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High Energy and Spectral Efficiency Analysis for 5g Based Spectrum Aggregation

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Abstract

A local anchor based architecture in which DC technique is applied in this paper to provide user-centric service for performance enhancement in the UDN scenario. Under the proposed architecture, anchor FAPs are selected for UEs, acting as the MeNBs while the other FAPs in VCs act as the SeNBs which only provide user service in the coverage of VCs. Key procedures are given for providing the user with satisfactory service following her movement and improving mobility robustness. For performance evaluation, first, analyze the impact of the size of anchor FAPs' physical coverage on handover performance in our scheme. Besides, different values of handover parameters are conducted in simulation to give an insight for optimal configuration. And comparisons between our proposed scheme and handover scheme in the LTE system are illustrated to show the gain. Results show that a maximum decrease of more than 53% can be obtained for HOF rate and a maximum increase of 5% average UE spectrum efficiency gains in the proposed scheme over the current LTE system when UE speed is 3km/h the ultra-dense demands vary in both temporal and spatial domains. As a large amount of ultra-dense demands may be generated in small hotspot regions, while only a small amount of ultra-dense demands may be generated in vast non-hotspot regions. In the time dimension, a large number of users may request intensive ultra-dense over the network during peak hours. Such user behavior is referred to as large-scale user behavior. Unsurprisingly, the large-scale user behavior creates enormous difficulties in energy consumption analysis. Some energy-efficient designs of heterogeneous cellular networks and a number of other dynamics transmit mode adjustment schemes supported large-scale user behavior. For this proposed a cell zooming mechanism where it was shown that the power consumption can be reduced using turning off some BSs and extending the coverage of the other BSs during periods of low ultra-dense demands. Resource allocation focusing on reducing the cross-tier interference can also save the energy of 5Gs. used the subchannel allocation mechanism to optimize 5G EE with a fairness constraint, and the authors extended the work to joint and disjoint subchannel allocation for open access anchor and closed access anchor respectively. Surveyed the recent findings in the area of energy-efficient resource allocation for 5Gs

***Keywords**: Density optimization for 5G,Energy Efficiency, spectral efficiency, 5Gnetwork*

1. INTRODUCTION

The European Union (EU) has launched the METIS (Mobile and Wireless Communications Enablers for the Twenty-Twenty (2020) Information Society) Project recently, which considers UDN together of the foremost important topics of the mobile system that is the fifth-generation (5G) for 2020 and beyond [1]. The growth of wireless data services driven by mobile Internet and smart devices has triggered the investigation of the 5G cellular network [2]. UDN, as one of the emerging 5G techniques, is the main enabler to address the high traffic demands [3]. In the scenario of UDN, the radius of small cell coverage is dozens of meters or even several meters [4]. Traditional macro-cell-only networks evolve to Heterogeneous Network (HetNet), in which low-power and low-cost small

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cells are deployed in large numbers, aiming at achieving traffic offload. Femtocells, also known as Femto Access Points (FAPs) are the main form of such small cell deployment [5]. Another crucial concept in 5G researches is UCN. Traditional cell-centric network techniques construct the network only based on the distribution and condition of base stations without taking users' distribution and traffic conditions into full account. By contrast, UCN lets the user feels like a network is usually following it and therefore network shall intelligently recognize the user's wireless communication environments, and then flexibly organize the required cell group and resource to serve the user [6]. However, the large number of small cells will cause the signaling load on the network nodes to increase due to frequent handovers and degraded mobility robustness due to increased handover and RLF [7]. In prior researches, one solution to solve the above-mentioned problems is the formation of virtual cells, i.e., a cluster of cooperating small cells that appears to the user as a single distributed cell [8]. Coordinated multipoint (CoMP) clustering is a key feature for improving system throughput and cell edge performance [9]. Bassey et al. [10] present a self-organizing, user-centric CoMP clustering algorithm in a control/data plane (C-plane/U-plane) separation architecture (CDSA), proposed for 5G to maximize spectrum efficiency for a given maximum cluster size. However, the HOF rate is not analyzed in their work. For further consideration about handover failure issues, Balakrishnan and Akyildiz [11] proposed a local anchor-based architecture for static clustering, which is proved to have an impact on the reduction in handover interruption. However, such static clustering does not take full account of users' preferences. Carrier aggregation is introduced in release 10 of LTE and further extended in release 11. It consists of equipping a cell with more than one carrier component for joint scheduling, hence reaching users with higher data rates [12]. In practice, however, the performance of CA is affected greatly because of the demand for ideal backhaul. Therefore, DC technique is more practical when considering about non-ideal backhaul. The DC technology is proposed for enhancing LTE-A small cell networks, with which the user equipment (UE) can connect to both the MeNB and the SeNB simultaneously [13]. However, in all of the existing works, DC is used for connecting users to a macro cell and a small cell simultaneously without considering about the situation when small cells may be more capable for acting as MeNB for future UCN, in which even multi-connectivity is more likely to be applied. And it is desirable to explore a novel architecture for applying DC technique.

The global mobile communication industry is growing rapidly. Today there are already more than 4 billion mobile phone subscribers worldwide more than half the entire population of the planet. Obviously, this growth is accompanied by an increased energy consumption of mobile networks. Global warming and heightened concerns for the environment of the planet require a special focus on the energy efficiency of these systems. The earth is a concerted effort to achieve this goal and as part of its objectives, a holistic framework is developed to evaluate and compare the energy efficiency of several design approaches of wireless cellular communication networks. For the quantification of energy savings in wireless networks, the power consumption of the entire system needs to be captured and an appropriate energy efficiency evaluation framework is to be defined. The EARTH E3F presented the key levers to facilitate the assessment of the overall energy efficiency of cellular networks over a whole country.

The E3F primarily builds on well-established methodology for radio network performance evaluation developed in 3GPP; the most important addendums, it are to add a sophisticated power model of the base stations as well as a large-scale long-term ultra-dense model extension to existing 3GPP ultra-dense scenarios. The energy efficiency of LTE is compared to that of already deployed networks is discussed and targets for the energy efficiency of future wireless networks are given. Energy-efficient green cellular networks have become a hot research topic nowadays to deal with the dramatically increasing energy consumption of cellular infrastructure. As one of the key features of 5G networks, the energy-efficient design is valued by operators from both the environmental and economic viewpoints. For cellular networks, BSs are dominant in energy consumption and consume around 60-80% of the total network energy. The objective of this project is to seize the opportunity of tracking

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the ultra-dense variation in the temporal and spatial domains of the network to adapt the radio resource allocation accordingly such that a great amount of energy can be saved.

As one of the most popular and efficient energy saving schemes, BS sleeping has a great potential in energy saving when the ultra-dense load is low. The following figure illustrates several simple BS sleeping patterns besides ultra-dense active BSS. Second, ultra-dense-aware sleeping makes both the topology of active BSs and the interference scenarios change. So new frequency reuses pattern, scheduling, and power control schemes should be developed accordingly.-aware BS sleeping, there are also new technical problems that need to be addressed and will be studied in this project. In order to provide a true real time service for media stream transmission, multicast with patching stream scheme has been proposed in, which operates as follows. In response to the first user's request, the transmitter delivers the requested media stream using multicast transmission. Late user that submits a new request for the same media stream will immediately join the multicast group and receive the ongoing multicast media stream, buffering the data received. Meanwhile, the fraction of the media stream that has been already transmitted in the multicast media stream before this user's request will be delivered with uncast transmission.

However, in these patching multicast schemes, the system bandwidth is always assumed to be unlimited and thus no request will be refused due to sufficient bandwidth, which is unreasonable in wireless communication networks. Fur-there more, in these schemes the transmission bandwidth for each media stream is also assumed fixed which will cause the serious wastage of transmission power due to the under- utilization of system bandwidth. 5Gs including conventional macro BSs and distributed low power BSs are shown to have higher spectrum efficiency and energy efficiency. Confirmed that the deployment of low power BSs generally leads to higher EE, but this gain saturates as the density of low power BSs increases. As a result, both the performance analysis and the energy-efficient design of 5Gs have become very popular recently. The locations of BSs may have a significant impact on the outage and throughput performance of a network. However, the locations are usually unknown in the analysis and the design of the 5Gs. The spatial stochastic process model is widely used to model the locations of BSs, such as the Poisson Point Process and Poisson Cluster Process.

A tractable, flexible and accurate model for a downlink 5G consisting of multi-tier BSs was recently presented in. Analytical results of important metrics like the Signal-to-Interference-plus-Noise-Ratio (SINR), coverage probability and average rate were obtained. Several important energy-efficient techniques were proposed including network planning, on-off BS operation, and cell zooming and resource allocation. Investigated the optimal combination of the density of macro BSs and micro BSs with a tradeoff between capacity extension and energy saving. For the case of low ultra-dense demands, it was shown that turning off some underutilized BSs can improve EE significantly. Investigated the sleeping strategy according to the temporal ultra-dense variation and similarly proposed a cell activation mechanism that enables BSs to be activated repulsively according to ultra-dense demands and thus the effective BS density can be scalable for ultra-dense fluctuation. For energy-efficient operation of low power BSs. Proposed a cell zooming mechanism where it was shown that the power consumption can be reduced by means of turning off some BSs and extending the coverage of the other BSs during periods of low ultra-dense demands. Resource allocation focusing on reducing the cross-tier interference can also save the energy of 5Gs. used the sub channel allocation mechanism to optimize 5G EE with a fairness constraint, and the extended the work to joint and disjoint sub channel allocation for open access anchor and closed access anchor respectively. Find the recent findings in the area of energy efficient resource allocation for 5Gs.

2. SYSTEM ANALYSIS

2.1 Existing System

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5Gs including conventional macro BSs and distributed low power BSs are shown to have higher spectrum efficiency (SE) and energy efficiency (EE) confirmed that the deployment of low power BSs generally leads to higher EE, but this gain saturates as the density of low power BSs increases. As a result, both the performance analysis and the energy-efficient design of 5Gs have become very popular recently. The locations of BSs may have a significant impact on the outage and throughput performance of a network. However, the locations are usually unknown in the analysis and the design of the 5Gs. The spatial stochastic process model is widely used to model the locations of BSs, such as the Poisson Point Process and Poisson Cluster Process (PCP).

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2.2Proposed System

In this project consider a general case of users in hotspot regions and non-hotspot regions that are different in terms of ultra-dense volume and the size of two regions. BS coverage is often larger or smaller than the hotspot regions or non-hotspot regions. The existing approaches cannot be applied in this case, which motivates us to design a completely new approach for modeling and analyzing 5Gs based on large-scale user behavior. Specifically, our main contributions are summarized as follows:

- A tractable expression to characterize large-scale user behavior is presented for a scenario where heterogeneous ultra-dense demands in hotspot regions and non-hotspot regions are taken into account.
- The quantitative relationship between large-scale user behavior and energy-efficient 5G configuration is presented in closed-form formulas. These results can be used to determine the density and the transmit power of BSs to achieve optimal EE.
- Three energy efficient control strategies for large-scale user behavior are proposed which includes micro BS sleep control, coverage expansion control, and coverage shrinking control.
- The proposed system consists of an energy geographical routing protocol that is used to produce energy-efficient in 5G.

3. HETEROGENEOUS NETWORK

A heterogeneous network is a network connecting computers and other devices with different operating systems and/or protocols. For example, local area networks (LANs) that connect Microsoft Windows and Linux based PC with Apple Macintosh computers are heterogeneous. The word heterogeneous network is also used in wireless using different access technologies. For example, a wireless network which provides a service through a wireless LAN and is able to maintain the service when switching to a cellular network is called a wireless heterogeneous network.

3.1 HetNet

HetNet often indicates the use of multiple types of access nodes in a wireless network. A Wide Area Network can use macro cells, pico cells, and/or anchor in order to offer wireless coverage in an environment with a wide variety of wireless coverage zones, ranging from an open outdoor environment to office buildings, homes, and underground areas. Mobile experts define a HetNet as a

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network with complex interoperation between macro cell, small cell, and in some cases Wi-Fi network elements used together to provide a mosaic of coverage, with handoff capability between network elements.

3.2 Semantic Of "Heterogeneous Network" In Telecommunications

From a semantically point of view, it is very important to note that the Heterogeneous Network terminology may have different connotations in wireless telecommunications. For instance, it may refer to the paradigm of seamless and ubiquitous interoperability between various multi-coverage protocols (a.k.a. HetNet). Otherwise, it may refer to the non-uniform spatial distribution of users or wireless nodes (a.k.a. Spatial In homogeneity). Therefore, using the term "heterogeneous network" without putting it into perspective may result in a source of confusion in scientific literature and during the peer-review cycle. In fact, the confusion may further be aggravated, especially in light of the fact that the "HetNet" paradigm may also be researched from a "geometrical" angle.

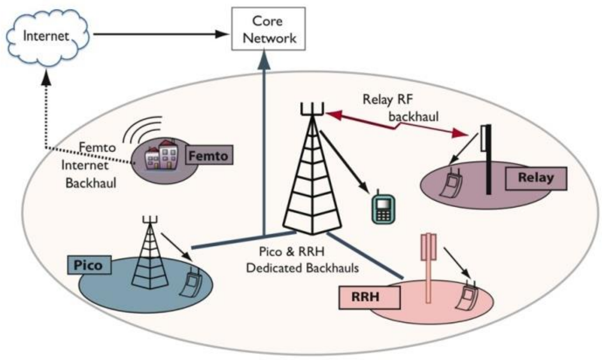

Figure1. HCG Network

Cellular system deployment has reached practical limits in many dense urban areas while data ultra-dense only continues to increase. This leaves cellular operators with few options to increase the most important metric: area spectral efficiency. Unfortunately, radio link improvements including coding, cognitive transmission, and multiple antennas are reaching their theoretical limits. Consequently, network operators are revisiting conventional cellular system topologies and are considering a new paradigm called heterogeneous networks. Heterogeneous networks consist of planned macro base station deployments that typically transmit at high power overlaid with several low power nodes such as Pico base stations, distributed antennas, Femto base stations, and relays. The low power nodes are deployed to eliminate coverage holes in outdoor and indoor environments and also to increase the capacity/area of the network. Remote radio heads or distributed antennas are connected to the macro base station using a high bandwidth low-latency dedicated connection. These radio heads have minimal autonomous intelligence and act as extensions of the base station antenna ports. Fixed relays are infrastructure equipment that connects wirelessly to the network backbone. These relays aid in the signal transmission between the macro base station and the mobile users by receiving and retransmitting the signal.

Relays offer flexible option where wire line backhaul is unavailable or not economically feasible. Picocells and anchor are new small base stations installed in dead spots to increase the coverage and capacity. A major advantage of anchor as compared to microcells and distributed antenna systems is that they do not need to be planned and maintained by cellular operators: they are connected to the core network through a last-mile Internet backhaul. The investigation of several components of

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heterogeneous networks including relays, distributed antenna systems, and anchor. One focus has been on analyzing the impact of out-of-cell interference, and developing practical techniques for managing interference. We are also investigating the interaction between different components of heterogeneous network, for example the simultaneous deployment of anchor and relays in the same cell. Check out the links on the left for more details about specific research projects.

3.3 Heterogeneous Cellular Network Model

We consider two kinds of regions which are covered by a 2-tier 5G consisting the conventional macro BSs that guarantee non-hotspot region coverage, and micro BSs that guarantee hotspot region ultra-dense demands. The hotspot regions and the non-hotspot regions are differentiated by two characteristics of ultra-dense demands. Specifically, the volume/density of ultra-dense demands in hotspot regions is generally higher than that in non-hotspot regions. The size of hotspot regions is generally smaller than that of non-hotspot regions.

In this system, the distribution of user location and the distribution of ultra-dense demands are considered to be different concepts. The locations of the users in two kinds of regions are assumed to follow uniform distribution with the same density but the ultra-dense demands and size of hotspot regions and non-hotspot regions can be different. The BSs in either macro or micro BS tiers are assumed to have same spatial density k, transmit power Pk, SINR threshold _k, which can be different in different tiers. Their locations are modeled by independent PPPs denoted as _k. Without loss of generality; we assume that a typical user is located at the origin. ‖x‖ is denoted as the distance between a BS located at point x and the typical user and hx is the channel fading (power), which is assumed to follow exponential distribution.

The path loss of desired or interference signals between them is given by x. Thus the received power of the typical user can be expressed as Pkh(x), where is path loss exponent. The total interference power consists of the interference power from the BSs in the same tier and that from BSs in other tiers. Consequently, the SINR of the typical user associated with the BS located at point x in the kth tier is:

$$SINR_x^k = \frac{P_k h_x \|x\|^{-\alpha}}{\sigma_n^2 + \sum_{i\in\{m,M\}} \sum_{x\in\Phi_i/\{x\}} P_i h_x \|x\|^{-\alpha}}$$

where the n is the additive noise power. Note that the channel fading here can be extended to the general case that includes both small-scale fading and long-term shadowing. The long-term shadowing effects can be interpreted as a random displacement of the BSs [21]. As a result, transmit power of BSs should be scaled by E[X 2], where X is the shadowing following any general distribution as long asE[X 2]< ∞.

4.5G Average rate

We assume that the typical user is associated with the BS that offers the maximum SINR, who is in the coverage if the maximum SINR is no less than the received SINR threshold _k. The macro BSs and micro BSs guarantee coverage and ultra-dense demands in non-hotspot regions and hotspot regions separately. Therefore, users in non-hotspot regions and hotspot regions are assumed to be connected to macro BSs and micro BSs respectively and such access model can be treated as the closed access model.

4.1 Large-Scale User Behavior Modeling for Two-Tier 5Gs

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In this section, we present a user behavior model for large-scale user behavior in two-tier 5Gs, where the concept of Gini coefficient in economics is used to characterize the heterogeneous degree of large-scale user behavior. A. User Behavior Curve and User Behavior Coefficient. The user behavior is defined mathematically based on the Lorenz curve and is shown in. The model is re-drawn it is noted that the locations of user are assumed to follow uniform distribution, the user behavior coefficient h, which is the ratio between the area over the total area.It is defined as follows:

$$h = \frac{A}{A+B}.$$

The value of user behavior coefficient is in the interval [0; 1]. In practice, both extreme values are not usually reached. On one hand, a low user behavior coefficient indicates the large-scale user behavior follows a more even distribution, with 0 corresponding to complete equality. On the other hand, a high user behavior coefficient indicates large-scale user behavior follows uneven distribution, with 1 corresponding to complete convergence (i.e., all of the ultra-dense demands are requested by one user). B. User Behavior Coefficient Calculation We first considers a general case that the ultra-dense rate in hotspot regions is higher than that in non-hotspot regions, i.e., _m > 1. Note that the ultra-dense rate is same in hotspot regions or non-hotspot regions and thereby the user behavior curve _ (x) consists of two fold lines. Because the m is the ratio between the area of hotspot regions and that of non-hotspot regions and thus the ratio between the area of non-hotspot regions and that of all regions is 1 m+1. Note that the ratio between the total ultra-dense volume of hotspot regions and that of non-hotspot regions is m_M and thus the ratio between the total ultra-dense volume in non-hotspot regions and that in all regions is 1 m_M+1. As a result, the coordinate of the fold point of the user behavior curve _ (x) is the area of the region B can be divided into a triangle “B1” and a trapezium “B2”.

4.2. Power and Density Optimization for 5Gs based on Large-Scale User Behavior

Two optimization problems was introduced with fixed micro BS density or fixed macro BS density. The optimal BS transmits power and therefore the optimal BS densities based on user behavior are derived. Then we analyze the impact of the large-scale user behavior on 5G EE. Note that ultra-densedemands in hotspot regions are completely guaranteed bymicro BSs and ultra-densedemands in non-hotspot regions arecompletely guaranteed by macro BSs. Therefore, the ASR ratioand the coverage ratioshould equal the ultra-dense rate ratio m and the area ratio m respectively.

4.3. Performance Evaluation of Base Station Sleeping and Resource Allocation in Green Cellular Networks

Energy-efficient green cellular networks became a hot research topic nowadays to affect the dramatically increasing energy consumption of cellular infrastructure. The energy-efficient design of 5G networks is valued by operators from both the environmental and economic viewpoints. For cellular networks, BSs are dominant in energy consumption and consume around 60-80% of the entire network energy. The objective of this project is to seize the opportunity of tracking the ultra-dense variation in the temporal and spatial domains of the network to adapt the radio resource allocation accordingly such that a great amount of energy can be saved. As one of the most popular and efficient energy-saving schemes, BS sleeping has great potential in energy-saving when the ultra-dense load islow. The figure illustrates simple BS sleeping patterns.

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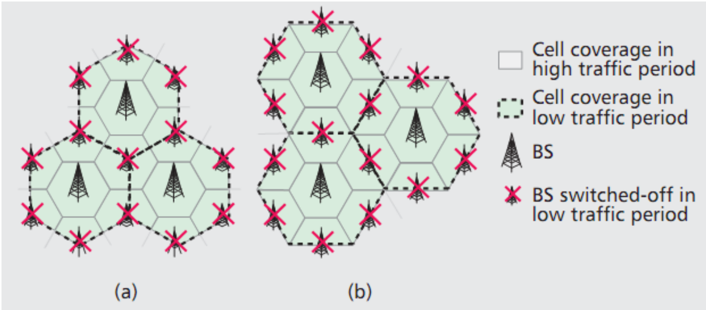
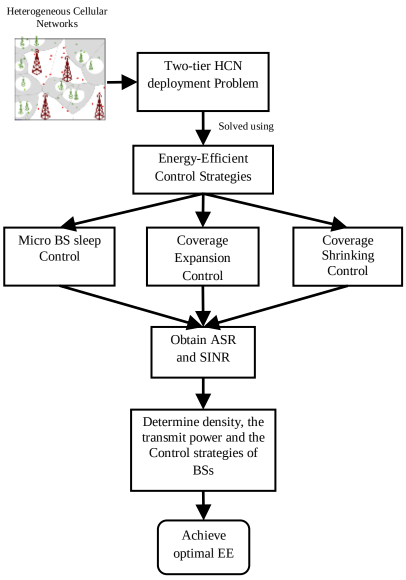


Figure2. Examples of BS sleeping patterns

Besides ultra-dense-aware BS sleeping, there are also new technical problems that need to be addressed and will be studied in this project. For example, users in sleeping cells areto be re-associated to the active BSs. Second, ultra-dense-aware sleeping makes both the topology of active BSs and the interference scenarios change. So new frequency reuse patterns, scheduling, and power control schemes should be developed accordingly.The main purpose of the thesis is to form a general study of the energy-efficient operations in green cellular networks from the following three respects, which is partitioned according to the time scale as BS sleeping design, user association, scheduling and power control. The goal is to minimize the total energy consumption of the system while satisfying QoS

5. System Architecture



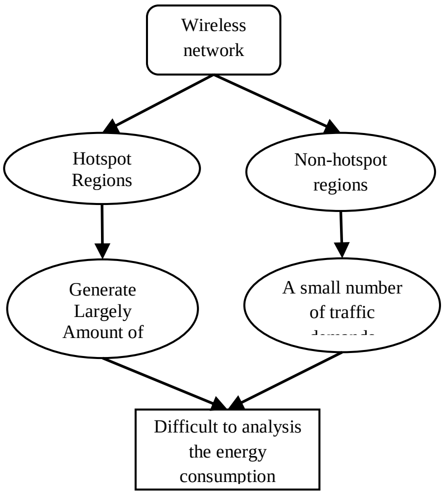


Figure 3.System Architecture **Figure 4.Small Hotspot Regions**

A large amount of ultra-dense demands may be generated in small hotspot regions, while only a small amount of ultra-dense demands may be generated in vast non-hotspot regions. In the time dimension, a large number of users may request intensive ultra-dense over the network during peak hours. Such user behavior is referred to as large-scale user behavior. The large-scale user behavior creates enormous difficulties in energy consumption analysis.

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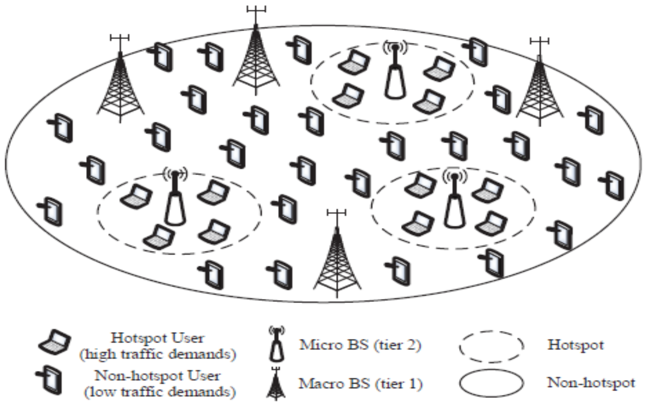

Figure5.Three Energy Efficient Control Strategies of Micro BSS

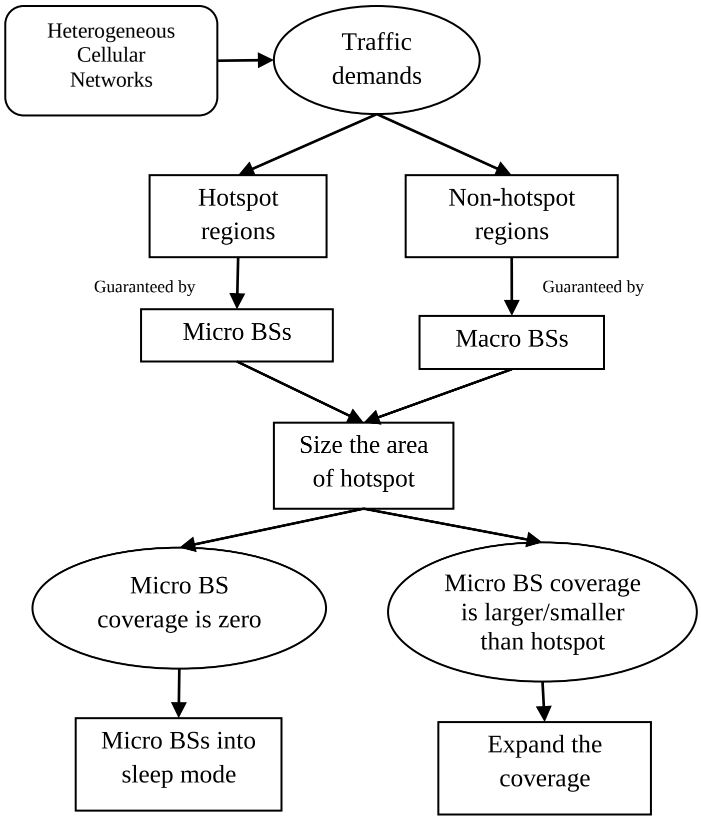

Figure6. System model

Three energy-efficient control strategies of micro BSs is aspecial case that the ultra-dense demands and/or the size of hotspot regions are much lower than those of the non-hotspot regions.

6. Performance of Control Strategies based on Ultra-Dense Demands

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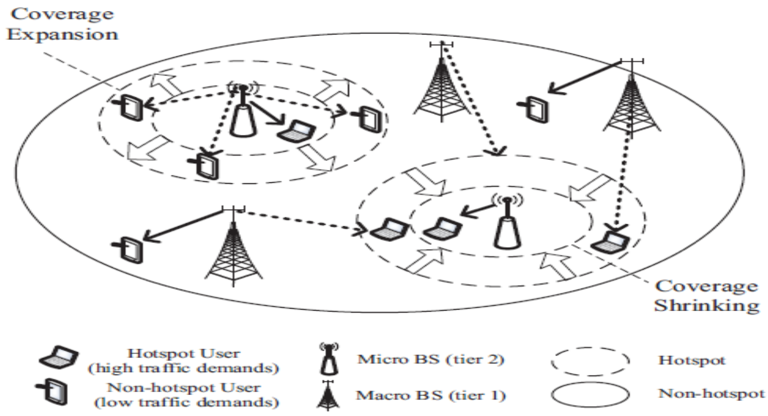

Figure7. Performance of Control Strategies based on Ultra-Dense Demands

7. Energy-Efficient BS Control Strategies for 5Gs

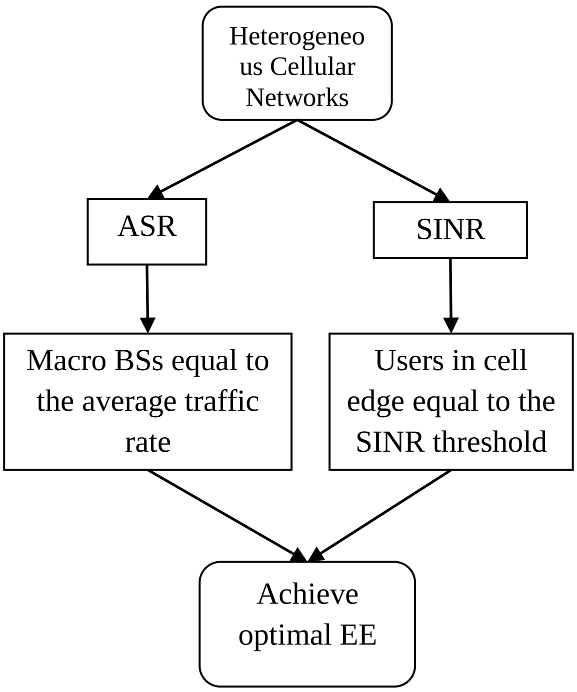

Figure8.Energy-Efficient ControlStrategies

Compute the EE under two constraints as follows:

- The ASR provided by macro BSs should equal to the average ultra-dense rate in the whole area.
- The SINR of the users in the cell edge should equal to the SINR threshold.

8. Results

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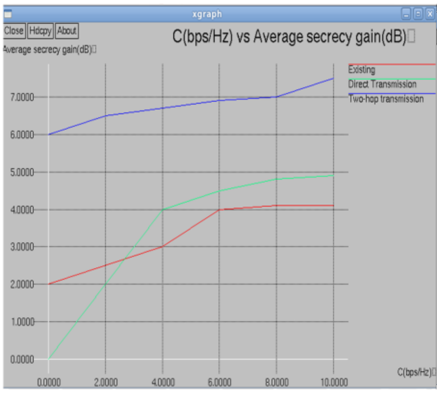
1.4 AVERAGE SECRECY GAIN(db)



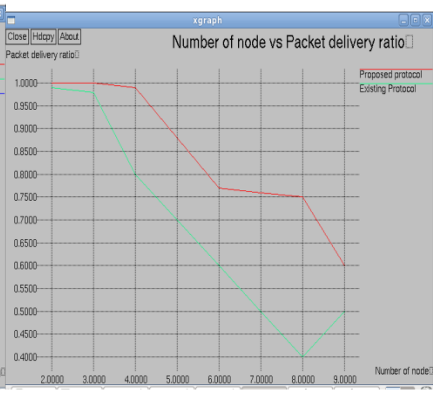
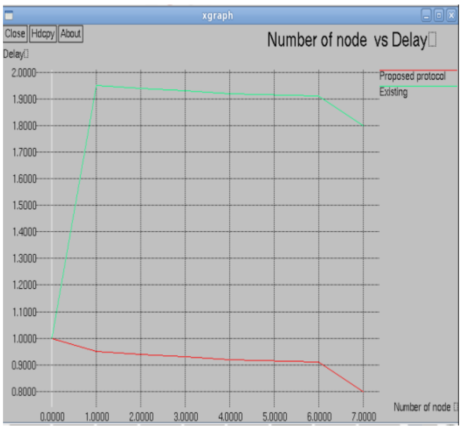


Figure 9 **Figure 10**

Figure 9represents the average secrecy gain of the proposed approach. In this graph shows that high secrecy gain in the beginning and is increase over a period of time and figure 10Shows the packet delivery rate over the high time period rate



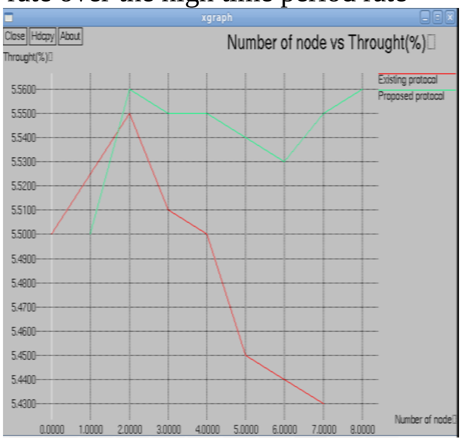


Figure 11 **Figure 12**

The figure 11shows the proposed system reduces the communication and delay overheads by limiting the injected bogus traffic. In Figure 12, the graph shows that increases the throughput to maximum level. It helps to achieving effective communication approach.

9. CONCLUSION AND FUTURE WORK

The heterogeneous degree of large scale user behavior and presented closed-form formulas that establish the quantitative relationship between large-scale user behavior and energy-efficient 5G configuration. Also, proposed three energy-efficient control strategies of micro BSS for the special case that the ultra-dense demands and/or the size of hotspot regions are much lower than those of the non-hotspot regions. Simulation results validate the theoretical analysis and demonstrate that the proposed control strategies can potentially lead to significant improvement of 5G EE. These theoretical results can be used to determine the density, the transmit power, and the control strategies of BSs for 5Gs to achieve optimal EE. The possible extensions of this work could include multiple antennas, bandwidth allocation, and interference cancelation.

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