The Brief Review on the Analysis of Frequency Reuse Methods

Kundan Kumar Pramanik, Assistant Professor

Department of Engineering & IT, Arka Jain University, Jamshedpur, Jharkhand, India

Email Id: kundan.parmanik@arkajainuniversity.ac.in

ABSTRACT: Frequency Reuse Techniques are needed to satisfy the fast growth in information needs across different networks, such as the Long Term Evolution (LTE) structure of the Universal Mobile Terrestrial Radio Access System (UMTS). Cell-edge clients, on the other hand, suffer cell obstruction due to the concurrent use of a similar Frequency in neighboring LTE cells. Techniques such as Between Cell Interference Coordination (ICIC) are utilized to prevent the negative effects of blockage on framework execution. This research examined how reuse-1 and reuse-3 plans are presented in different client circulations and structured current ICIC methods. The execution of cell-focus and cell-edge clients is examined, as well as phantom efficacy, throughput, and organization load. Framework level reenactments are used to determine which ICIC technique is most suitable to employ by showing the advantages and limits of each of the studied methods under various client circulations.

KEY WORDS: LTE, Pulse, Communication, Modulation, Demodulation

1. INTRODUCTION

Long-term commitment Third Generation Partnership Project (3GPP) in Toronto in 2004 and officially started as LTE work thing in 2006. Evolution is a big job defined by third Generation Partnership Project (3GPP) in Toronto gathering of 3GPP in 2004 and formally began as LTE work thing in 2006. LTE is the most cutting-edge 4G technology for both GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access) cell companies. When compared to previous generation mobile networks, LTE as a transition from 3G has achieved amazing limits and speed. As a result, LTE must meet a number of important level requirements, as follows [1]:

1. Lower per-bit cost

2. Open interfaces and a simple architecture

3. Use of existing and future frequency bands with flexibility

4. Terminal power that is reasonable

5. Improved customer experience—more services at a cheaper cost and at a faster rate [2].

LTE innovation is important since it will enhance cell companies' execution by multiple times and increase their overall productivity. It is an excellent invention for assisting high date rates for services like as voice over IP (VOIP) and videoconferencing. Time Division Duplex (TDD) and Frequency Division Duplex (FDD) modes are used [3].

Frequency Reuse:

Every cell in distant communication has its own transmitter (Base Stations) and a collection of channels. These channels are usually 8 to 10 in number, with a couple used for voice control and others for information control. Thus, if a city has 100 base stations, the total number of channels will be in the thousands, despite the fact that the TRAI has set a predetermined range (Telecom Regulatory Authority of India). In the event that each channel has its own recurring transfer speed, the range will be measured in gigabytes. That is outside the scope of TRAI's jurisdiction. As a result, you'll need to figure out a way to deal with these channels. Recurrence Reuse or Frequency Planning is the arrangement [4].

Problem: There have recently been two major challenges for developing LTE organizations:

- How to get updated framework limits[5].
- How can cell inclusion territory be improved?
- Recurrence reuse methods are used to enhance the limit and cell inclusion.

- The entire recurrence is repeated, these techniques suffer from the negative effects of between cell impedance at cell limit.

So, in order to resolve the problem of between-cell impedance, we shall use these recurrent reuse methods and conduct their exhibition research [6].

Objectives:

From the literature review it is concluded that Frequency Reuse Techniques have been studied by various researchers and there is lot of scope for research in this area. Therefore objectives for our Research are:

- To study the Frequency Reuse Techniques[7].
- Spectrum Sharing Techniques installation using LTE-Sim; Frequency Reuse Techniques efficiency comparison.

Inter-cell interference severely limits the performance of cellular networks. Several solutions, including as frequency reuse techniques and dispersed antenna systems, have been suggested to alleviate this interference (DAS). The combinations of hard frequency reuse (HFR) and soft frequency reuse (SFR) approaches with DAS in a unique cell layout, dubbed DAS–HFR and DAS–SFR, respectively, are investigated in this study. In terms of average spectral efficiency, this research analyzes the performance of the downlink multi-cell for DAS–HFR and DAS–SFR. This also demonstrates that the best frequency reuse approach relies not only on the maximum attainable data rate within the cell, but also on the maximum guaranteed data rate (the minimum achievable data rate which is necessary to be obtained regardless of geographic location). When frequency reuse factor 1 is used, the findings reveal that DAS–SFR enhances the attainable data rate of cell edges in a multi-cell environment when compared to DAS–HFR. When frequency reuse factor 3 is used, the findings reveal that DAS–SFR greatly boosts system capacity when compared to DAS–HFR. Technique for boosting the overall capacity of a radio system without increasing its assigned bandwidth by employing a certain range of frequencies several times in the same radio system. Frequency reuse methods need appropriate separation between signals that utilize the same frequencies so that reciprocal interference is kept to a minimum. Frequency reuse may be done for satellites by transmitting with orthogonal polarization states and/or employing satellite antenna (spot) beams that serve different, non-overlapping geographic areas. Also see spot beam[8].

Long Term Evolution (LTE) is a key project that was outlined by the 3rd Generation Partnership Project (3GPP) at their Toronto conference in 2004 and was formally launched as an LTE work item in 2006. For both GSM (Global System for Mobile Communication) and CDMA (Code Division Multiple Access) cellular networks, LTE is the next-generation 4G technology. In comparison to previous generation cellular networks, LTE has reached significant capacity and fast speed as a transition from 3G. As a result, LTE must meet the following high-level requirements:

1. Lower per-bit cost

2. Open interfaces and a simple architecture

3. Use of existing and future frequency bands with flexibility

4. Consumption of terminal power that is reasonable

5. Improved customer experience—more services at a lesser cost and at a faster rate

LTE technology is significant because it will increase cellular networks by up to 50 times in terms of performance and spectral efficiency. It's a suitable technology for applications like Voice over IP (VOIP) and videoconferencing that need high data rates. Time Division Duplex (TDD) and Frequency Division Duplex (FDD) modes are both used[9].

Each cell in wireless communication has its own transmitter (Base Station) and channel group. These channels are usually 8 to 10 in number, with some utilized for voice control and others for data control. As a result, if a city has 100 base stations, the equivalent number of channels will be in the 1000s, yet the TRAI has set a fixed spectrum allocation (Telecom Regulatory Authority of India).

If each channel has its own frequency bandwidth, the total amount of spectrum available will be measured in gigabytes. TRAI has no control over this. As a result, a solution to control these channels is required. Frequency Reuse or Frequency Planning is the answer. Long Term Evolution Simulator (LTE-Sim) is an open source framework for simulating LTE networks created by Giuseppe Piro, Luigi Alfredo Grieco, Gennaro Boggia, Francesso Capozzi, and Pietro Camarda. The Evolved Universal Terrestrial Radio Access (E-UTRAN) and the Evolved Packet Core System (EPS) were both included in the created LTE Simulator (LTESim).

It supports single and heterogeneous multi-cell settings, Quality of Service management, multi-user environments, Frequency Reuse methods, user mobility, and handover processes in both single and heterogeneous multi-cell environments. A variety of network nodes are emulated in this simulator, including user equipment (UE), evolved Node B (eNB), Home eNB (HeNB), and Mobility Management Entity/Gateway (MME/GW).

It supports the implementation of four separate traffic generators at the application layer, as well as data radio bearer management. The capability for using Frequency Reuse methods is offered to overcome interference between nearby cells. The LTE radio access is based on Orthogonal Frequency Division Multiplexing (OFDM), which allows for a wide range of bandwidth options (from 1.4 to 20 Mhz). Multiple access mechanisms such as frequency division duplex (FDD) and time division duplex (TDD) are supported.

In a temporal frequency domain, radio resources are divided among users. At the start of each sub frame, the eNB allocates radio resources between uplink and downlink flows. LTE-Sim supports the LTE system’s six channel bandwidths as well as cellular frequency reuse. Finally, the Frame Manager is in charge of TDD and FDD.

2. REVIEW OF LITERATURE

A paper titled “Analysis of Frequency Reuse Techniques in LTE Network” by Seema 1st and Ashok 2nd discusses the Long Term Evolution is a crucial job defined by 3rd Generation Productive Resources (3GPP) at Toronto meeting of 3GPP in 2004 and officially begun as LTE work it [1]. For both GSM (Global System for Mobile Communication) and CDMA (Code Division Multiple Access) cellular networks, LTE is the next-generation 4G technology. Frequency Reuse Techniques are required to meet the outstanding increase in information requests in diverse networks, such as the Long Term Evolution (LTE) organization of Universal Mobile Terrestrial radio access System, as a transition from 3G has achieved great capacity and high speed as compared to previous generation cellular networks (UMTS). However, the concurrent usage of a comparable Frequency in adjacent LTE cells causes cell-edge clients to experience cell blockage. To avoid the detrimental effect of obstruction on framework execution, techniques called Between Cell Interference Coordination (ICIC) are used. This study organized existing ICIC techniques and looked at how reuse-1 and reuse-3 plans are presented in various client circulations. The execution of cell-focus and cell-edge clients, as well as phantom effectiveness, throughput, and organization load, are all investigated. Framework level reenactments are performed to demonstrate the benefits and drawbacks of each of the examined methods under different client flows, which is used to choose the most appropriate ICIC process to be used[10].

3. DISCUSSION

This paper discusses about the Long-term dedication The Third Generation Partnership Project (3GPP) was founded in Toronto in 2004 and became an official LTE project in 2006. Evolution is a major undertaking that was outlined by the third Generation Partnership Project (3GPP) in Toronto in 2004 and officially started as LTE work in 2006. For both GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access) cell operators, LTE is the most cutting-edge 4G technology. LTE, as a shift from 3G, has attained incredible limitations and speed when compared to prior generation mobile networks.

LTE innovation is critical because it will improve cell company performance by a factor of ten and boost overall productivity. It's a fantastic technology for helping with high data rates for applications like voice over IP (VOIP) and videoconferencing. The modes employed are Time Division Duplex (TDD) and Frequency Division Duplex (FDD) .In remote communication, each cell has its own transmitter (Base Station) and set of channels.

There are normally 8 to 10 of these channels, with a handful for voice control and others for information control. Despite the fact that the TRAI has established a preset range, if a city has 100 base stations, the total number of channels will be in the thousands (Telecom Regulatory Authority of India). The range will be calculated in gigabytes if each channel has its own repeating transfer speed. That is not within the purview of the TRAI. As a consequence, you'll have to devise a strategy for dealing with these channels. The arrangement is called recurrence reuse or frequency planning.

Each cell has its own transmitter (Base Station) and channel group in wireless communication. There are normally 8 to 10 of these channels, with some used for voice control and others for data control. As a consequence, if a city has 100 base stations, the corresponding number of channels will be in the thousands, despite the fact that the TRAI has established a fixed spectrum allotment (Telecom Regulatory Authority of India).

The total amount of spectrum accessible will be calculated in gigabytes if each channel has its own frequency bandwidth. TRAI has no say in the matter. As a consequence, a control solution for these channels is needed. The solution is Frequency Reuse or Frequency Planning. Long Term Evolution Simulator (LTE-Sim) was designed by Giuseppe Piro, Luigi Alfredo Grieco, Gennaro Boggia, Francesco Capozzi, and Pietro Camarda as an open source framework for modeling LTE networks. The LTE Simulator includes both the Evolved Universal Terrestrial Radio Access (E-UTRAN) and the Evolved Packet Core System (EPS) (LTESim).

In both single and heterogeneous multi-cell environments, it enables single and heterogeneous multi-cell settings, Quality of Service management, multi-user environments, Frequency Reuse techniques, user mobility, and handover operations. In this simulator, user equipment (UE), evolved Node B (eNB), Home eNB (HeNB), and Mobility Management Entity/Gateway (MME/GW) are all simulated network nodes.

It allows for the development of four different traffic generators at the application layer, as well as the management of data radio bearers. To avoid interference between close cells, the possibility to employ Frequency Reuse techniques is provided. The radio access for LTE is based on Orthogonal Frequency Division Multiplexing (OFDM), which provides a broad variety of bandwidth possibilities (from 1.4 to 20 Mhz). Multiple access techniques are offered, including frequency division duplex (FDD) and time division duplex (TDD).

Radio resources are shared among users in a temporal frequency domain. The eNB divides radio resources between uplink and downlink flows at the start of each sub frame. The six channel bandwidths of the LTE system, as well as cellular frequency reuse, are supported by LTE-Sim. Finally, TDD and FDD are managed by the Frame Manager.

4. CONCLUSION

Recurrence Reuse Techniques are implemented in the LTE test system, and their near-term investigation is carried out based on various parameters such as throughput, spectral efficiency, network load, and so on. In the LTE test system, Recurrence reuse one and Improved Recurrence reuse three calculations are carried out. At that moment, the recurrence scheduler starts working on these two computations, and their display is evaluated based on these limits. Spectral Efficiency, Throughput, and Organization Load are some of the boundaries used to investigate the performance of these techniques. When compared to Frequency Reuse 3, Recurrence Reuse 1 has a better Spectral Efficiency. When the number of customers is low, Frequency Reuse 3 performs better in terms of network load. The Network load on Frequency Reuse 3 increases as the number of customers grows. The Cumulative Distribution Function is used to analyze the throughput of both Frequency Reuse 1 and Frequency Reuse 3. In comparison to Reuse 1, this capacity has the highest throughput due to Frequency Reuse 3. Improved Frequency reuse three is better than Frequency reuse three in phantom productivity, obstruction commotion percentage, network load, and throughput, according to the consequences of execution. When comparing the exhibition of Improved Frequency Reuse Three to the Frequency Reuse Three depending on different boundaries after calculating the presentation rate, it is clear that the exhibition of Improved Frequency Reuse Three is increased by approximately 4-5 percent. This demonstrates better performance when compared to the Reuse three computation.

REFERENCES:

[1] E. Dahlman, S. Parkvall, and J. Skold, *4G: LTE/LTE-Advanced for Mobile Broadband*. 2013.

[2] J. Sachs, G. Wikstrom, T. Dudda, R. Baldemair, and K. Kittichokechai, "5G Radio Network Design for Ultra-Reliable Low-Latency Communication," *IEEE Netw.*, 2018, doi: 10.1109/MNET.2018.1700232.

[3] A. Khandekar, N. Bhushan, J. Tingfang, and V. Vanghi, "LTE-advanced: Heterogeneous networks," 2010, doi: 10.1109/EW.2010.5483516.

[4] A. Damnjanovic *et al.*, "A survey on 3GPP heterogeneous networks," *IEEE Wirel. Commun.*, 2011, doi: 10.1109/MWC.2011.5876496.

[5] W. Cai *et al.*, "Increased frequency of extreme La Niña events under greenhouse warming," *Nat. Clim. Chang.*, 2015, doi: 10.1038/nclimate2492.

[6] Y. Zaki and Y. Zaki, "LTE Network Simulator," in *Future Mobile Communications*, 2013.

[7] B. Bangerter, S. Talwar, R. Arefi, and K. Stewart, "Networks and devices for the 5G era," *IEEE Commun. Mag.*, 2014, doi: 10.1109/MCOM.2014.6736748.

[8] M. P. Pase *et al.*, "Sugar- and Artificially Sweetened Beverages and the Risks of Incident Stroke and Dementia: A Prospective Cohort Study," *Stroke*, 2017, doi: 10.1161/STROKEAHA.116.016027.

[9] K. Walton *et al.*, "Secular trends in family dinner frequency among adolescents Public Health," *BMC Res. Notes*, 2016, doi: 10.1186/s13104-016-1856-2.

[10] S. Palat and P. Godin, "Network Architecture," in *LTE - The UMTS Long Term Evolution: From Theory to Practice*, 2009.