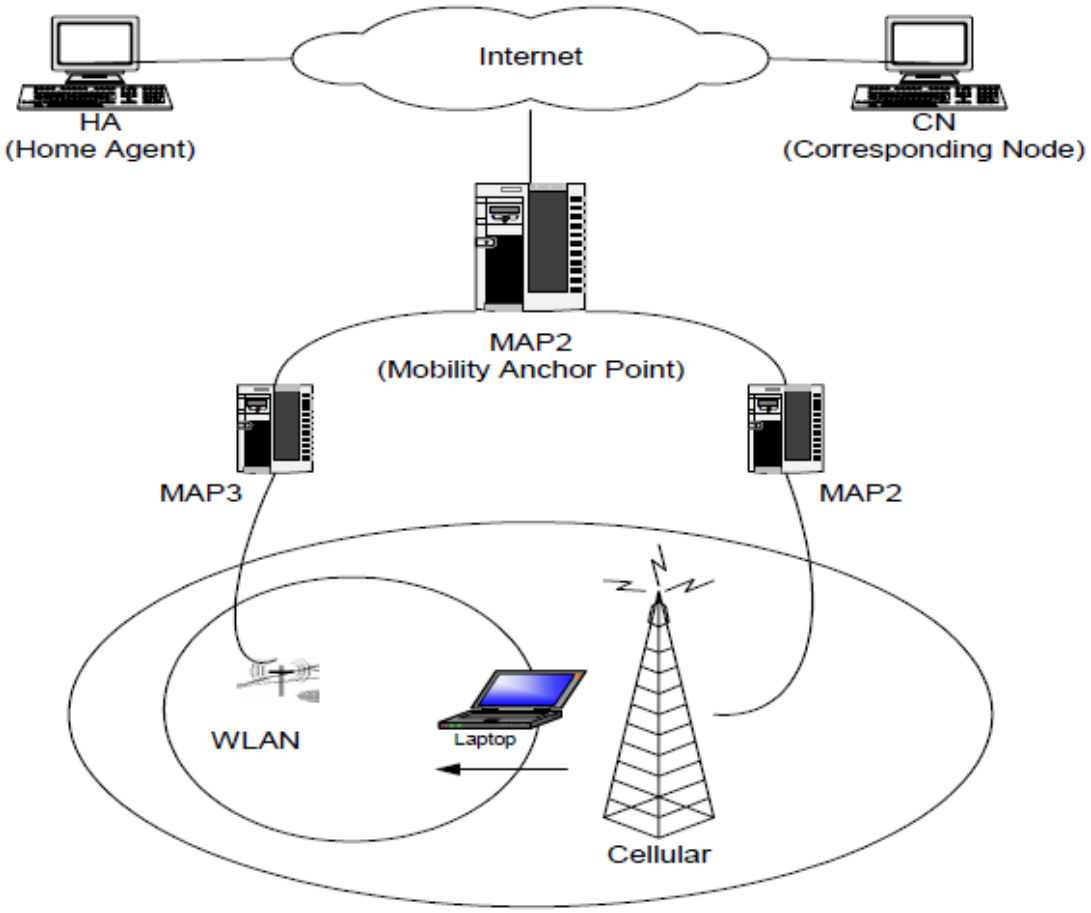

Fig.3 handoff architecture based on 4G Mobile communication

VI. CONCLUSION

In mobile communication, frequency reuse in co-channel cellular system is best approach to maintain the network capability in communication system by using two phase as base station, other one is mobile station. A heterogeneous IP-based wireless access network handoff architecture that supports uplink and downlink traffic services with different bandwidth. It provides two end-to-end mobility supports to utilize disparity of available bandwidths in wireless cells improving system capacity and getting transmission efficiency. A novel mechanism on frequency reuse need to be adopted which provides low cost and less complexity in implementing and offers high efficiency, compatibility with different networks, fairness among cell users, adoption on rapid changes of network environments and so on. And in Mobile communication, Handoff between cells is unavoidable because it is very necessary to maintain the ongoing calls. There are occurrences where a handoff is unsuccessful and lots of research was conducted regarding this. In adjacent cells, when a user moves from one cell to another frequencies cannot be reused; a new frequency must be allocated for the call. The user's call must be terminated if a user moves into a cell when all available channels are in use.

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