Analysis of Dynamic Frequency Reuse Techniques in LTE – A Cellular Network

S Karthika¹* and PIndumathi²

¹Associate Professor, Department of Electronics and Communication Engineering, Sri Krishna College of Engineering and Technology, Coimbatore.
²Professor, Department of Electronics Engineering, Madras Institute of Technology, Coimbatore.

Corresponding Author mail Id: karthikas@skcet.ac.in

Abstract: Inter-cell Interference (ICI) is a significant obstacle which is degrading the efficiency of mobile cellular networks particularly for end users. Frequency reuse is an ICI synchronization technique which helps to mitigate ICI by assigning dissimilar frequency reuse factors on the basis of its position to User equipment (UE). This paper proposes a Self-organized resource allocation (SORA) framework that chooses the reuse factors randomly. The output of this strategy is configured using MATLAB and correlated with numerous reuse factor combinations. Results from simulation show improved efficiency for Cell Edge Users (CEU).

Keywords: CoMP, Frequency reuse, LTE-A, OFDMA.

1. Introduction

In 3GPP LTE-Advanced (LTE-A), Coordinated Multipoint Communication (CoMP) is considered a crucial methodology for increasing CEU in communicationsystems. Successful frequency reuse would be employed in promoting resource allocation in CoMP. OFDMA is commonly recognized as multiple access strategy towards different forms of communication schemes like mobile telecommunications networks such as Long Term Evolution (LTE) and LTE-A. In OFDMA, the frequency selective wideband channels are separated to several subcarriers of narrow bands. The orthogonality concept amongst narrow bands guarantees that the ICI is avoidable.

Fractional Frequency Reuse (FFR) is being used for efficient reduction of ICI in mobile cellular networks. The FFR definition was argued in [1]. FFR alleviated ICI by adding various reuse factors to UEs, depending on their position. FFR optimization-based process is discussed in [2-3]. Generalized Fractional Frequency Reuse (GFFR) is often used in broad and irregularly organized cellular networks [4]. A downlink LTE model metric Signal to Interference Noise Ratio (SINR), throughput and average cell energy efficiency were considered by the authors in [5]. The authors in [6] found another possibility upon integrating FFR with numerous scheduling algorithms including Round Robin Scheduling and Proportional Fairness. The non linear fault and detection algorithm has been discussed in [7]. In [8], the dynamic process is established and the optimum reuse factor is selected on the basis of user privilege.

2. Proposed Resource Allocation Scheme

The entire band is separated into 2 parts: the inner/outer parts. Inner prepossessing frequency reuse-1 serves Cell Center Users (CCU) and Outer group serves Cell Edge Users (CEU) with frequency reuse-3. Based on SINR, the users are distinguished into edge/middle users. The β-range available is split
into $\beta_{F-1}$ and $\beta_{F-3}$. Frequency Reuse-1 is employed for the inner band $\beta_{F-1}$ and Frequency Reuse-3 is used for the outer band $\beta_{F-3}$. Fig. 1 displays the flowchart of this algorithm.

Fig. 1. Flowchart of Algorithm
3. Simulation Results

The resource allocation efficiency is evaluated via MATLAB and is correlated with other reuse factors. Simulation parameters are chosen as Bandwidth-20 MHz, Carrier Frequency-2.6GHz, eNB power-46dBm, Channel Model-LTE Model, Number of Resource Block-100 RB per slot/7Symbols, Modulation Scheme-16QAM, Total Number of Subcarriers-1200.

From fig.2, it could be found that, as compared with other reuse methods, the proposed strategy has greater performance. For example, when SINR is 20dB the proposed scheme achieves 0.57% decreases when compared to reuse 1 and it achieves 9.7% increases when compared to reuse 3. Reuse 1 provides better throughput to cell center users.

From fig.3, as related to those other reuse factors, the proposed methodology provides greater throughput as it dynamically assigns the reuse factor to users on the basis of SINR. Reuse-3 provides better throughput to the edge users. For example, when SINR is 20dB the proposed scheme achieves 23% increases when compared to Reuse-3. Fig.4 and Fig.5 shows the total cell throughput comparison and fairness comparison of suggested method with other reuse factor.

![Cell Center Throughput Evaluation of Proposed Scheme with other Reuse Factor](image1)

![Cell Edge Throughput Evaluation of Proposed Scheme over Reuse Factor](image2)

![Total Cell Throughput Evaluation of Proposed Scheme with other Reuse Factor](image3)
Fig. 5 Fairness Comparison of Proposed Method with other Reuse Factor

Fig. 6 Cumulative Distribution Function of SINR for all users

Fig. 6 depicts that the proposed scheme attains improved performance in comparison with other schemes because it allocates reuse factor in an organized manner. As per Fig. 7, center users provide better performance due to reuse-1 while coming to both users such as center and edge users proposed scheme performs well.

Fig. 7 Cumulative Distribution Function of SINR for edge users

4. Conclusions
LTE-Advanced's tasks are to deliver services in a fair way to edge/center cell users, and to offer high SINR and low ICI in LTE-A. An algorithm is formulated in this work to deliver optimal efficiency for both edge/center users. In this algorithm, edge and center users are assigned with separate frequency reuse factors. Hence, in case of edge users ICI is found to be minimum. This scheme balances efficiency for edge/center cell users. The simulation results indicate that the proposed methodology offers maximum performance towards edge/center cell throughput. ICI is eliminated in the proposed system with the application of FR methodology. The proposed scheme is assessed with Reuse-
Results showed that this developed methodology offers excellent reasonable throughput for edge/center cell users.

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