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Assessment of Dynamic Spectrum Allocation Technique in Heterogeneous Network

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Abstract

Mobile devices are becoming the priority of access to a growing trend of online services. As services use higher quality images & video, an increase of wireless network capacity is required. In this case, spectrum is a way to go. Even though capacity is important, there are other factors as well, for example, coverage, flexibility and resilience. Dynamic spectrum access technology allows higher transmission power according to location & safe sharing with licensed users (LU). Dynamic spectrum allocation (DSA) technique enhances the spectrum efficiency for the users in Heterogeneous Network. This paper explains about the findings that are observed by two different researches that are related to our research title. The first paper is about the basic OFDM structure using GNU Radio software and implemented using USRP hardware. The second research is about the implementation of Dynamic Resource Allocation for LTE using GNU Radio. The first research explained about the advantages and disadvantages of OFDM configuration. The second research explained more about the implementation of Dynamic Resource Allocation in the uplink and downlink configuration, and are tested using three algorithms; Max-sum, max-min and max-product. All the results are obtained from GNU Radio. However, the results are not implemented using USRP because of the short amount of time. Based on these two researches, we identified the advantages and disadvantages of the proposed designs and develop our own design to mitigate the cross-tier interference in multi-tiers HetNets.

Keywords*: We would like to encourage you to list your keywords in this section*

1. Introduction

Latest advancements in 4th generation cellular technology; the Long Term Evolution /Advanced (LTE/LTE-A) are mainly directed towards the pursuit of increased throughput. As it can be observed, both frequency and time domains had been overworked to augment this Orthogonal Frequency Division Multiplexing (OFDM) system's capacity. There are many mitigation methods that have been discussed to mitigate the interference that exists in communication networks. Frequency Partitioning Method is one of them. It uses the cochannel access approach in femtocell networks and partitions the whole frequency band into several non-overlapping parts and allocate different parts to the macrocell and femtocells in different regions [1]. Intelligent Scheduling is also one of the mitigation methods for co-tier interference that exists between LTE femtocells. This method helps to reduce the Cross-tier interference that maximizes the cell total throughput. It also gives

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better SINR ratio that is useful to implement in LTE network [2]. Besides that, Resource Partitioning Technique proposed muting of tiny cells. It is said to offer better quality of service to the macrocell users, eliminating macrocell coverage holes, which are present in the regions between neighboring picocells. The proposed function adds fairness to the system by offering corresponding bitrates to the users [3]. Spectrum Efficiency and Management of Cross-Tier Interference in Femtocell Network has additionally been broke down in [4]. It presents Dynamic cross-level impedance coordination component (D-CTIC) and is utilized just when the meddled client hardware can't guarantee its Quality of administration requirement. Consequently, higher cell spectrum effectiveness can be accomplished by enduring a specific level of cross-level interference. In view of the perceptions made in the specified past papers, the interference mitigation strategies disregard the usage of Dynamic Spectrum Allocation. In view of [5], adjoining designation still uses neighboring squares of range allotted to various systems, and are isolated by a reasonable monitor band. This plan permits the range dividing to change to the detriment of the frightfully contiguous other framework's range. The improvement of element frequency allotment strategies that consider the application necessities, nearness of different gadgets in the area and connection picks up between the transmit-get sets [6]. Examine in [7] planned an incorporated DSA plan to upgrade the range usage and boost the benefit of administrators for agreeable remote systems. Other than that, DSA are likewise utilized for other sort of systems too. For instance, in [8-9], they presented the DSA calculation for psychological systems by concentrate the specialized practicality of DSA in a multi-innovation and multi-administrator perspective.

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2. OFDM Configuration

All The study conducted in [10] showed the step by step instructions on how to construct the basic OFDM configuration using GNU Radio software. GNU Radio is a software development toolkit that provides signal processing blocks to implement software-defined radios and signal-processing systems [11]. The blocks for the transmission and reception flow graphs are as shown in Figures 1, 2, 3 and 4 below [11]:

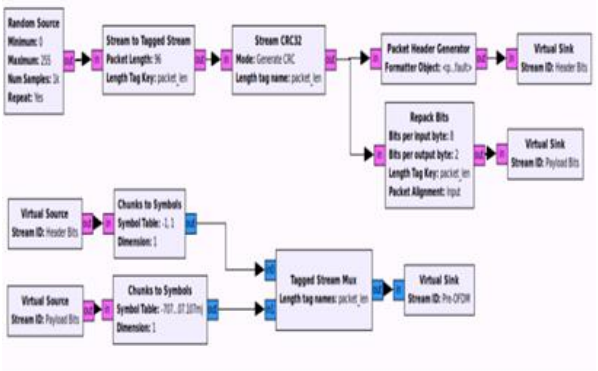

Figure 1. Mapping the Data in Packets for Transmission

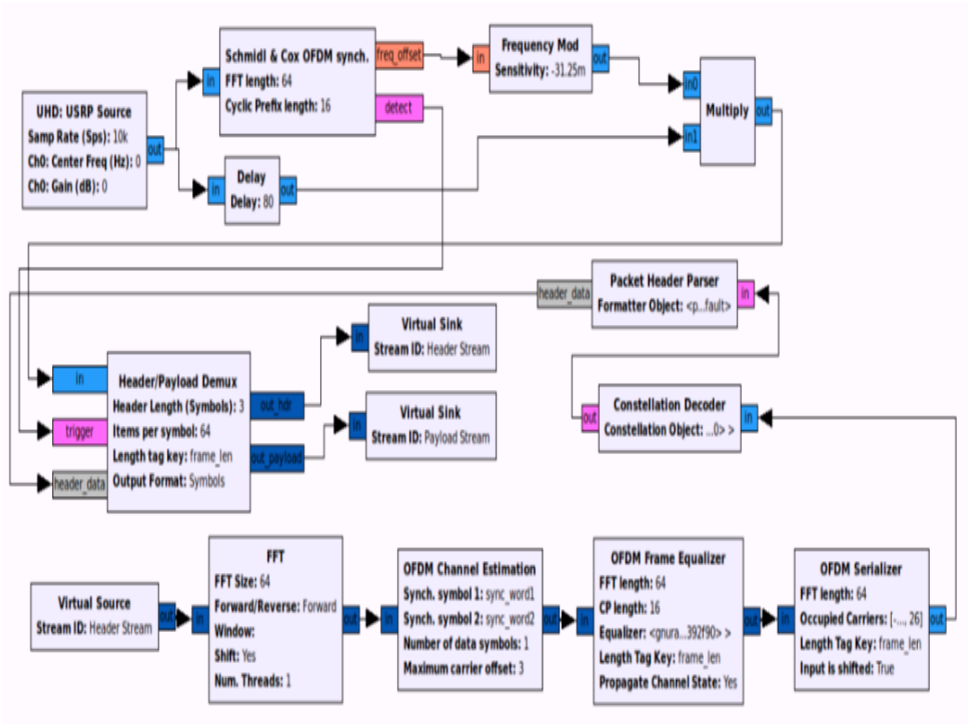

Figure 2. Implementing OFDM and Transmission

Reception flow graph:

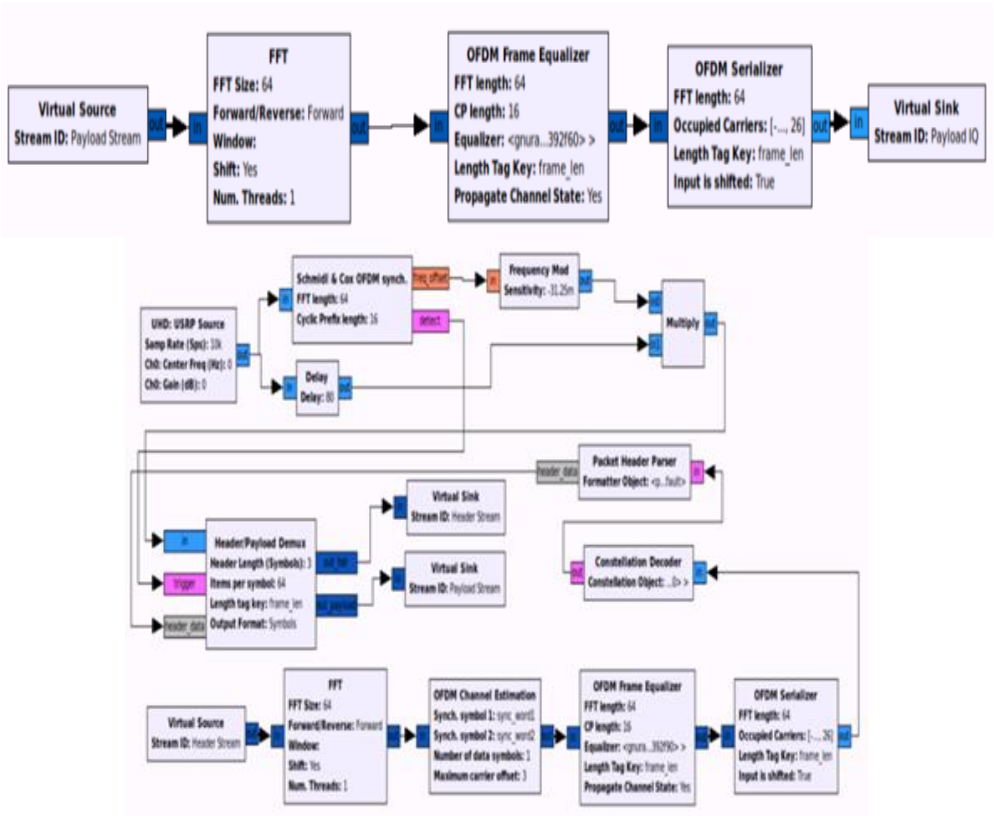

Figure 3. Reception and Equalization through Frames

Figure 4. Fetching Data Back after Demodulation

3. DSA System Model

By studying the research done in [12], Dynamic Resource Allocation is implemented for LTE System Using GNU Radio. It studied about the vital issues in wireless communication and dynamic resource allocation for OFDM based systems. It also implements a simplified signal processing structure for an LTE communication system using GNU Radio. Our design will be made to mitigate the cross tier interference that exists at HetNets. This research is also implemented using USRP hardware. The considered interference scenario is presented in Figure 5.

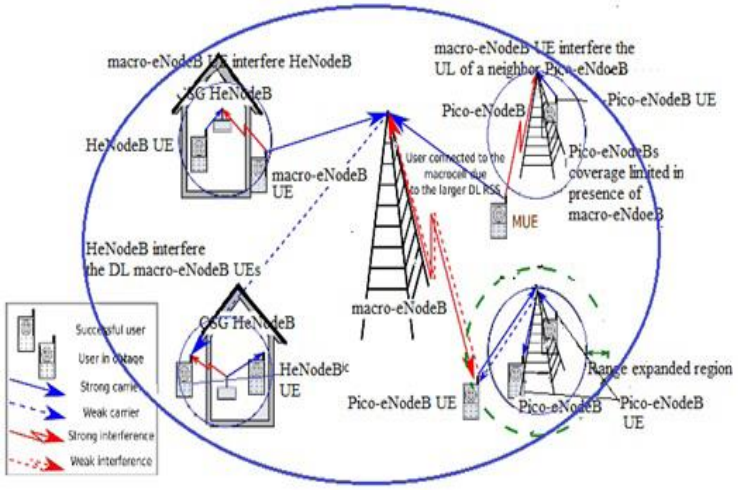

Figure 5. Interference Scenario in Heterogeneous Network [2]

Our design will consist of two base stations and several user devices. In our flow graph, we will construct new blocks that will represent different base stations and user devices. From this, cross tier interference will occur, and by implementing dynamic spectrum allocation scheme, the interference will then be mitigated [13]. We will also add some additional noise to determine the best way to mitigate the interference caused by the HetNets and also the noise. The result of the project will be seen and analyzed using GNU Radio. Lastly, we will implement the design using USRP to ascertain that our design is suitable for communication technologies in real life. This research comprised of three typical dynamic resource allocation algorithms; Max-sum, Max-min and Nash Bargaining Game, and Water filling algorithm. The communication logic of user device & base station is the establishment of communication using distinctive three-way model and the packet allocation and identification. The flow graph of DSA is shown in Figure6 and Figure7 [10].

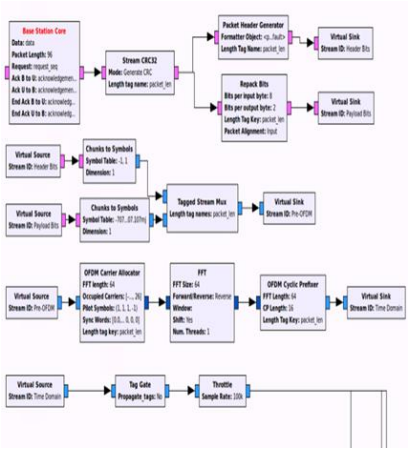

Figure 6. OFDM Modulator Flow Diagram Constructed Iin GNU Radio [10]

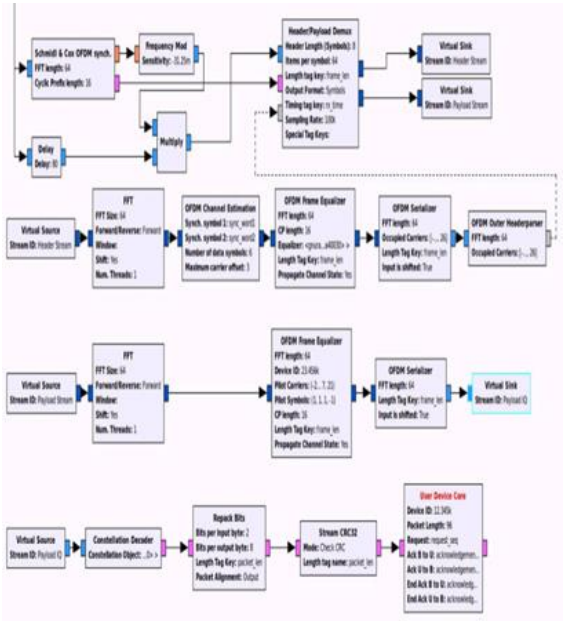

Figure 7. The Flow Graph of OFDM Demodulator Built by GNU Radio [10]

4. Result and Discussion

The figure shows the signal received from the flow graph of the Transmission blocks without additional noise. Based on the results, we can know the advantages and disadvantages of OFDM.

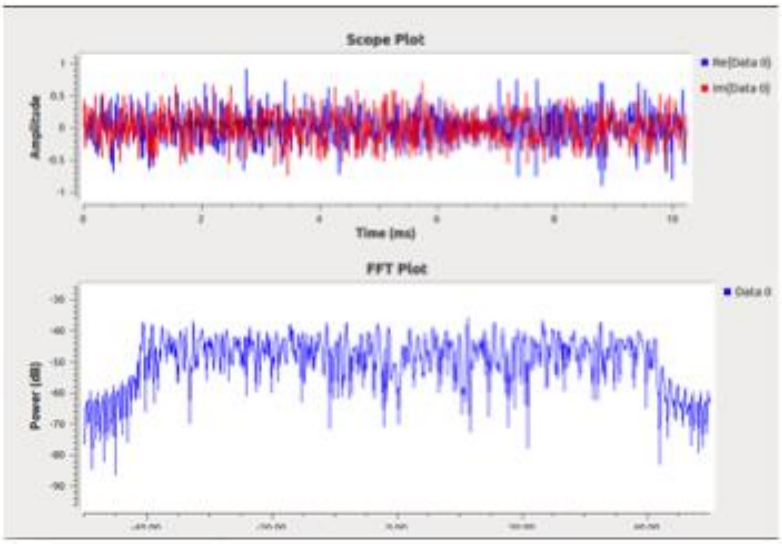

Figure 9. OFDM Signal from [10]

The advantages of OFDM include reduced ISI because of the presence of Cyclic Prefix block. It eliminates ISI in single-path channels and minimizes it in multi-path channels. Spectrum use is additionally one of the upsides of OFDM it permits simple channel estimation and leveling, through known settled images (pilot images). It is only backings parcel exchanging progressively [14]. One of the prevalent methods is MIMO frameworks which can be fundamental to alleviate impedance in OFDM. Another procedure is versatile regulation and element control portion which additionally can be actualized utilizing GNU radio to moderate obstruction as a part of OFDM framework. The primary issue of OFDM framework is the affected ability to synchronization blunders and especially with recurrence synchronization issues and everything can turn out severely. To be sure, demodulation of an OFDM motion with a balance in the recurrence can prompt to a high piece blunder rate. We could watch this impact plainly while accepting the flag through an RTL-SDR dongle when little recurrence blunders prompt to parcel drop. Therefore, the pieces actualized keeping in mind the end goal to portray OFDM framework.

5. Conclusion

In conclusion, we have discovered several mitigation techniques that can help in reducing or minimizing the interference occurrence in communication networks. After observing the previous papers, there is no doubt that Dynamic Spectrum Allocation is one of the best techniques for interference mitigation in cellular networks. Based on the two studies that we have closely examined, we now know how to construct the basic OFDM configuration and implementation of Dynamic Spectrum Allocation by using a software defined radio called GNU Radio. The future recommendation of this study is to implement the extended level of the proposed DSA implementation in OFDMA system by using USRP based testbed.

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