International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 393-398 June 2018-Dec 2018 www.csjournals.com

Performance Analysis of Fractional Frequency Reuse Schemes

[1]Girisha Kumar, [2]Garima Saini
[1]ME Scholar, [2]Assistant Professor
ECE Department, NITTTR,Chandigarh,India
girish.smp66@gmail.com, garima@nitttrchd.ac.in

Abstract: In wireless communication the Inter Cell Interference (ICI) is one of the major challenges and it affects the performance of network. The Fractional Frequency Reuse (FFR) schemes are solution to reduce the ICI.The two-level FFR scheme improves the performance of cell edge user but unable to provide proper quality for cell intermediate users. To overcome this Multi-level fractional frequency reuse scheme is proposed. In multi-level FFR scheme the cell area is divided into three regions like cell interior, intermediate and cellexterior regions**.** The proposed multilevel FFR scheme improves the cell edge user SINR value, CDF of user SINR value and throughput of cell edge user as compared to conventional frequency reuse and two-level FFR schemes.

Key Words: *Fractional Frequency Reuse (FFR), Soft Frequency Reuse (SFR), Long Term Evolution (LTE).*

I. Introduction

The next generation networks aims to provide high data rate with low latency with efficient spectral usage along with flexible in design and implementation [1].Due to reputation of smart phones, tablets the traffic load on the network is increased to a large extent. To meet this requirements the mobile operators needto implement a dense network. This network covers wide range along with additional features flexible, dynamic supply. The Frequency reuse 1 pattern increases the efficiency of spectrum but at the cost of increasing interference [2]. To reduce the interference fractional frequency reuse is introduced. In which the total spectrum is divided into major and minor subcarriers. Based on the coverage area the total cell is divided into inner and outer zones. Due to FFR scheme the cell edge throughput is increased and according to [4], the FFR scheme enhances the average cell and cell edge throughput by maintaining proper peak data rate. The uniform power distribution for FFR scheme is used for (Long term Evolution) LTE networks. The authors in [6], proposed a two schemes such as FFR and soft frequency reuse (SFR) the authors compared both schemes. A distance dependent frequency reuse has been proposed in [7] for irregular macro base stations.

The remaining sections of the paper are organized as follows. The proposed Multi-Level FFR scheme is explained in section II, the results and discussion is done at section III, and finally concluded in section IV.

II. a) Multi-level FFR Schemes

In this scheme the coverage area of cell is partitioned into three regions like cell interior, cell middle and cell exterior region. The allotment of frequencies to each region is done separately. The transmission power of base station varies according to the region of cell. The frequency allocation pattern for multi-cellular FFR scheme is shown in Fig. 2 The inner region of all cells using common frequencies.

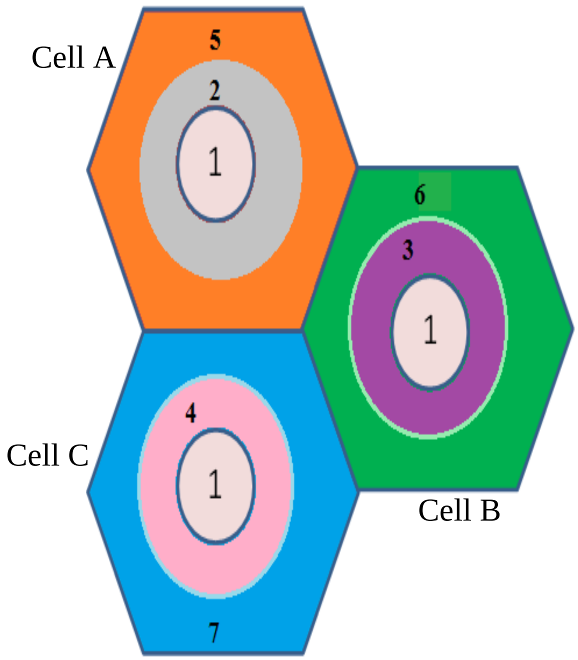

Fig. 1 Multi-Level FFR Scheme

The different regions of cell are using variable transmission power to avoid the interference. The SINR of user is measured and according to this value the frequency and power is allocated to the user. If the measured SINR of user is less than 1st threshold value user is considered in cell center region and if the threshold value is in between 1st and 2nd threshold value then user is in cell intermediate region and if the SINR of user is greater than 2nd threshold value then user is served by cell exterior region. The allocation of radio resources and transmission power is done by base station after estimation of area of cell the user belongs. .

III.Results and Discussion

The proposed scheme is simulated using parameters as cited in Table 1. The simulation results are used to analyze different types of frequency reuse schemes. The parameters like SINR, CDF of user SINR and CDF of throughput are compared for different frequency reuse schemes.

International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 393-398 June 2018-Dec 2018 www.csjournals.com

Table 1 Simulation Parameters

Sl.No	Parameter	Value
1	Number of User per Cell	10
2	Number of Cells	21
2	Radius of Cell	75m
3	Users per cell	24
5	Bandwidth of Channel	500MHz
6	Carrier frequency	26GHz
7	BS Tx power	40dBm

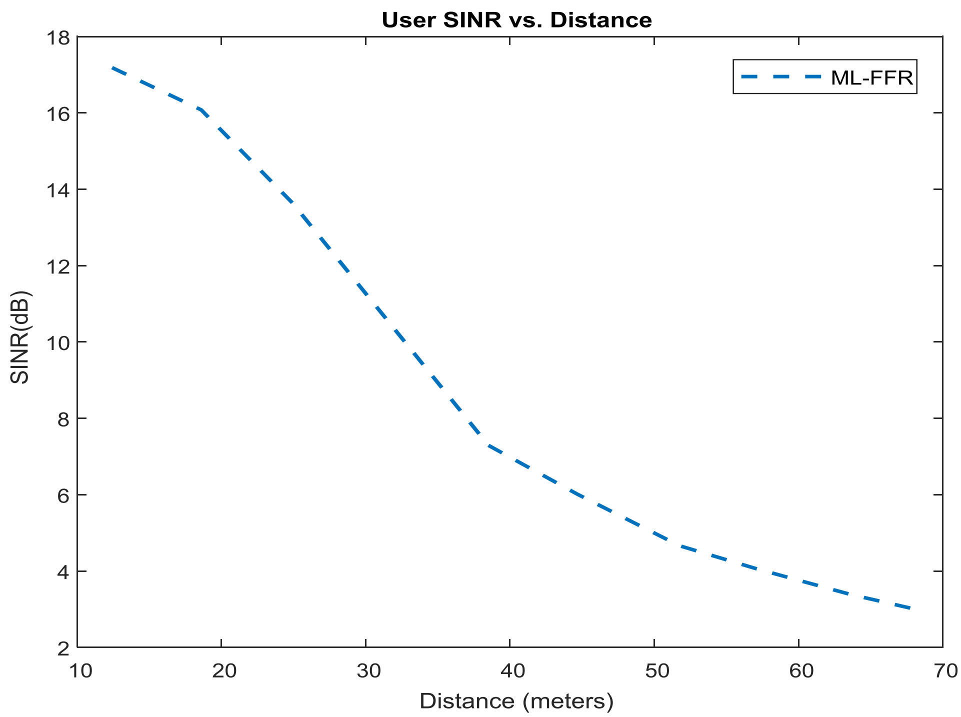

Fig. 3 User SINR v/s Distance

The users SINR with respect to distance for ML-FFR are as shown in Fig. 3. The simulation result shows that the SINR value for ML-FFR is better than conventional and strict FFR schemes as in [8]. In case of cell edge region the SINR value is better for ML-FFR due to less interference. For cell edge region the SINR value for ML-FFR it is up to +5dB. The CDF of user SINR value is as shown in Fig. 4. It shows the overall performance of user SINR value.

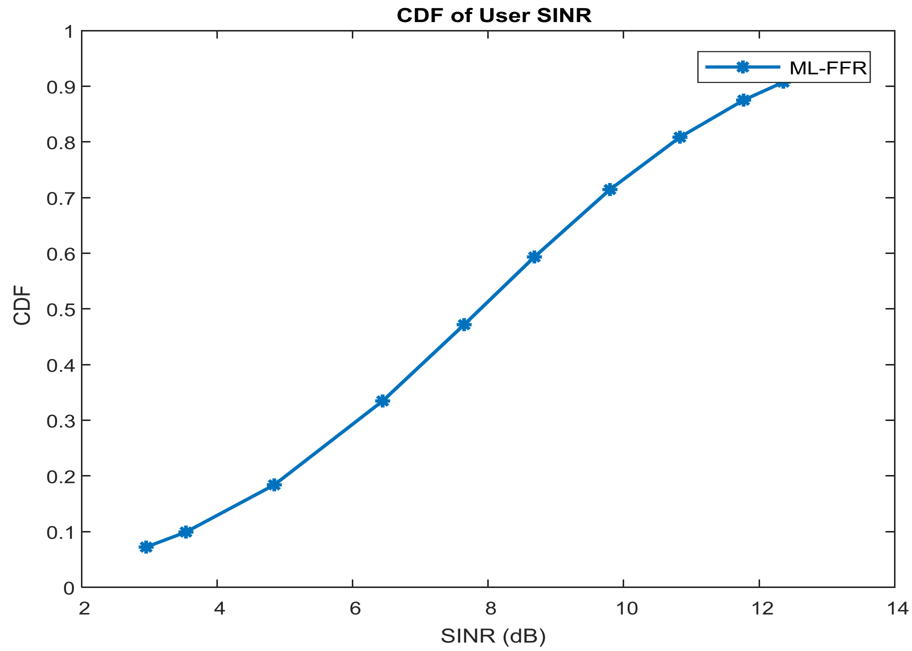

Fig. 4 CDF of User SINR

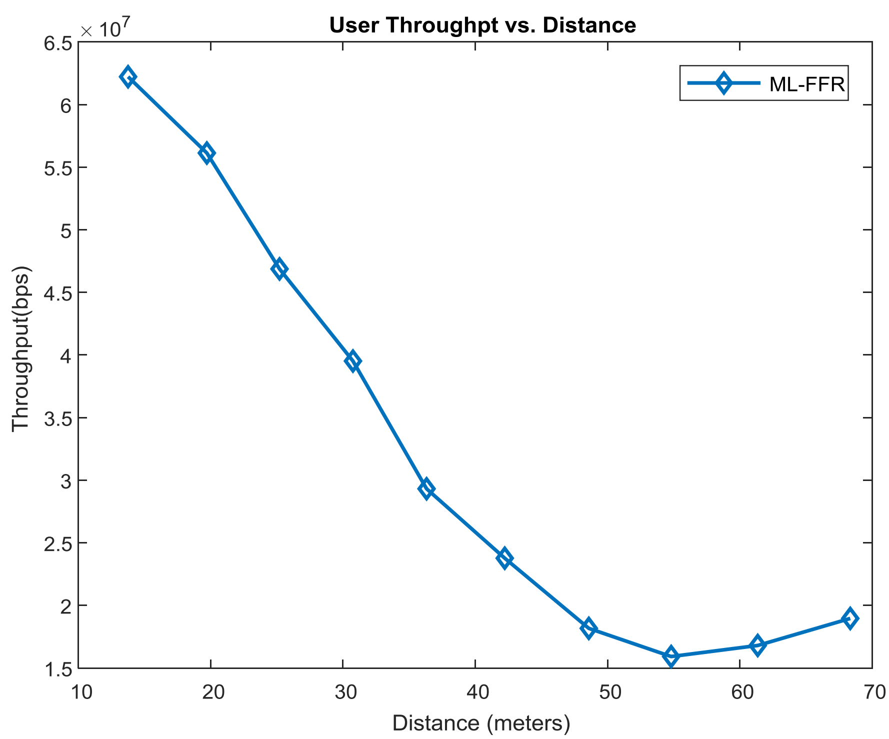

Fig. 5User Throughput v/s Distance

International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 393-398 June 2018-Dec 2018 www.csjournals.com

The user throughput with respect to distance for ML-FFR is as shown in Fig. 5. It shows that the user throughput for inner region is up to 62 Mbps and for cell edge region is up to 18 Mbps. The overall performance of user throughput is better in ML-FFR schemes as compared to [8].The CDF of Average cell throughput is as shown in Fig. 6. It shows that the average cell throughput is up to 330Mbps.

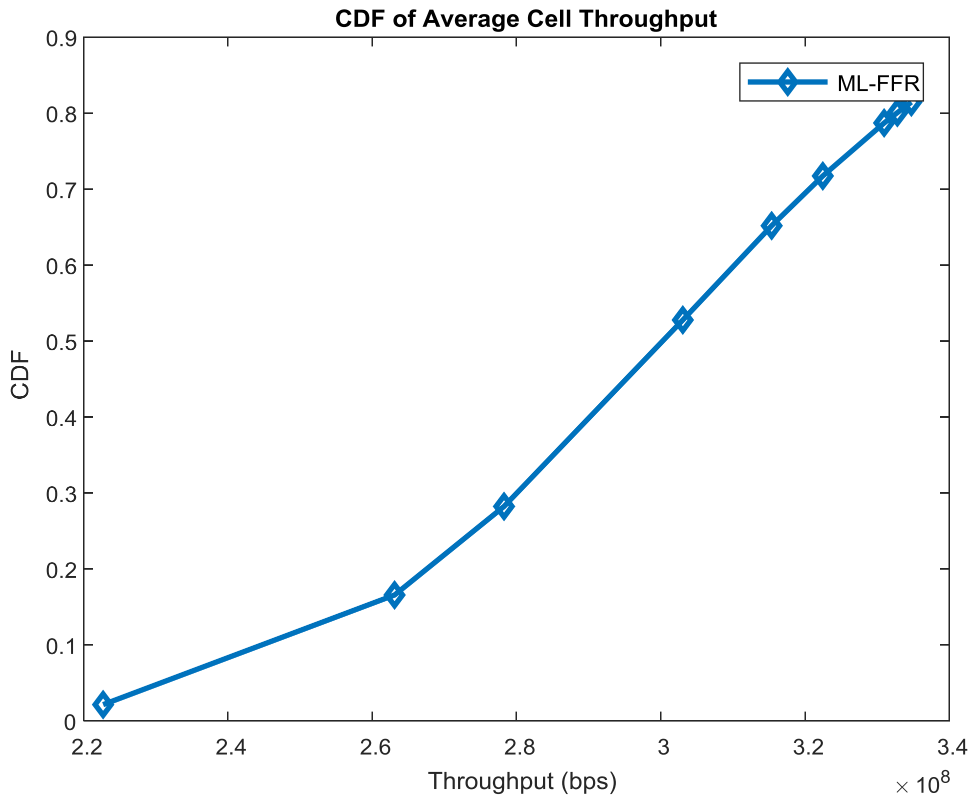

Fig. 6 CDF of Average Cell Throughput

Conclusion

The increasing number of user in network increases network traffic load. The frequency reuse pattern 1 increases efficiency of spectrum at the expense of interference. The fractional frequency reuse schemes acts as solution to inter-cell interference. The two-level FFR scheme improves the performance of cell exterior region user. The users in the middle region of cell get poor SINR value in two-level FFR. The multi-level FFR scheme helps to improve the performance of user in terms of data rate irrespective of geographical location of user. The multi-level FFR scheme improves the SINR value of user at the cell exterior region, In proposed scheme the throughput of user in cell edge region is improved to 18 Mbps and average cell throughput is up to 330Mbps. CDF of user SINR value and throughput of user is improved in ML-FFR as compared to conventional frequency reuse and two-level FFR scheme.

Reference

[1] N. Al-Falahy and O. Alani, "Technologies for 5G Networks: Challenges and Opportunities," IEEE IT Prof., vol. 19, no. 1, pp. 12–20, 2017.

[2] C. Cox, An Introduction to LTE, LTE-Advanced, SAE And 4G Mobile Communications, First Edit. Sussex: John Wiley & Sons, Ltd., 2012.

[3] J. Ikuno, M. Taranetz, and M. Rupp, "A Fairness-based Performance Evaluation of Fractional Frequency Reuse in LTE," in 17th International ITG Workshop on Smart Antennas (WSA),Stuttgart, Germany, 2013, pp. 1–6.

[4] M.Assaad, "Optimal fractional frequency reuse (FFR) in multicellular OFDMA system," in IEEE 68th Vehicular Technology Conference (VTC 2008-Fall), Calgary, Canada, 2008, pp. 1–5.

[5] M. Taranetz, J. Colom Ikuno, and M. Rupp, "Capacity density optimization by fractional frequency partitioning," in 45th Asilomar Conference on Signals, Systems and Computers, Pacific Grove, CA, USA 2011, no. November, pp. 1398–1402.

[6] H. Elmutasim, O. Mohamed, M. Adil, and M. Abas, "Fractional frequency reuse in LTE networks," in 2nd World Symposium on Web Applications and Networking (WSWAN), Sousse, Tunisia 2015, pp. 1–6.

[7] A. Adejo, S. Boussakta, and J. Neasham, "Interference Modelling for Soft Frequency Reuse in Irregular Heterogeneous Cellular Networks," presented at the ninth International Conference on Ubiquitous and Future Networks (ICUFN), Milan, Italy, July 4-7, 2017.

[8].Naser Al-Falahy, Omar Y.K. Alani, "Network Capacity Optimisation in Millimeter Wave Band Using Fractional Frequency Reuse", IEEE Access Journal, Vol. 06, pp. 10924-10932, October 2017.