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Improvement of Coexistence of LTE Femtocell Network with Dynamic Resource Allocation

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Abstract: In the current scenario, interference is one of the most challenging problems we are facing in femtocell deployment under the coverage of existing macrocell. Allocation of resources between femtocell and macrocell is essential to counter the effects of interference in dense femtocell networks. Advances in resource management strategies have improved the control mechanism for interference reduction at lower node density, but most of them are ineffective at higher node density. In our research work, a dynamic resource allocation management algorithm for spectrum shared hybrid access is accomplished in a femtocell network. In base paper only throughput is represented with FAP but in our research work we set up cognitive radio network (CRN), comparison between power used by Femto cell and macro user and power factor is very important parameters in our daily life and when there is comparison between Femto and macro Femto cell user consume very less power as compared to macro. Besides this, in our research work, we show the throughput and power used by Femto cell at different floor and result clearly shows that if Femto cell used on the same floor then coverage area will be more with respect to that if used at different floor. Power consumption between macro and Femto user shows us that Femto user utilizes very less power as compared to the macro user.

Keywords: Dynamic, Femto cell, QoS, Orthogonal, Interleaved, LTE, Localized, QAM, Optimization.

I. INTRODUCTION

Small cell size and short transmission distance are two of the most effective ways to improve spectral efficiency and cellular coverage. The deployment of femtocells based on orthogonal frequency-division multiple access (OFDMA) has been promoted to effectively use the precious spectrum, however, the true benefit of femtocell networks will be limited without proper configuration [1-2]. Due to spectrum scarcity, femtocells and macro cells are encouraged to share frequency spectrum. Femtocell is the smallest type of small cell used to expand cellular network connectivity within a targeted geographic area (typically a small, single location). In addition to being the smallest in the family of small cell technologies, Femtocell also uses the least amount of power; and, as such, they don't offer as much of an impact when attempting to expand network connectivity [4-7].



Figure 1 Femtocell for Home

Just like they're used for applications in the home, Femtocell architecture is fully capable of hooking into an office's existing broadband network to provide cellular service to everyone inside. If the office's internet backhaul is extensive enough, several Femtocells can even be strategically placed around the office in order to provide expanded network coverage [10-12].

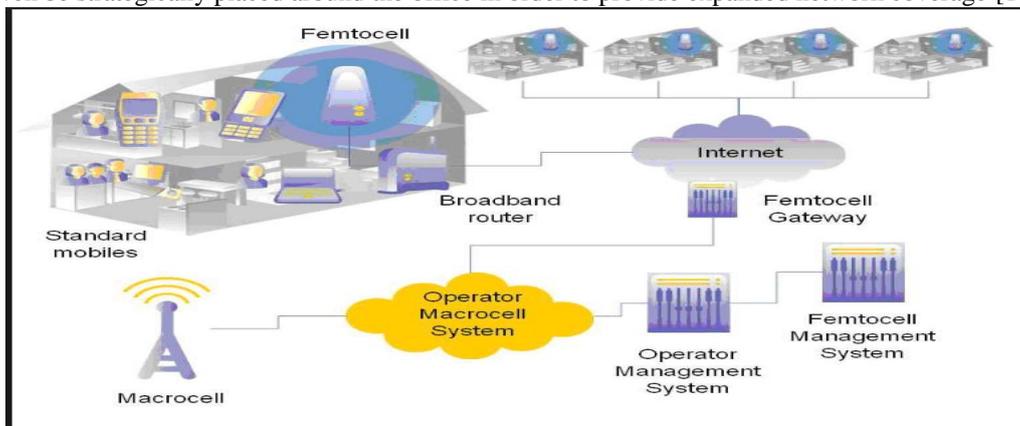


Figure 2 Femtocell Management Systems

In fact, compared to other types of small cells, like picocells and microcells, femtocells offer the least amount of additional bandwidth, so they should only be deployed in specific situations [14]. Despite having limited capacity, Femtocells have certain advantages over other small cell devices that benefit both the home user and businesses alike. Because of their low powered nature, Femtocell implementation is less expensive than its counterparts, and in some situations, can provide mobile users with better cellular connectivity. In current cellular network services, about 50% of phone calls and 70% of data services take place indoors. For such indoor use cases, network coverage is a critical issue. One way to improve the indoor performance is to deploy the so called femtocell access points (FAPs) besides macrocell base stations (MBSs). The use of femtocells does not only benefit the users but as well as operators. As the distance between transmitter and receiver is reduced, users will enjoy high-quality links and power savings [17-19].

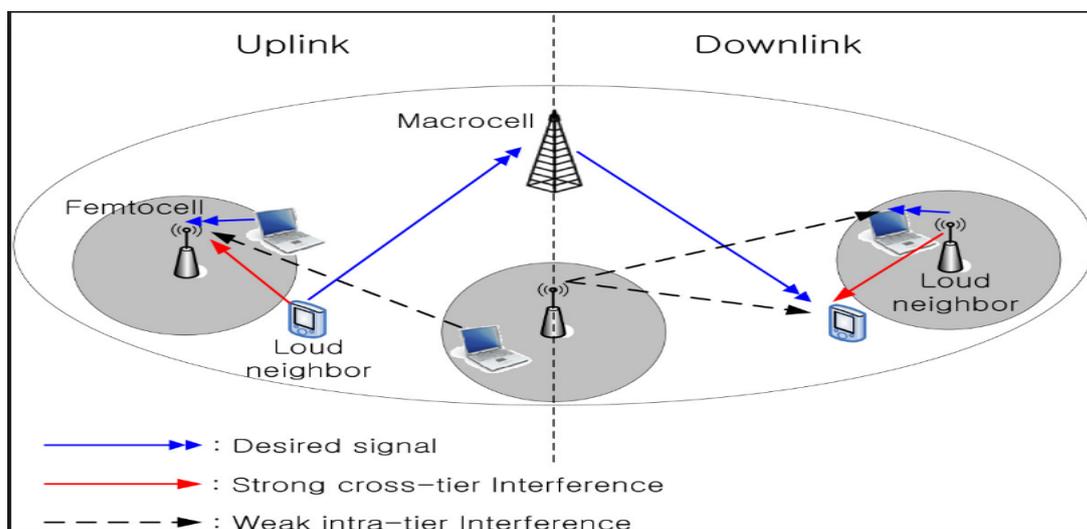


Figure 3 Uplink Downlink cross-tiers, intra-tier network model for hybrid access Femtocell

Access control mechanisms play an important role in mitigating cross-tier interference and handover attempts, which is why they have to be carefully chosen depending on the customer profile and the scenario under consideration. The goal of this article is to provide an overview of the existing access methods [15] to femtocells (i.e., open, closed, and hybrid), as well as to describe in detail the benefits and drawbacks of each of them. Furthermore, the business case, scenarios, and technical challenges of different access mechanisms along with some potential solutions are presented. In addition, system-level performance analyses of these methods in terms of network outages, throughput, and handover are provided.

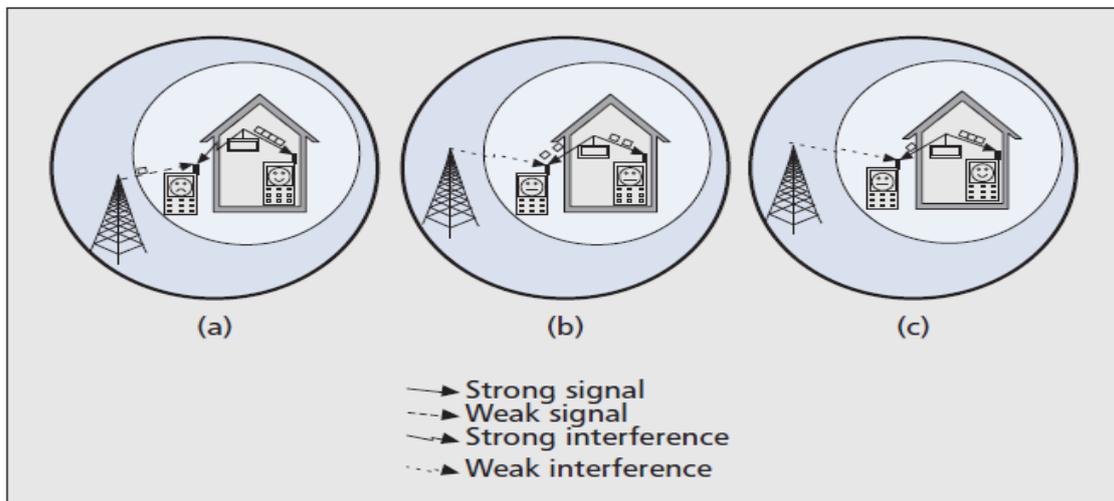


Figure 4 Access methods: a) closed subscribers group (CSG) (b) open access (c) hybrid access.

II. LITERATURE SURVEY

Wireless Communication is a broad and dynamic field that has spurred tremendous excitement and technological advance over the last few decades. Wireless Communication is, by any measure, the fastest growing segment of the communications industry. As such it has captured the attention of the media and the imagination of the public [13]. Cellular systems have experienced exponential growth over the last decade and there are currently about two billion users worldwide. An evolution path from second generation digital cellular CDMA networks to third generation networks is depicted in the following figure:

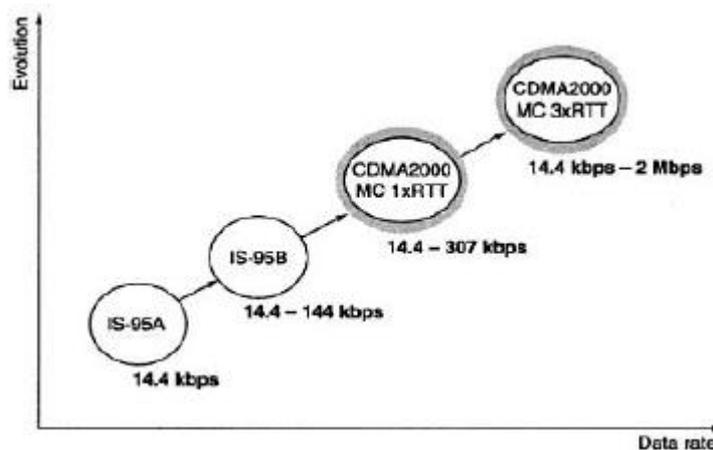


Figure 5 Evolution paths from GSM to 3G network

Interference control and quality-of-service (QoS) awareness are the major challenges for resource management in orthogonal frequency-division multiple access femtocell networks. This paper investigates a self-organization strategy for physical resource block (PRB) allocation with QoS constraints to avoid the co-channel and co-tiered interference. Femtocell self-organization including self-configuration and self-optimization is proposed to manage the large femtocell networks. We formulate the optimization problem for PRB assignments where multiple QoS classes for different services can be supported, and interference between femtocells can be completely avoided [21]. A cognitive femtocell is a new small cell based on a smart home base station to solve the spectrum-scarcity problem. Recently, dedicated resource allocation for cognitive femtocells is extensively researched to mitigate the co-channel interference. However, the cognitive femtocell may suffer from the lack of frequency resource for its users due to high data traffic load of the macrocell. In this paper, we propose a novel resource allocation scheme based on the channel sensing and the spatial radio resource reuse mechanism, which enables Femto users in the cognitive femtocell to obtain more feasible radio resource [22]. Abbas et.al paper proposes a new joint power control and resource allocation algorithm in OFDMA femtocell networks. We consider both QoS constrained high-priority (HP) and best-effort (BE) users having different types of application and bandwidth requirements. Our objective is to minimize the transmit power of each femtocell while satisfying a maximum number of HP users and serving BE users as well as possible. This optimization problem is multi-objective NP-hard. Hence, we propose a new scheme based on clustering and taking into account QoS requirements of users [23].

III. PLANNING OF WORK/METHODOLOGY

Hybrid access femtocell divides radio resources of a femtocell into two regions for non-CSG and CSG users. This method guarantees the CSG members' throughput is not affected by sharing the resource with non-CSG users. In this work, we focus on

Frequency Division Duplex systems, and the allocation of the resources is based on Orthogonal Frequency Division Multiple Access (OFDMA), which means it is done in terms of resource blocks of 12 subcarriers, the minimum unit that can be allocated to a user [8]. When the same spectrum is utilized by two BSs, the resulting interference is evaluated through the achieved Signal to Interference and Noise Ratio of the users. Two mechanisms are proposed that dictate femtocell transmission parameters. The first coordinates femtocells and macrocells, to establish hybrid access mode for femtocells when required. The second takes place between femtocell clusters, i.e. multiple Femto BS deployments in a small area, and how they coordinate their power transmission, to relief the performance reduction of an individual Femto BS, because of its hybrid access operation [3].

Power control for femtocell cluster: Multiple femtocells within a small area are a highly possible future scenario. Inadequate services in an area will probably lead many different individuals to the femtocell solution. When a non-subscribed user is located near such a cluster of femtocells, he may experience high interference. The main source of the interference will most likely be the closer femtocell, but neighboring femtocells will also contribute. In hybrid access mode above, the femtocell would allow access to its resources to the non-subscribed user. This, however, will reduce the capacity of its subscribed users while the rest femtocells will remain unaffected. Below, we propose a scheme according to which all femtocells in the cluster have to share the burden of providing services to the non-CSG user [9]. When a femtocell serves a nonsubscriber, its capacity decreases depending on the level of access it provided to the user. In a cluster, its capacity suffers due to neighbouring femtocells, too.

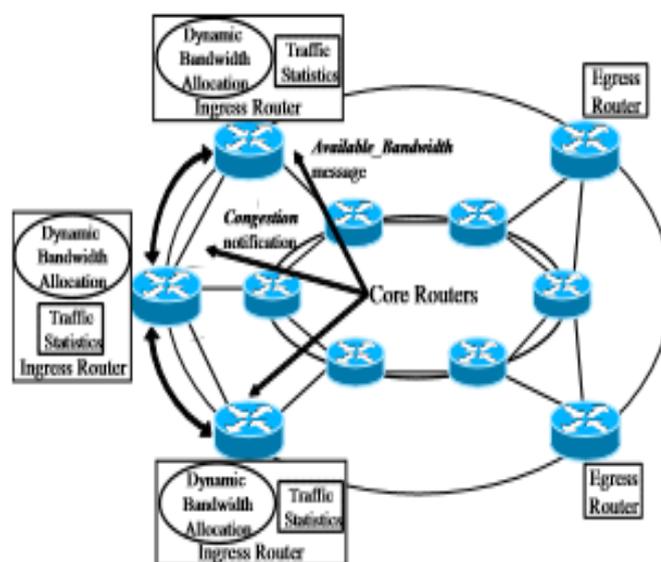


Figure 6 Proposed distributed architecture that supports dynamic bandwidth allocation

Hybrid Access Femtocells In the two-tier network

We consider two types of access points, MBSs and FAPs. The MBSs constitute the macro cell tier, and they induce a Voronoi tessellation of the plane

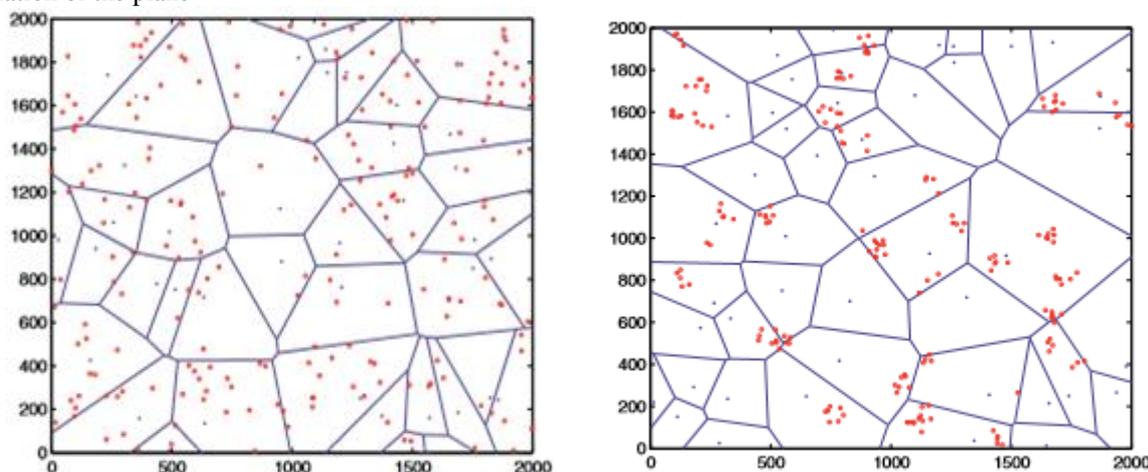


Figure 7 Voronoi macrocell topology in which each Voronoi cell is the coverage area of a macrocell and each small circle represents a femtocell

IV. SOFTWARE USED AND SIMULATION RESULT

Software: MATLAB Version R2015a: It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format. It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation. Figure represents that if we install Femto cell at different floor then converge area will be different with respect to each other and if we compared coverage area of each Femto cell with respect to other we find that on the same floor at which Femto cell installed cover more area wrt another floor

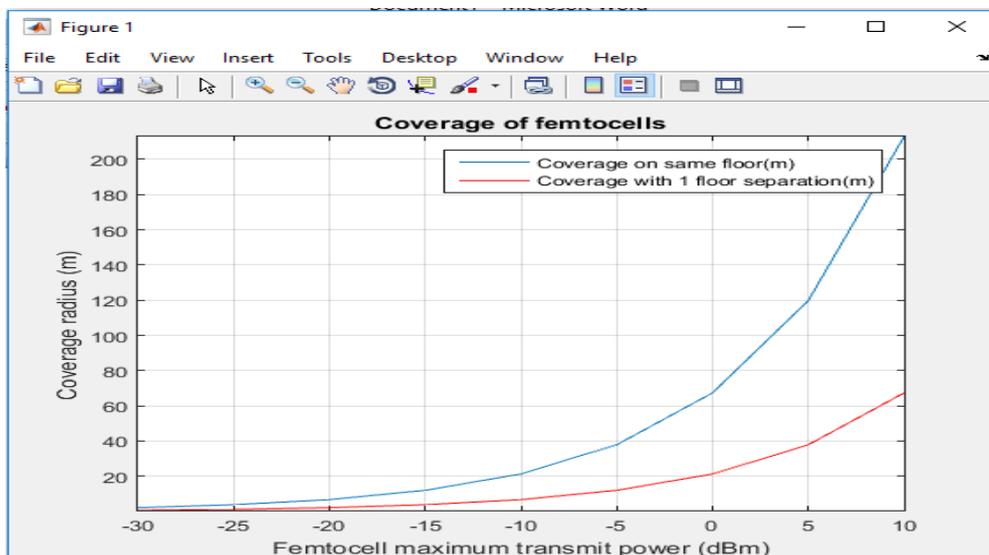


Figure 8 Coverage of Femto cell at different floor

As we see in our daily life if there are more users in a cell then the quality of service decreases and vice versa. Therefore in the same scenario, as Femto cell increases definitely throughput decreases but not too much as depicted in figure 9

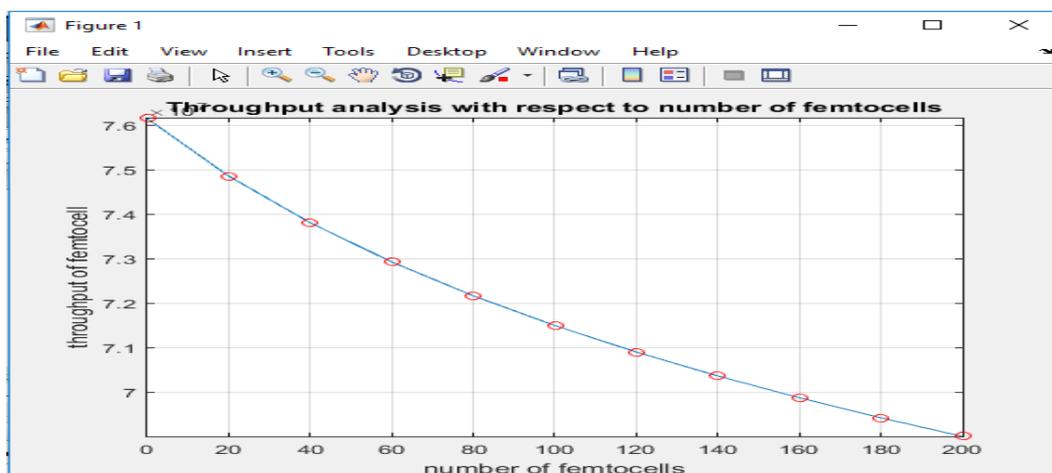


Figure 9 Throughput of Femto cell wrt femtocell

In our daily life, we come across a situation that power consumption must be minimum so this figure represents power comparison between Femto and macro cell and we know Femto cell definitely consume less power as compared to macro cell

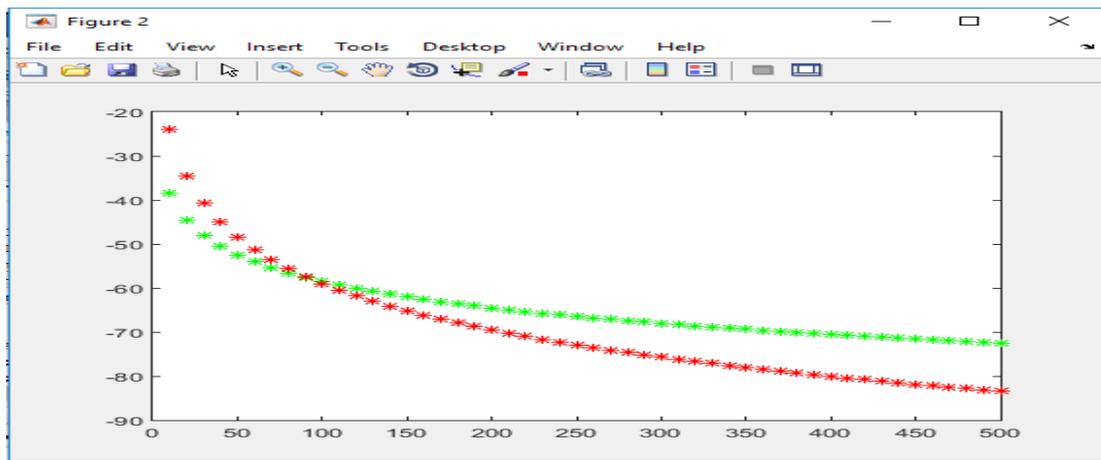


Figure 10 Femto and Macro power comparison

Now we will make Cognitive radio network or we can say that dynamic resource allocation strategy and the different graph will be depicted for different number no parameters. To form cognitive radio network FAP=5, Femto User=10, Non real time user=15 and total iteration executed to set up a CRN are 38 and its CRN are depicted below

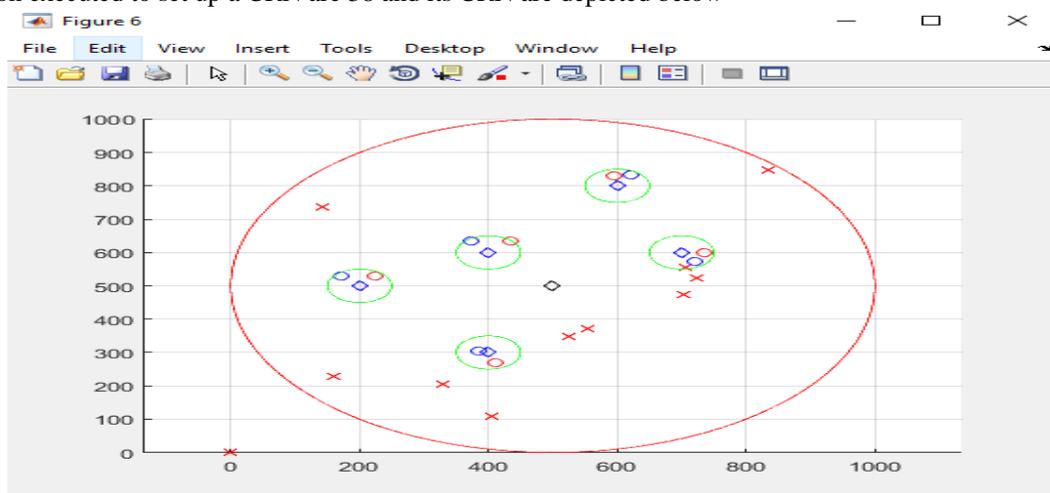


Figure 11 Cognitive radio networks with 5 FAP

Figure 12 shows power consumed by Femto user 38 iterations took place to set up CRN and initially we assign 2 watt maximum power and in Femto cell power consumed used by the user is very less.

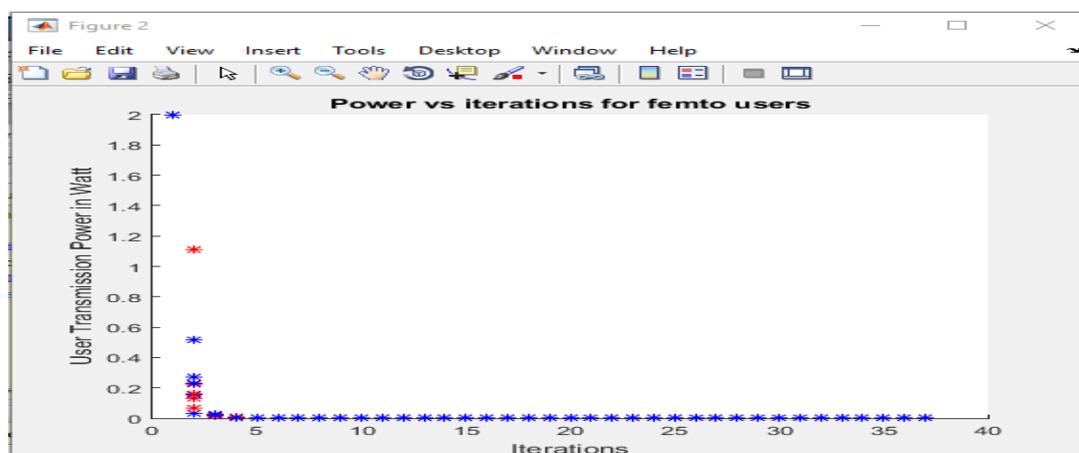


Figure 12 Femtocells power consumption with respect to iteration

Figure 13 shows power consumed by the macro user and 38 iterations took place to set up CRN and if we compare Femto power consumption with respect to macro then macro cell consume more power as wrt Femto cell.

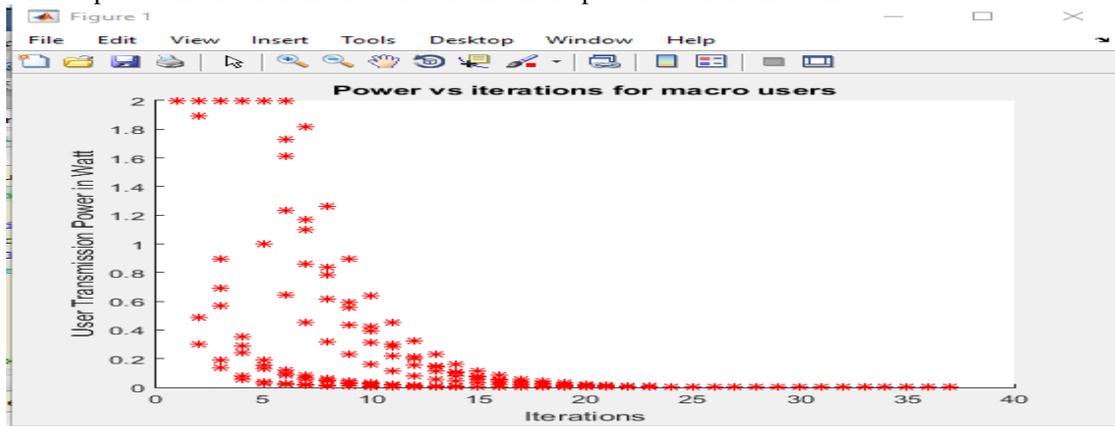


Figure 13 Macrocells power consumption wrt iteration

To form cognitive radio network FAP=10, Femto User=20, Non real time user=30 and total iteration executed to set up a CRN are 22 and its CRN are depicted below

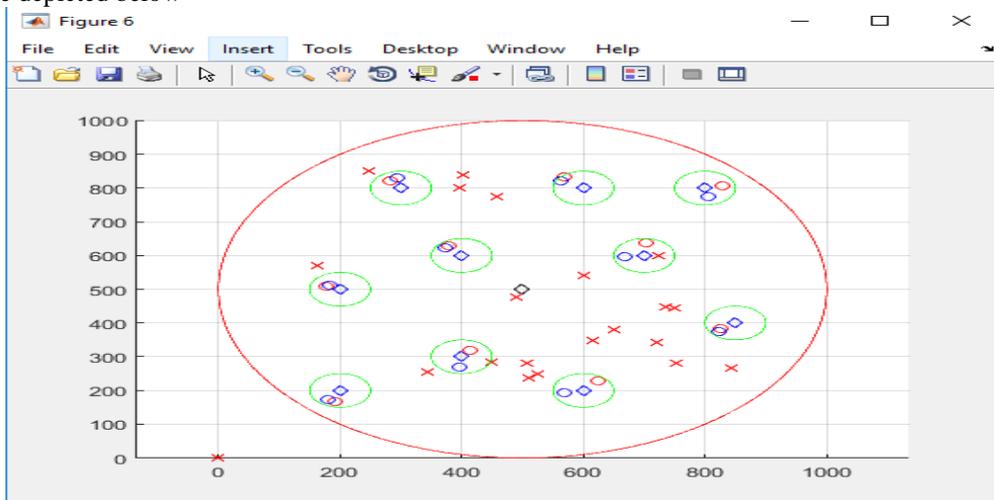


Figure 14 Cognitive radio networks with 10 FAP

To form cognitive radio network FAP=15, Femto User=30, Non real time user=50 and total iteration executed to set up a CRN are 28 and its CRN are depicted below

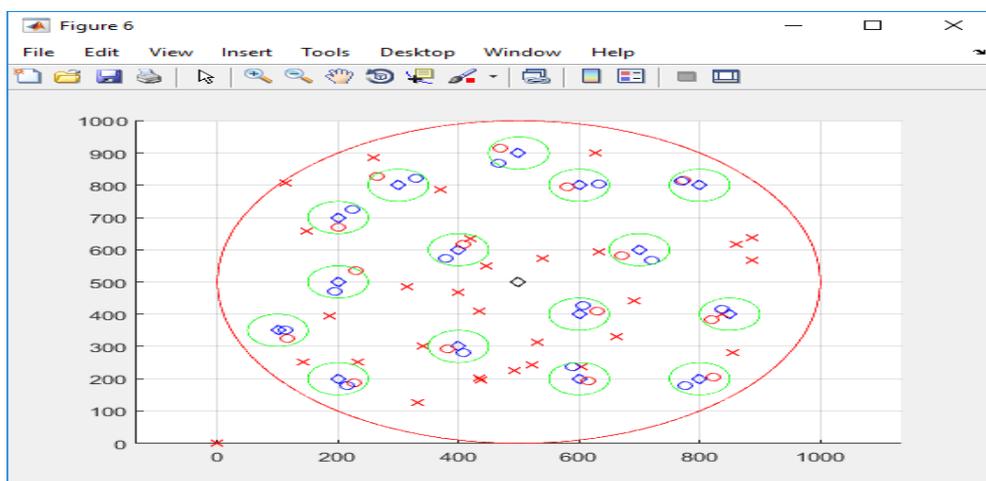


Figure 15 Cognitive radio networks with 15 FAP

In the same way, we can represent Femtocells power consumption and Macrocells power consumption with respect to iteration as in the case of 5 FAP in very first case.

CONCLUSION

With the pace of time, new technologies came into existence and also demand increasing day by day for high speed and quality of service at low cost. There are two types of users RT users and NRT users and earlier we used macro cell, micro cell, pico cell and now Femto cell which resided in the home or with in the office and we have to face lot of challenges so need to adapt advance algorithm so that resources can be used optimized. Inter cell interference is one of the most challenging issues in femtocell deployment under the coverage of existing macrocell. Allocation of resources between femtocell and macrocell is essential to counter the effects of interference in dense femtocell networks. Advances in resource management strategies have improved the control mechanism for interference reduction at lower node density, but most of them are ineffective at higher node density. In this paper, a dynamic resource allocation management algorithm (DRAMA) for spectrum shared hybrid access OFDMA femtocell network is proposed. In base paper only throughput is represented with FAP but in our research work we set up cognitive radio network (CRN), comparison between power used by Femto cell and macro user and power factor is very important parameters in our daily life and when there is comparison between Femto and macro Femto cell user consume very less power as compared to macro.

Besides this, in our research work, we show the throughput and power used by Femto cell at different floor and result clearly shows that if Femto cell used at the same floor then coverage area will be more with respect to that if used at different floor.

REFERENCES

- [1] G. de la Roche, A. Valcarce, D. L'opez-P'erez, and J. Zhang, "Access control mechanisms for femtocells," *IEEE Communications Magazine*, vol. 48, no. 1, pp. 33–39, 2010.
- [2] A. U. Ahmed, M. Islam, R. Azim , M. Ismail, andM. F.Mansor, "Microstrip antenna design for femtocell coverage optimization," *International Journal of Antennas and Propagation*
- [3] P. Xia, V. Chandrasekhar, and J. G. Andrews, "Open versus closed access femtocells in the uplink," *IEEE Transactions on Wireless Communications*, vol. 9, no. 12, pp. 3798–3809, 2010.
- [4] M. Zuair, "Development of an access mechanism for femtocell networks," *Journal of Theoretical and Applied Information Technology*, vol. 51, no. 3, pp. 434–441, 2013
- [5] H.-S. Jo, P. Xia, and J. G. Andrews, "Open, closed, and shared access femtocells in the downlink," *EURASIP Journal on Wireless Communications and Networking*, vol. 2012, article 363, 2012.
- [6] R. M. Radaideh and M.-S. Alouini, "Switched-Based Interference Reduction Scheme for Open-Access Overlaid Cellular Networks," *IEEE Transactions on Wireless Communications*, vol. 11, no. 6, pp. 2160–2172, 2012
- [7] S. Wang, F. Huang, M. Yuan, and S. Du, "Resource allocation for multiuser cognitive OFDM networks with proportional rate constraints," *International Journal of Communication Systems*, vol. 25, no. 2, pp. 254–269, 2012
- [8] J. Zhang, Z. Zhang, H. Luo, W. Wang, and G. Yu, "Initial spectrum access control with QoS protection for active users in cognitive wireless networks," *International Journal of Communication Systems*, vol. 25, no. 5, pp. 636–651, 2012.
- [9] K. D. Nguyen, H. N. Nguyen, and H. Morino, "Performance study of channel allocation schemes for beyond 4G cognitive femtocell-cellular mobile networks," in *IEEE Eleventh International Symposium on Autonomous Decentralized Systems (ISADS '13)*, pp. 1–6, Mexico City, Mexico, March 2013.
- [10] W. Zheng, H. Zhang, X. Chu, and X. Wen, "Mobility robustness optimization in self-organizing LTE femtocell networks," *EURASIP Journal on Wireless Communications and Networking*, vol. 2013, article 27, 2013
- [11] C.-Y. Oh, M. Y. Chung, H. Choo, and T.-J. Lee, "Resource allocation with partitioning criterion for macro-femto overlay cellular networks with fractional frequency reuse," *Wireless Personal Communications*, vol. 68, no. 2, pp. 417–432, 2013.
- [12] S.Wang, J. Wang, J. Xu, Y. Teng, and K. Horneman, "Fairness guaranteed cooperative resource allocation in femtocell networks," *Wireless Personal Communications*, vol. 72, no. 2, pp. 957–973, 2013.
- [13] E. Oh and C. Woo, "Performance analysis of dynamic channel allocation based on the greedy approach for orthogonal frequency-division multiple access downlink systems," *International Journal of Communication Systems*, vol. 25, no. 7, pp. 953–961, 2012.
- [14] C.Olariu, J. Fitzpatrick, P. Perry, and L.Murphy, "A QoS based call admission control and resource allocation mechanism for LTE femtocell deployment," in *Proceedings of the IEEE Consumer Communications and Networking Conference (CCNC '12)*, pp. 884–888, Las Vegas, Nev, USA, January 2012.
- [15] J. L. Chen, S. W. Liu, S. L. Wu, and M. C. Chen, "Cross-layer and cognitive QoS management system for next-generation networking," *International Journal of Communication Systems*, vol. 24, no. 9, pp. 1150–1162, 2011.
- [16] Y.-S. Liang, W.-H. Chung, G.-K. Ni, Y. Chen, H. Zhang, and S.-Y. Kuo, "Resource allocation with interference avoidance in OFDMA femtocell networks," *IEEE Transactions on Vehicular Technology*, vol. 61, no. 5, pp. 2243–2255, 2012.
- [17] W.-S. Lai, M.-E. Chiang, S.-C. Lee, and T.-S. Lee, "Game theoretic distributed dynamic resource allocation with interference avoidance in cognitive femtocell networks," in *Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC '13)*, pp. 3364–3369, Shanghai, China, April 2013
- [18] D. L'opez-P'erez, X. Chu, A. Vasilakos, and H.Claussen, "Power minimization based resource allocation for interference mitigation in OFDMA femtocell networks," *IEEE Journal on Selected Areas in Communications*, vol. 32, no. 2, pp. 333–344, 2014.

- [19] J.-H. Yun and K.G. Shin, "Adaptive interference management of OFDMA femtocells for co-channel deployment," IEEE Journal on Selected Areas in Communications, vol. 29, no. 6, pp. 1225–1241, 2011.
- [20] D. Fooladivanda and C. Rosenberg, "Joint resource allocation and user association for heterogeneous wireless cellular networks," Wireless Communications, IEEE Transactions on, vol. 12, no. 1, pp. 248–2257, 2013.
- [21] L. Le, D. Niyato, E. Hossain, D. Kim, and D. Hoang, "QoS-aware and energy-efficient resource management in OFDMA femtocells," IEEE Transactions on Wireless Communications, vol. 12, no. 1, pp. 180–194, 2013.
- [22] F. Mhiri and G. Pujolle, "Cognitive interference management for autonomic femtocell networks," International Journal of Applied Information Systems, vol. 2, no. 2, pp. 40–48, 2012
- [23] F. Tariq, L. S. Dooley, A. S. Poulton, and Y. Ji, "Dynamic fractional frequency reuse based hybrid resource management for femtocell networks," in Proceedings of the 7th International Wireless Communications and Mobile Computing Conference (IWCMC '11), pp. 272–277, Istanbul, Turkey, July 2011