International Journal on Applications in Information and Communication Engineering
Volume 6 : Issue 2 : May 2020 , pp 16 –22 www.aetsjournal.com ISSN (Online) : 2394 - 6237

Macro Bss And Decentralized Micro Bss In Hcn Focus On Providing High Transmission Distance And Smart Grids

A Wasimraja, S. Kanithkar, K. Balaji, K. Dharmaprakash
Department of Computer Science and Engineering,
Rathinam Technical Campus, Coimbatore, Tamilnadu, India

Abstract - It is possible to implement and configure heterogeneous cellular networks (HCNs) if they are designed in some kind of a manner that takes the information importance of high user activity. This is one of the conditions that must be met for this to be the case. It is expected that large amounts of user activity will be distributed in a manner that is not uniform across wireless networks. As a consequence of this, achieving high levels of energy effectiveness in HCN will be fraught with a considerable measure of difficulty. Research has been carried out specifically for the objectives of this study in order to investigate the energy efficiency (EE) of HCNs. Configuring and establishing the base station as intended is one approach that might be taken to address the issue of low energy efficiency. This would be the initial step in the process of solving the problem. In addition to this, we determine the quality of service, the transmission rate, the static power of the base station, and the intensity (QoS). Formulas are provided here that can be applied in order to figure out how efficient HCN is in terms of energy use. These formulas can also be used to demonstrate quantification correlations with the appropriate data. These pieces of information can be used to calculate the amount of energy that can be saved by combining the BS density and BS transmit power in order to come up with the most efficient solution possible. This can be done in order to determine which solution will be the most beneficial. There is also a selection of control methods that can be utilized, such as micro BS sleep regulation, control over the expansion of bandwidth, and control over the reduction of throughput. The results of our simulations have been presented in order to evaluate the theories that we have developed and the regulatory systems that we have proposed; both of these have the potential to significantly improve energy efficiency. In addition, the regulatory systems that we have proposed have the potential to reduce carbon emissions.

Keyword: Energy Efficiency; High COverage zrange; HCN; micro BSS

I. INTRODUCTION

Small-scale, relatively brief system level assessments include statistical traffic models (such as FTP shared folders or VoIP calls), specific small-scale revealed a marked (such as an urban macro-cell with 57 hexagonal cells and uniform distribution users), and electricity product lines that quantify the power consumption of components within one node. Examples of these types of evaluations include a macro-cell with 57 hexagonal structure and uniform distribution users (bottom block in Fig. 1.1). Conducting system level performance reviews on a small scale and over a short period of time enables for a thorough overview of the energy consumption at the base station.

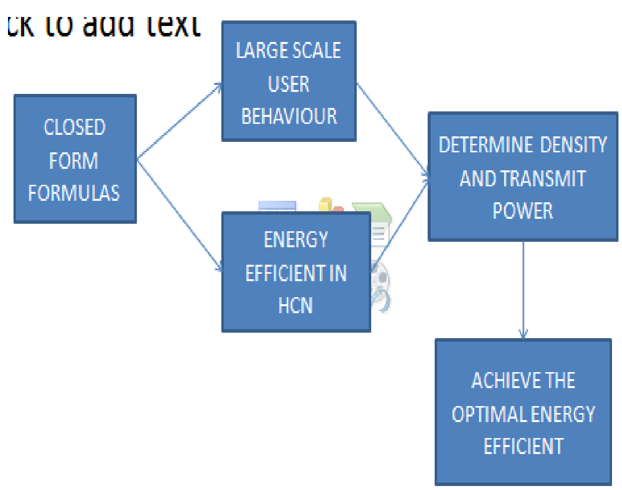
System level evaluations are conducted on a platform for system level simulation, which is complemented with a model that represents the BS power consumption. Fig. 1.2 A schematic illustration diagram of something like a complete BS that can be applied to all different kinds of BSs, which include macro, micro, micro - level, and femto BSs, is what this symbol conveys. A base station (BS) is made up of multiple transceivers, or TRXs, and each of these transceivers is responsible for providing service to a single data transmission antenna structure. A baseband (BB) interface is made up of a frequency transmitter and receiver part, a modem firmware (BB) interface with such a receiver (uplink) and transponder (downlink) section, a Power supply, an energetic cooling system, as well as an AC-DC unit (mains supply) for linkage to the electrical power grid. Additionally, a baseband (BB) interface includes an active cooling system. This section will provide an overview as well as a breakdown of the various TRX components. Antenna Interface: In order to represent the effect that the type of antenna has on the power efficiency, it is necessary to take into account a certain amount of losses. It is necessary to take into consideration the feeder, music group filters for the transmitter, duplexers, and perfectly matched components when calculating these losses. It is necessary to take into account a feeder loss of approximately feed=3 dB in order to take into account the fact that macro BS stations are typically situated in different different places than their antennas. The addition of a multiple antennas head (RRH) for which the PA is situated at the same specific address as the transmit antenna is required in order to get rid of the feeder loss that is encountered by a macro base station. In a similar vein, feeder losses for BSt varieties with a lesser degree of importance are frequently nonexistent.

It has been demonstrated that high-capacity networks (HCNs), which would include both conventional macro base stations and dispersed low power BSs, have both a superior spectral efficiency (SE) and a higher energy efficiency. [Citation needed] (EE). Confirmation that the deployment of low power base stations typically results in increased effective energy, despite the fact that it was evidenced that this benefit will eventually reach a point of saturation as the density of reduced power base stations increases. As a direct consequence of this, tremendous momentum has been gained over the past several years in the performance assessment of HCNs and the design of their systems to maximize energy efficiency.

Location of BS:

There is a possibility that the positioning of ground stations will have a major influence on the throughput and breakdown effectiveness of a network. When HCNs are being analyzed or designed, however, the positions are typically unknown in the vast majority of cases. The spatial stochastic process model is utilized rather frequently in the process of simulating the locations of BSs. The Poisson Point Process (PPP) and the Poisson Cluster Process are two examples that are included in this paradigm (PCP).

Recent work has resulted in the development of a model for a downlink HCN consisting of multi-tier ground stations that is tractable, adaptable, and accurate. It was possible to conduct an analysis of significant metrics including the Signal-to-Interference-plus-Noise-Ratio (SINR), the coverage probability, and the average rate. In order for mobile networks to maintain with the incremental increase in traffic, the architecture is getting thicker [1]; traditional macro network nodes (BSs) are being augmented with small-cell BSs which thus function as trouble spots within macro cells. [Cellular networks] need to be able to keep up with the accelerating increase in traffic in order to be successful. [Providers of cellular networks] are working hard keeping up with the exponential growth in the amount of traffic.



Number of methodological and load balancing between many BSs are among the most significant challenges to be addressed in practice. Non - homogenous networks, abbreviated as (HetNets), are commonly used in reference to these types of systems [2], and the term is frequently used to refer to all these types of systems. The infrastructure in today's networks is also not the only variable aspect; user conditions, particularly user mobility, also alter the composition of today's networks. Because users with low mobility inside coexist with users with medium to high mobility outside, traditional cellular networks, also referred to as mobile networks, were intended primarily for use in the open air. However, we may already find significant gap in use cases despite the fact that mobile networks were specifically intended for use in the open air. Mobility as well as the quality of the channel conditions (CSI) that can be obtained at the BSs have a very strong correlation; excessive mobility is an indication that the CSI has a low quality.

The mobility of different types of users is the most important factor that is taken into consideration

$$r_k = D\left(\alpha, \beta_{th}\right) \frac{\lambda_k P_k^{\frac{2}{\alpha}}}{\lambda_M P_M^{\frac{2}{\alpha}} + \lambda_m P_m^{\frac{2}{\alpha}}},$$

where

$$D\left(\alpha, \beta_{th}\right) = \frac{\pi \log\left(1+\beta_{th}\right)}{C\left(\alpha\right) \beta_{th}^{2/\alpha}} + \frac{{}_2F_1\left(1, 2/\alpha, 1+2/\alpha, -1/\beta_{th}\right)\alpha\pi}{2C\left(\alpha\right) \beta_{th}^{2/\alpha}},$$

when making scheduling decisions in traditional networks since these networks employ orthogonal methods to allot their time and frequency resources. On the other hand, contemporary cellular networks are equipped to accommodate multi-antenna transmission, which makes it possible for a large number of consumers to be supplied simultaneously utilizing the same time - frequency resources. Because of this, spatial precoding helps to reduce the amount of interference that occurs between users [3–5]. In light of the fact that participation in CSI is obligatory, E. Bjornson has been awarded financial support from the Swedish Research Organization in the form of an International Postgraduate Grant 2012-228. The Starting Grant 305123 MORE from the European Research Council made it feasible for this research to be conducted (Advanced Mathematical Tools for Complex Network Engineering). Because of this, the question arises as to how the precoding design can adequately take into consideration the movement of the user, which is essential for the efficient suppression of spatial interference [3]. When it comes to precoding with faulty CSI, the vast majority of previous research makes the assumption that all users have the same CSI quality. However, this is not the case in mac protocols (HetNets).

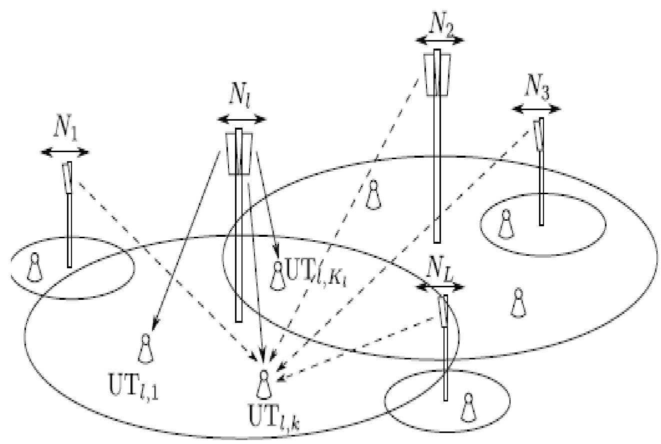


Fig. 1. Illustration of a general heterogeneous downlink system.

An extraordinary departure from the norm was taken by the authors of the paper [6] when they investigated collaborative scheduling and precoding in the downlink of a single-cell system. The authors came to the conclusion that consumers with high mobility should be given orthogonal transmission resources, while users with restricted mobility can only be supplied in a collaborative manner if they have a limited ability to move around. In [7], the authors studied a phone connection with cooperative transmission between the BSs, which led to the development of a result that was extremely similar to the one that was found here. According to the results of the experiment, users who have a high degree of mobility limit the benefit of multiplexing. As a result, it

International Journal on Applications in Information and Communication Engineering
Volume 6 : Issue 2 : May 2020 , pp 16 –22 www.aetsjournal.com ISSN (Online) : 2394 - 6237

would appear that all other users are badly affected when users who have a high degree of mobility are present. Inside the scope of this research, we conduct an analysis of a mobile network in which the users' mobility fluctuates within each cell. In HetNets, where macro base stations provide users with great mobility and small-cell base stations supply users with lower latency, this contrast is critical. In contrast to [7], we address coordinated beam generation, which is a method in which each user is only provided by a single BS, but the recoding throughout the cells is coordinated in order to limit the amount of inter-cell interference that occurs. In order to acquire a fundamental knowledge, we are going to investigate the large-system regime, which is characterized by the simultaneous expansion of the number of user terminals and transmission antennas to an unlimited number while maintaining the ratio. Our most important contribution was the development of deterministic formulae for estimating asymptotic user rates. These formulas can also be used as exact approximations when applied to regimes that are not asymptotically optimal in practice. [Citation needed] [Citation needed] These completely new expressions generalize the work that was done in [8] for single-cell systems and in [9] for multi-cell systems, both of which entail the suppression of inter-cell involvement only by the use of deterministic statistical CSI. [8] and [9] respectively. [8] and [9] independently of one another. In order to take into account the wide range of user mobility, the precoding has already been simplified in comparison to the ideal precoding parameterization that is described in [10]. To provide further clarity, distinct priority weights have been assigned to cells that have varying degrees of user mobility.

The findings of our research indicate that a user's mobility can have a negative impact on the highest rate it is capable of attaining, but it does not have any direct impact on the rates achieved by other users. Users who have limited mobility won't suffer any negative effects as a result of living around people who have better mobility if coordinated beam formation is used for the installation. The cooperative multi -cell transmissions model described in [7] contrasts sharply with this finding in a significant way. Additionally, within the framework of our paradigm, heterogeneity can be handled by either actively increasing or actively decreasing the value of user flexibility.

$$ASR_k = D\left(\alpha, \beta_{th}\right) \frac{\lambda_k^2 P_k^{\frac{2}{\alpha}}}{\lambda_M P_M^{\frac{2}{\alpha}} + \lambda_m P_m^{\frac{2}{\alpha}}}, \quad ($$

and the ASR of HCNs is:

$$ASR = \sum_k ASR_k = D\left(\alpha, \beta_{th}\right) \frac{\lambda_M^2 P_M^{\frac{2}{\alpha}} + \lambda_M^2 P_M^{\frac{2}{\alpha}}}{\lambda_M P_M^{\frac{2}{\alpha}} + \lambda_m P_m^{\frac{2}{\alpha}}} \quad ($$

The point of operation of a PA that is typically the closest to its maximum output power is also the one at which it operates at its most efficient (near saturation). Unhappily, non-linear effects and OFDM modulating with non-constant amplitude signals force the power supply to operate 6 to 12 dB below saturation in a more linear zone. This is because the non-linear effects cause the envelope signals to vary. This is due to the fact that nonlinear processes generate adjustments to the envelope of the signal. Because of this, Adjacent Channel Interference (ACI), which is caused by nonlinear distortion, is avoided, and there is no loss of productivity at the receiver as a result. However, because of this significant operating back-off, the power efficiency PA is quite low, which results in an extremely high power consumption PPA. Increasing the power efficiency and linearizing the PA can be accomplished by combining digital techniques like as clipping and digital which was before with Doherty power amplifiers. This is accomplished while maintaining a manageable level of ACI; however, the approaches used to accomplish this goal require more feedback for pre-distortion as well as a significant increase in signal processing. Despite the fact that these methods are necessary for both macro and micro BSs, they are rarely used since the energy consumption of the PA contributes a lesser share to the power breakdown in smaller BSs. This is because lower BSs allow for an improved operational back-off, which is the reason for this finding.

II. Power Utilization of the BS

The amount of traffic is directly related to the amount of power that a typical BS uses; however, as the amount of traffic declines, it is primarily the energy consumptions of the PA that decreases. This normally takes place whenever the number of occupied subcarriers is decreased during operating in idle mode and/or while there are subframes that do not transport any data. At macro BSs, the PA is responsible for between 55 and 60 percent of the total power consumption when the system is operating at full load. On the other hand, in low power nodes, the PA is responsible for less than 30 percent of the system's overall power consumption. It should come as no surprise that the type of BS has a significant impact on how this scaling over signal load works. The base station power consumption curves for such an LTE network with a bandwidth of 10MHz and a 2x2 MIMO configuration are depicted in Figure 1.3. In the case of macro base stations, three separate sectors are taken into consideration; nevertheless, omnidirectional antennas are used for smaller types of base stations. Although the energy consumption Pin is massive amount for macro and, to a smaller degree, micro BSs, it is load-independent for pico and femto BSs, which means that it is not at all load-dependent. This is in contrast to micro BSs, for which it is load-dependent to a lesser extent. This is due to the fact that the influence of the PA is reduced when it is paired with BSs that have a lower power. Even while other components in a state-of-the-art implementations hardly scale with load, unique designs might nonetheless lead to enhanced power scaling at low loads. For your consideration, the correlations between relative RF output are depicted below in figure 1.3.

III. Heterogeneous Wireless Communications Model

They are protected by a high-capacity network (HCN) that has two tiers and is comprised of normal macro base stations that provide coverage in areas that do not have hotspots and micro base stations that provide adequate traffic capacity in areas that do have hotspots. Two aspects of the visitor volume serve as distinguishing factors between hotspots and other places. To be more specific, the volume and density of traffic demands in hotspots zones are frequently higher than in places that are not considered to be hotspots. In many cases, the size of a hotspot is noticeably less than the size of an area that does not contain a hotspot. It is well knowledge that the allocation of user locations as well as the dispersion of traffic needs are two separate but connected concepts. However, there is a close connection between these two ideas. It is presumed that the locations of users in the two different types of regions follow a uniform distribution with the same density. Despite this assumption, the traffic requirement and size of hotspot regions and non-hotspot regions can vary greatly from one another. It is presumed that the macro and micro base stations, denoted by the notation k M,m, have the same spatial density _k, transmitting power Pk, and SINR threshold k, the latter of which can change depending on the grade. In order to mimic their locations, independent PPPs, which are represented by the letter k, are utilized. Without wishing to narrow the scope of the statement,

IV. The Typical Rate of HCN:

We make the assumption that the ordinary user is connected to the BS that provides the highest possible SINR and that this user is located within the coverage area if the highest possible SINR is higher than the threshold for the received SINR, Bk. In non-hotspot and hotspot zones, respectively, both macro and micro base stations are utilized to guarantee network coverage and match the demands of the traffic in such regions. Because of this, it is projected that users in non-hotspot zones and persons in hotspot zones will be attached to macro base stations and individuals in hotspot zones will be connected to micro base stations, and this kind of access model can be regarded the closed user model.

V. POWER AND DENSITY OPTIMIZATION FOR HCNS BASED ON LARGE-SCALE USER BEHAVIOR

Two different optimization approaches, one with a fixed micro BS density and the other with a fixed macro BS density, are offered here for your perusal and consideration. The behavior of users can be used to identify not just the ideal density of base stations but also the optimal transmit power of base stations. We investigate the effect that the activities of a significant number of users have on HCN EE. It is vital to keep in mind that macro base stations fully guarantee bandwidth requirements in non-hotspot regions, whereas micro base stations fully guarantee traffic demands in hotspot zones.

HCN configuration:

Case 1: The objective of fulfilling of macro base stations (BSs) should be enhanced while their density should be decreased when users of a hotspot want a greater traffic rate but do not relocate to areas that are not considered hotspots. On the other hand, neither the transmit power nor the density of micro BSs have altered in recent years. It has been found that the parameters m, m, pm, and pm have no influence whatsoever on the coverage area of micro BSs. [Citation needed] [There is a need for citations] The amount of ASR that is provided by micro BSs increases in areas that are considered to be hotspots.

Case 2: When the area of hotspot zones increases but the traffic flow remains the same, the transmission power of macro base stations (BSs) should decrease, while the density and transmission power of micro base stations should both increase. This is because the micro BSs are better able to accommodate the increased demand. During this time period, there has been no discernible shift in the micro BSs concentration. It was discovered that changes in m, M, Pm, and PM did not have any effect on the ASR that was provided by the micro BSs that were situated in the hotspot zones. The coverage area that is provided by micro BSs, on the other hand, expands.

Case 3: The density of both micro and macro base stations should grow when there is an increase in the number of hotspots but there is no change in the traffic volume or the size of the hotspot zones. On the other hand, it was necessary to lower the transmission powers of both micro and macro base stations. The ASR that is offered by micro BSs in hotspot sites and the coverage area that is provided by micro BSs were studied after modifications were made to m, m, pm, and pm. It was discovered that these modifications had no effect. On the other side, there are more and more hotspots appearing all over the world.

7. POWER-SAVING BS CONTROL METHODS FOR TWO-TIER HCNS

In areas that are considered to be hotspots, it is the responsibility of micro base stations to fulfill all of the traffic needs, whereas it is the responsibility of macro base stations to meet all of the traffic demands in areas that are not considered to be hotspots. In this article, we are going to modify this assumption in order to design microcontrol techniques that have more flexibility. For instance, if the optimal micro BS coverage is zero, we would put the micro BSs into standby mode even though the size of the hotspot zones has significantly risen. This is the case even if the size of the hotspot zones has not changed. Alternately, if the optimal coverage offered by micro BSs is larger or smaller than that provided by hotspot regions, we should raise or decrease the transmit power of micro BSs in order to expand or shrink the coverage area, respectively.

As a consequence of this, the ASR proportion e m as well as the coverage ratio e m may be greater than or lesser than the traffic rate ratio _m and the area ratio m, respectively.

VIII. CONCLUSION

We have established the mathematical relationship between large-scale user behavior and energy-efficient HCN setup by utilizing closed-form formulas. Additionally, we have characterized the varying degree of large-scale user behavior.

We have also developed three energy-efficient control algorithms for micro BSs, which are designed to be used in the exceptional circumstance in which the traffic needs and/or the size of hotspot regions are much lower than that of non-hotspot regions. The results of the simulation validate the findings of the theoretical study and demonstrate that the proposed regulatory systems possess the potential to greatly improve HCN EE. These theoretical insights can be used to compute the optimal density, transmission power, and control methods for base stations in high-capacity networks (HCNs). This work might be developed to incorporate a plethora of antennas, as well as the allocation of bandwidth and the suppression of interference.

XI. REFERENCE:

[1]. Yang, J., Pan, Z., Xu, H., & Hu, H. (2019). Joint Optimization of Pico-Base-Station Density and Transmit Power for an Energy-Efficient Heterogeneous Cellular Network. *Future Internet*, *11*(10), 208.

[2]. Jie, Y., Ziyu, P., & Yonghong, C. (2019, October). Performance analysis of two-tier heterogeneous cellular networks based on Poisson hard-core process. In *2019 IEEE 19th International Conference on Communication Technology (ICCT)* (pp. 589-592). IEEE.

[3]. Zhang, S., Gong, J., Zhou, S., & Niu, Z. (2015). How many small cells can be turned off via vertical offloading under a separation architecture?. *IEEE Transactions on Wireless Communications*, *14*(10), 5440-5453.

[4]. Qahar, Abdul, et al. "Energy Efficient Millimeter Wave Backhauling in 5G Heterogeneous Networks." *2021 International Conference on Innovative Computing (ICIC)*. IEEE, 2021.

[5]. KT, Sruthi. "Energy Efficient Design in Heterogeneous Cellular Networks." (2015).

[6]. Liu, Zhixin, et al. "Maximizing lower bound of energy efficiency in multi-tier heterogeneous cellular network via stochastic geometry." *Computer Communications* 184 (2022): 64-72.

[7]. Guo, Weisi, Min Chen, and Athanasios V. Vasilakos. "14 Energy-efficient architectures." *Heterogeneous Cellular Networks: Theory, Simulation and Deployment* (2013): 426.

[8]. Khan, Md Hashem Ali, et al. "ENERGY EFFICIENCY OF 5GCELLULAR NETWORKS FOR BASE STATIONS SWITCHING SYSTEM."

[9]. Tang, L., He, Y., Zhou, Z., Ren, Y., Mumtaz, S. and Rodriguez, J., 2019. A distance-sensitive distributed repulsive sleeping approach for dependable coverage in heterogeneous cellular networks. *Transactions on Emerging Telecommunications Technologies*, *30*(11), p.e3784.