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RESOURCE DYNAMIC FREQUENCY INTERFERENCE MITIGATION BASED ON LTE-A AND NEIGHBOURING NODE NETWORK COMMUNICATION

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ABSTRACT

Spectrum scarcity is one of the most discussed restraining aspects in wireless communication system. To solve this issue Frequency Reuse (FR) concept is introduced. It is a promising development to fulfill the requirement of Long Term Evolution Advanced (LET-A). With the introduction of FR comes the problem of Inter Cell Interference as the neighboring eNodeBs (eNB) which uses the same frequency band that will act as an interference source. In this paper, a Dynamic Frequency Reuse (DFR) method is anticipated. Continuous optimization of resource allocation of each cell is considered in this method. The important focus of the paper is to expand the capacity of the users placed in cell edge areas by reducing out of cell interference. Simulation has been done to prove that the proposed scheme leads to efficient resource management.

Keywords: FR, LTE-A, DFR, ICI, capacity

1. INTRODUCTION

High speed, uninterrupted service and reliable connections are the requirement for present day's communication network users. Adding up to that, with the increased number of users, people need something new that will fulfill all their above requirements. Long Term Evolution (LTE) is the cellular standard that can solve all the issues regarding the problems of the network. LTE is considered as the standard for high speed and reduced latency in the service. LTE is also known as the standard of the fourth generation (4G) technology in communication system. Many developed countries are now using this technology to attend to their need of reliable connection. For mobile standard system, the 3rd Generation Partnership Project (3GPP) is currently the main standards development group. They are considered as 2nd Generation system. The 'Third Generation' mainly known as the Universal Mobile Telecommunication System (UMTS) family which has introduced Code Division Multiple Access (CDMA) technology and became known as Wideband CDMA, commonly known as WCDMA. Finally, LTE has taken Orthogonal Frequency Division Multiple Access (OFDMA) technique that is a technology to access, which is dominating the newest mobile technologies.

Inter Cell Interference (ICI) is one of the main restrictive factors. This problem is mainly caused by two sources, the first is the frequency reuse factor equals to '1' in LTE-A system. This means all the neighboring eNodeBs (eNB) use the same frequency channels which will act as an interference source.

Which the same frequency can be used in the network is considered to be frequency reuse factor. It can be denoted as 1/K, where K denotes the number of cells which cannot operate in the identical frequency for transmission of data. The second limitation is the heterogeneous positioning of LTE-A networks containing of traditional Macro base stations overlapped with Low Power Nodes (LPN). Often haphazard and unintentional location of these points of access can create severe interference scenario primarily for the users located in cell edge. Figure 1 illustrates the condition of ICI in LTE-A network. For this ICI the efficiency of the system decreases as both the LTE and LTE-A system is planned for frequency reuse factor of ‘1’ to maximize the spectrum capacity. If no accurate planning for the interference management, there is a high probability of call drops and low throughput. Traditional Fractional Frequency Reuse is an effective solution of this problem.

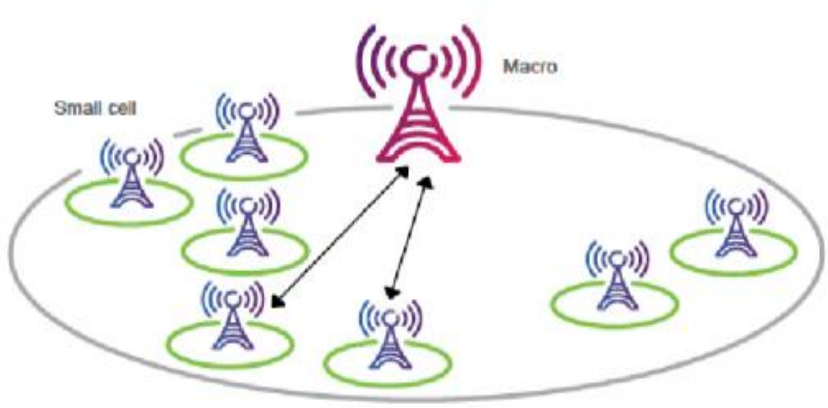


Figure 1.1. Inter Cell Interference Scenario

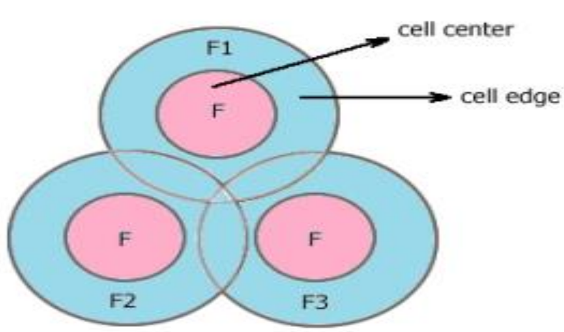


Figure 1.2. Fractional Frequency Reuse Concept

2. RELATED WORK

Application of fractional frequency reuse in the LTE-A system has been a highly-discussed topic in communication society. Adaptive partial frequency reuse has been proposed an improve the system capacity. However different transmit power and positions has been assumed. Contention based FFR is proposed but the algorithm is applicable for certain conditions only. Congestion management in intellectual transportation system is proposed. Soft Frequency Reuse (SFR) is proposed. However, most of the paper of them do not consider the effect of inter cell interference [1]. Dynamic allocation of frequency is considered. However, none of these considered multiple base stations with each serving randomly placed users. As the ICI mitigation technique has become one of the major concerning issues in the communication sector, there are many researchers working on this topic to improve the condition [2]. Some of the leading techniques that are being discussed are pointed out in the next section. In this paper, a novel interference coordination scheme based softer frequency reuse (SerFR) to mitigate inter-cell interference in Orthogonal Frequency Division Multiple Access (OFDMA) cellular systems is presented. [3] In OFDMA systems inter-cell interference is the most important interference source. Inter-cell interference coordination is considered to improve coverage and increase date rate at cell edge. Soft Frequency Reuse (SFR) interference coordination scheme is proposed in 3GPP Long Term Evolution (LTE). [4] But the scheme cause frequency selective scheduling gain loss, and the peak rate for cell edge users is low because the cell edge users only can use a fraction of the entire frequency band. However, in Ser FR scheme, cell edge users can use the entire frequency band, so there are more frequency selective scheduling garn and more peak date rate than SFR scheme.

3. OVERVIEW OF THE PROPOSED MODEL

The proposal of initial dynamic frequency reuse includes two steps of initialization. The first is implementation of an empirical, circulated algorithm for ideal resource allocation in LTE-A system. When there is no chance of communication with other Base stations (BS), each BS can dynamically assign resource for each of its users. But assigning resources allocation to improve the capacity leads to Non-Deterministic Polynomial Time Hard (NP-Hard) problem. A problem is considered NP-hard, if an algorithm for simplifying it can be interpreted into one for explaining any NP problem. So, NP-Hard means it is as hard as ay NP problem even though it can be even tougher. Due to this problem, computational complexity arises. In order to avoid this, a proposal has been made in this paper called Dynamic Frequency Reuse scheme.

The total power allocated is minimized with a constant data rate for each of the user by resources allocated by BS. The idea is to grouping the subcarriers into sub-bands. In telecommunication system, the subcarriers are signal carrier which is passed on top of an additional carrier.

As a result, two signals can be carried at the same time. In the receiver side, the main carrier and the subcarrier signals are demodulated distinctly. On the other hand, the subband is the sub-division of a frequency band and sub-band coding, typically done by Fast Frequency Transformation (FFT) breaks the signal into different frequency bands. In other word, it is simply the set of subcarriers. For a user to be placed in an exact sub-band meaning his virtual channel will contain the frequencies that are portion of the sub-band.

4. RESULTS AND DISCUSSION

The combination of these to reuse factors gives the capacity of the FFR scheme. The capacity of the FFR scheme the capacity of FFR scheme can be seen at different power levels. When the power level is increasing the capacity also increasing with the distance.

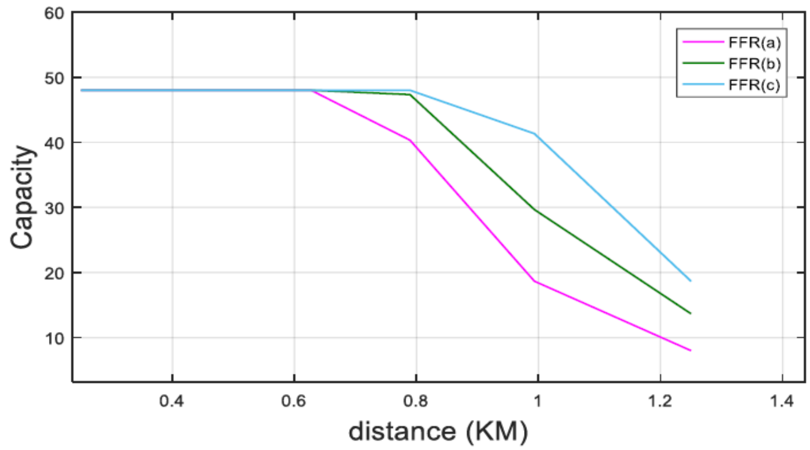


Figure 4.1 Performance of FFR at different Power Levels

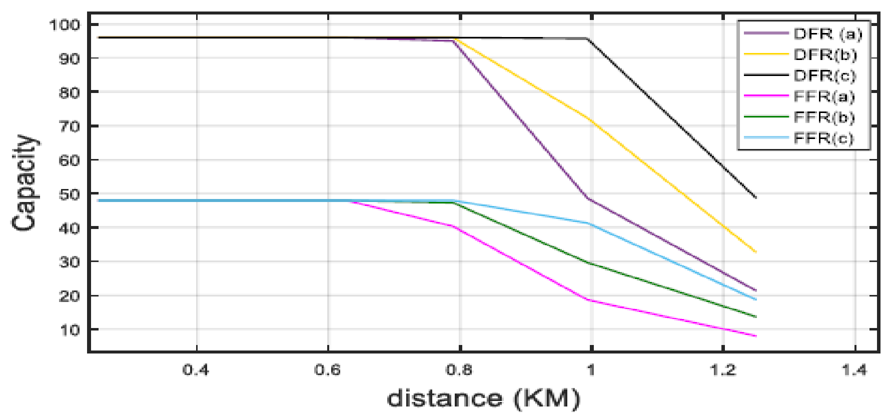
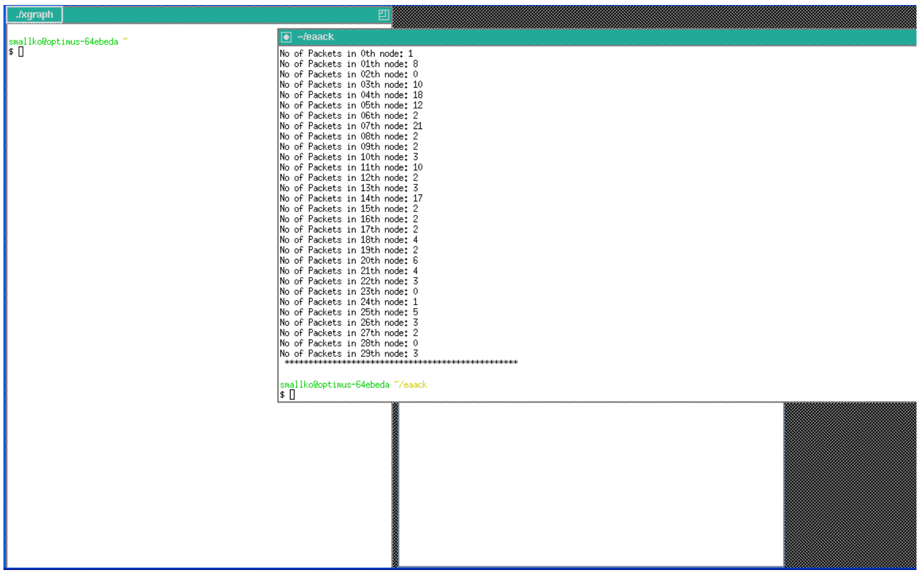
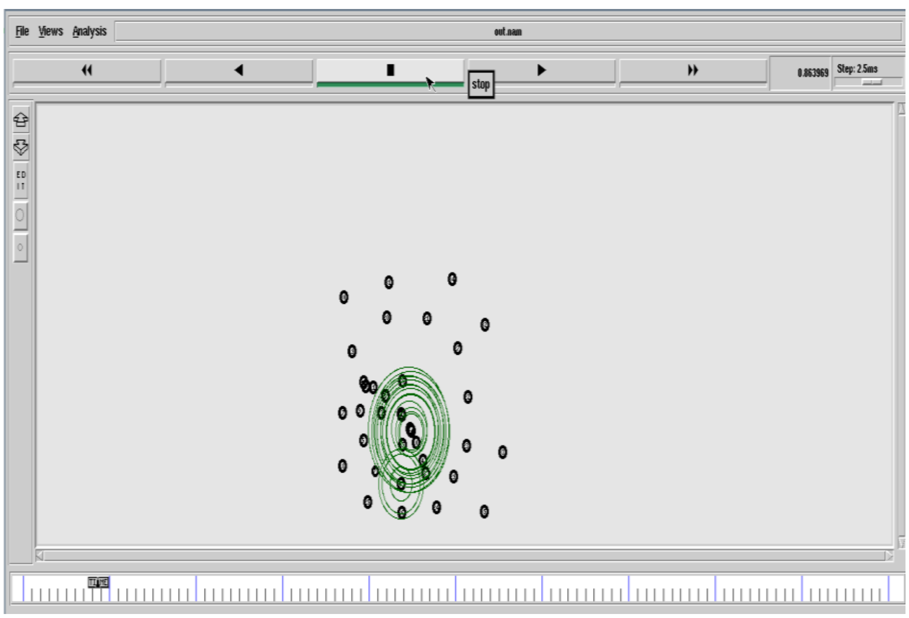


Fig : 4.2 Performance Comparison of DFR vs FFR

In the simulation for our proposed model, a limit has been considered for the users to be assigned in the sub-bands and power consumption. The simulation will stop when there is lack of subcarriers or power. User's placement and fading has been considered multiple times. Then the data are analyzed and stored for the use of simulation and take care of randomness. New users are added from the different locations. The system capacity based on the number of users supported using DFR comparing to the FFR. From the simulation results, it is clear that DFR outperforms the FFR in terms of increasing the system capacity

Communication of the node





CONCLUSION

Inter cell interference avoidance in LTE-A system through Dynamic Frequency Reuse has been discussed in this paper. The proposed scheme compares the available sub-bands and then chooses the best sub-band for the users. Simulations results also indicate that this scheme outperforms the traditional FFR scheme. At the cell edge area and also the cell center area, the capacity is almost double comparing to FFR. Simulation has been used to justify the proposed method. Adding up to that, in the simulation, the environment is considered with the realistic parameters. Further studies regarding this matter may lead to efficient radio resource management. While this scheme increases the capacity of the system through interference avoidance, there are some parameters which are assumed. To take care of the randomness some of the parameters are considered constant which is need to be taken care of in future researches. Different data rates, path loss models may also be considered for the future research.

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