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Green Energy Efficiency and Traffic Optimization in Heterogeneous Cellular Mobile Radio Networks

Mrs.R.Gomathi[1], Dr.A.Subramanian[2],Ms.S.Kalpana[3]
Research Scholar(ECE), IFET College of Engineering
Professor(EEE), IFET College of Engineering
Senior Assistant Professor(ECE), IFET College of Engineering

ABSTRACT:- Mobile networks with high BS density, traffic load balancing is critical in order to exploit the capacity of SCBSs and also the efficiency of homogeneous and heterogeneous networks consisting of a varying number of micro sites with regard to traffic load conditions has been investigated. In order to overcome the existing drawbacks, a traffic optimization techniques and Green Hetnetsframework is used, it strives a balance between network utilities, the traffic optimization technique and green Hetnets framework is implemented, which significantly reduces the communication overheads between users and BSs. The results demonstrate that the proposed activity stack adjusting system empowers a flexible exchange off between the on-network control utilization and the normal movement conveyance inertness, and recoveries a considerable amount of on-grid power.

INDEX TERMS: *Energy Efficiency, Hybid Optimization, HCRAN, HetNet, Traffic Optimization Technique*.

1. INTRODUCTION

Proliferation of wireless devices and bandwidth greedy applications drive the exponential growth of mobile data traffic that leads to a continuous surge in capacity demands across mobile networks. Heterogeneous network (HetNet) is one of the key technologies for enhancing mobile network capacity to satisfy the capacity demands [1]. In HetNet, low-power base stations referred to as small cell base stations (SCBSs) are densely deployed to enhance the spectrum efficiency of the network and thus increase the network capacity. Owing to the disparate transmit powers and base station (BS) capabilities, traditional user association metrics such as the signal-to interference- plus-noise ratio (SINR) and the received-signalstrength- indication (RSSI) may lead to a severe traffic load imbalance [1]. Hence, user association algorithms should be well designed to balance traffic loads and thus to fully exploit the capacity potential of HetNet.

In order to maximize network utilities, balancing traffic loads requires coordination among BSs. The dense deployment of BSs in HetNet increases the difficulty on coordinating BSs. To address this issue, programming characterize radio access organize (SoftRAN) design [2] has been proposed. SoftRAN empowers composed radio asset administration in the incorporated control plane with a worldwide perspective of system assets and movement loads. The client affiliation calculation utilizing the SoftRAN engineering is wanted for future versatile systems with an amazingly thick BS arrangement. Owing to the direct impact of greenhouse gases on the earth environment and the climate change, the energy consumption of Information and Communications Technology (ICT) is becoming an environmental and thus social and economic issue. Portable systems are among the significant vitality hoggers of correspondence systems, and their commitments to the worldwide vitality utilization increment quickly. In this way, greening versatile systems is significant to decreasing the carbon impressions of ICT. In spite of the fact that SCBSs devour less power than full scale BSs (MBSs), the quantity of SCBSs will be requests of greatness bigger than that of MBSs for a wide scale arrange organization. Hence, the overall power consumption of such a large number of SCBSs will be phenomenal. Greening HetNets have thus attracted tremendous research efforts [3], [4].

As energy harvesting technologies advance, green energy such as sustainable bio fuels, solar and wind energy can be utilized to power BSs [5]. Telecommunication companies such as Ericsson and Nokia Siemens have designed green energy powered BSs for mobile networks [6]. By adopting green energy powered BSs, mobile network operators (MNOs) may further save on-grid power consumption and thus reduce their CO2 emissions.

However, since the green energy generation is not stable, green energy may not be a reliable energy source for mobile networks. Therefore, future mobile networks are likely to adopt hybrid energy supplies: on-grid power and green energy. Green energy is utilized to reduce the on-grid power consumption and thus reduce the CO2 emissions while on-grid power is utilized as a backup power source. In HetNets with hybrid energy supplies, the utilization of green energy should be integrated into user association metrics to optimize the green energy usage. For instance, while balancing traffic loads, MNOs may enable BSs with sufficient green energy to serve more traffic loads while reducing the traffic loads of BSs consuming on-grid power [7]. The traffic load balancing with the consideration of green energy may not maximize network utilities such as the network capacity and the traffic delivery latency. Therefore, a trade-off between the green energy utilization and network utilities should be carefully evaluated in balancing traffic loads among BSs. In addition, as a result of the trade-off, users' utilities such as data rates and the service latency may be decreased because of the consideration of green energy in the traffic load balancing. In this way, clients may not participate in the rush hour gridlock stack adjusting. For instance, an appropriated client affiliation calculation may include numerous associations amongst clients and BSs and expect clients to report their estimations to BSs [8], [9]. Trying to enhance their own particular utilities, they may not report the right data to BSs. In this way, it is attractive to conceal BSs' vitality data from clients to maintain a strategic distance from fake reports.

The proposed scheme, in determining user association, allows an adaptable trade-off between network utilities, e.g., the average traffic delivery latency and the green energy utilization. Based on the above features, we name the proposed user association scheme as vGALA: **v**irtualized **G**reen energy **A**ware and **L**atency **A**ware us a traffic load balancing framework that endeavors a harmony between organize utilities, e.g., the normal activity conveyance idleness, and the environmentally friendly power vitality usage. Different properties of the proposed system have been inferred. Utilizing the product characterized radio access arrange engineering, the proposed conspire is executed as a for all intents and purposes appropriated calculation, which altogether diminishes the correspondence overheads amongst clients and BSs. The reenactment results demonstrate that the proposed activity stack adjusting system empowers a customizable exchange off between the on-framework control utilization and the normal movement conveyance dormancy, and recoveries an extensive sum of on-grid power, e.g., 30%, at a cost of only a small increase, e.g., 8%, of the average traffic delivery latency , user association

2. Related Works

Balancing traffic loads in HetNet has been extensively studied in recent years [10]. In mobile networks, traffic loads among BSs is balanced by executing handover procedures. In the LTE system, there are three types of handover procedures: Intra-LTE handover, Inter-LTE handover, and Inter-RAT (radio access technology) handover [11]. There are two ways to trigger handover procedures. The first one is "Network Evaluated" in which the network triggers handover procedures and makes handover decisions. The other one is "Mobile Evaluated" in which a user triggers the handover procedure and informs the network about the handover decision. Based on the radio resource status, the network decides whether to approve the user's handover request. In 4G and LTE networks, a hybrid approach is usually implemented where a user measures parameters of the neighboring cells and reports the results to the network. The network makes the handover decision based on the measurements. Here, the network can decide which parameters should be measured by users.

Aligning with the above procedures, various traffic load balancing algorithms have been proposed to optimize the network utilities. The most practical traffic load balancing approach is the cell range expansion (CRE) technique that biases users' receiving SINRs or data rates from some BSs to prioritize these BSs in associating with users [12]. Owing to the transmit power difference between MBSs and SCBSs, a large bias is usually given to SCBSs to offload users to small cells [1]. By applying CRE, a user associates with the BS from which the user receives the maximum biased SINR or data rate. Although CRE is simple, it is challenging to derive the optimal bias for BSs. Singh *et al.* [13] provided a comprehensive analysis on traffic load balancing using CRE in HetNet. The authors investigated the selection of the bias value and its impact on the SINR coverage and the downlink rate distribution in HetNet.

The traffic load balancing problem can also be modeled as an optimization problem and solved by convex optimization approaches. Ye *et al.* [8] modeled the traffic load balancing problem as a utility maximization problem and developed distributed user association algorithms based on the primal-dual decomposition. Kim *et al.* [14] proposed anα-optimal user association algorithm to achieve flow level load balancing under spatially heterogeneous traffic distribution. The proposed algorithm may maximize different network utilities, e.g., the traffic latency and the network throughput, by properly setting the value of α. In addition, game theory has been exploited to model and solve the traffic load balancing problems. Aryafar*et al.* [15] modeled the traffic load balancing problem as a congestion game in which users are the players and user association decisions are the actions.

The above solutions, though effectively balance the traffic loads to maximize the network utilities, do not consider the green energy utilization as a performance metric in balancing traffic loads. As green energy technologies advance, powering BSs with green energy is a promising solution to save on-grid power and reduce the carbon footprints [5]. It is desirable to recognize green energy as one of the performance metrics when balancing the traffic loads. Zhou *et al.* [16] proposed a handover parameter tuning algorithm for target cell selection, and a power control algorithm for coverage optimization to guide mobile users to access the BSs with renewable energy supply. Considering a mobile network powered by multiple energy sources, Han and Ansari [7] proposed to optimize the utilization of green energy for cellular networks by optimizing BSs' transmit powers. The proposed algorithm achieves significant on-grid power savings by scheduling the green energy consumption along the time domain for individual BSs, and balancing the green energy consumption among BSs. The authors have also proposed a user association algorithm that jointly optimizes the average traffic delivery latency and the green energy utilization [9].

3. Problem Statement

In HetNet, low-control base stations alluded to as little cell base stations (SCBSs) are thickly sent to improve the range productivity of the system and hence increment the system limit. Owing to the disparate transmit powers and base station (BS) capabilities, traditional user association metrics such as the signal-to interference- plus-noise ratio (SINR) and the received-signal strength- indication (RSSI) may lead to a severe traffic load imbalance [1].

Besides reducing the carbon footprint of the industry, there is a strong economical incentive for network operators to reduce the energy consumption of their systems. Currently over 80% of the power in mobile telecommunications is consumed in the radio access network, more specifically the base stations [3]. Concerning energy needs, it is regularly trusted that system topologies including high thickness organizations of little, low power base stations yield strong improvements compared to low density deployments of few high power base stations [3].

Owing to the direct impact of greenhouse gases on the earth environment and the climate change, the energy consumption of Information and Communications Technology (ICT) is becoming an environmental and thus social and economic issue.The green energy generation is not stable, green energy may not be a reliable energy source for mobile networks.

While adjusting movement loads, MNOs may empower BSs with adequate environmentally friendly power vitality to serve more activity loads while decreasing the movement heaps of BSs devouring on-network control [7]. The traffic load balancing with the consideration of green energy may not maximize network utilities such as the network capacity and the traffic delivery latency.

4. Traffic Management Framework for Heterogeneous Networks

A PC organize is formed, e.g., of connections with fluctuating transmission capacities, and switches with shifting support sizes that all must be imparted to various applications and clients. Packet delays and losses occur if the network cannot handle all the traffic that is offered to the system or due to variations in the traffic or in link quality. A network that supports QoS should actively manage and monitor traffic and coordinate resource allocations. The network elements need to implement the following features: packet identification and order, activity administration and queueing, policing, and organization of QoS approaches and administration. Without suitable activity designing and asset distribution systems, the system execution and administration quality falls apart under overwhelming movement changes due to dropped bundles and blockage. Blockage would first be able to be recognized by using system execution estimation and observing strategies. For blockage taking care of there are two principle approaches: clog control and blockage aversion/evasion. Clog control is a responsive strategy and is actuated when the system is over-burden. The halfway hubs partake in clog control with the goal that a quick sender or numerous senders can't obstruct the ways speedier than a system can deal with. Clog counteractive action is a proactive approach impeding the system for getting to be over-burden including a wide range of strategies at application, transport, system and information interface layers, for example, bundle estimate improvement,rate control, routing algorithms, and admission control. Congestion control involves the design issues to limit the offered traffic to match the capacity constraints of the system. Especially for real-time traffic, it is important to understand how congestion arises and find efficient ways to keep the network operating within its capacity. The fundamental outline issues of blockage control are what gives input to sources and chooses how to respond to the criticism. The network endpoints, i.e., the source and destination, do not usually have the details of congestion point(s) and reason(s). Therefore, the application-based adjustment works just when the system endpoints bolster adjustment instruments, e.g., for altering the required information rate changes. Intermediate nodes can use network layer techniques like ICMP (Internet Control Message Protocol) to inform hosts that congestion has occurred. However, the ICMP feedback from routers can suffer from problems related to accuracy and reliability [58]. The fundamental TCP method did not include congestion control or avoidance schemes and solely used Go-Back-N sliding window for end-to-end flow control. Current TCP implementation utilizes congestion control [59] and avoidance [60] methods that adjust the source nodes transmission rates. The downside of this is the transmission rate is diminished simply after the identification of datagrams misfortunes, which causes a period delay (due to round trek time, RTT) and results in buffer overflows in routers and further losses of datagrams. Hence, the flow and congestion control schemes of TCP are not sufficient in terms of the network performance and overall service quality. On the other hand, the real-time flows with stringent delay requirements make use of UDP (User Datagram Protocol), which does not provide any mechanism to regulate the amount of data being transmitted. UDP does not return acknowledgements and cannot signal congestion to the sender. The inability of UDP flows to regulate transmission rate at the transport layer makes it especially vulnerable to congestion. Therefore, for the UDP sessions, applications have to provide some form of integrated flow control.

4.1 Traffic Optimization Techniques in Heterogeneous Networks

i. Queuing and scheduling mechanisms
ii. Network information management
iii. Fuzzy logic based traffic management

i) Queueing and scheduling mechanisms

Queueing and planning calculations take an interest in arrange asset sharing and portion. Effective queueing systems enable the movement to be part into different lines after which the scheduler will choose the administration request of the bundles. A packet scheduler has an imperative part in dequeueing the bundles and monitoring the system assets. On the off chance that there is a circumstance in which arrange assets can't serve all streams, lines will begin to develop in the switches. Queueing strategies are regularly ordered as work-saving and non-work-monitoring ones [61]. A large portion of the notable schedulers are work-moderating and the rule is that they generally plan parcels when there are some sitting tight for an administration. A non-work-saving control proposes to diminish convenient components, similar to defer and jitter, by just booking bundles that are thought to be qualified.

The most popular queueing algorithm is First-In-First-Out (FIFO), which determinesthe service order of packets based on their arrival order. In Priority Queueing (PQ)[62–64], traffic classes with the highest priority are forwarded with the least delay; inthis case the low priority packets are prone to starvation, particularly when there is asteady flow of high-priority packets. Class based queueing (CBQ) [65] provides anequal share of the bandwidth for each class. Round Robin (RR) algorithm process packets thus with an equivalent offer and accomplish high exactness and decency in the yield data transfer capacity sharing however can't give tight defer prioritization. These issues were unraveled with Fair

Queueing (FQ) methods concocted by Demers et al. in [66] of which the WFQ is a standout amongst the most well known varieties of FQ. A WFQ scheduler [67]can allocate resources or bandwidth to different flows by defining a weight parameterto each session flow. A WFQ scheduler chooses bundles from numerous lines in light of their landing time, estimate and related weight. A parameter called virtual time is computed for a bundle each time it enters a switch. Parcels are embedded in an administration line arranged by the virtual occasions. The packet with the smallest virtual finishing time isscheduled first. This type of approach enables the sharing of resources between trafficaggregates in a fair and predictable way. Considering that B is the aggregate throughput of a yield connect, and if all sessions of the WFQ scheduler are dynamic, at that point each administration class gets a part of the aggregate transmission capacity dictated by its weight wi, which is equivalent to wiB. In any case, ordinary planning and queueing techniques give a fairly powerless type of asset reservation, e.g., in weighted data transfer capacity plans, in which the weights are just in a roundabout way identified with the transmission capacity the flow receives. In addition in heterogeneous networking systems, scheduling and coordination of the resources is complex due to the various QoS requirements of the different links and flows. Specifically, apportioning assets reasonably between various applications in a remote domain is certifiably not a minor assignment, where a higher measure of channel mistakes are available. Another issue of ordinary planning techniques is that they are very static in their activities. The most recent advancement is coordinated at the dynamic adjustment of booking parameters, which gives better in general execution [68– 73]. The versatile way to deal with WFQ in [69] is a variety of the reasonable line calculation with dynamic need booking. [70] presents a versatile way to deal with WFQ that uses an idea of income to adjust weights.

ii) Network information management

Effective QoS provisioning incorporates different systems from the entire TCP/IP stack, cross-layer [74] arrangements that gather data from numerous substances and layers are observed to be valuable. Particularly in reacting to basic difficulties in sight and sound conveyance and enhancing the client encounter over the remote Internet, QoS can be presented in various layers [75]. The mobility management mechanisms residing at the mobile device or at the network side are finding suitable ways to manage QoS between these entities. To effectively manage the changes in resource adaptation, there needs to be a realtime monitoring mechanism for the changing network environment [19] and information. Network measurements can be divided in to active and passive measurements [76]. Dynamic estimations depend on finding the system execution by sending exceptional test bundles on organize ways, and recording and dissecting the reaction. Passive measurements monitor the traffic at one or multiple points without intervening in the traffic itself. A solitary point estimation can be used for observing the execution of Local Area Networks (LANs) that are associated with bigger systems. Be that as it may, the assortment of observed execution measurements is somewhat constrained when there is no plausibility of estimating time subordinate qualities. Generally, throughput and distribution of different traffic types can be monitored with the single-point measurement. With multi-point measurement time-related parameters, such as packet loss, delay, and delay jitter, can also be measured, requiring that measurement point clocks are synchronized. Consequently, the estimation exactness increments however having numerous estimation focuses additionally builds the multifaceted nature and measure of conceivable blunder focuses. The application QoS and in general nature of a specific connection can be observed well when setting the estimation focuses at activity end-focuses. In any case, while having different heterogeneous connections it can be requesting to decide the real movement bottlenecks causing system blockage.

iii)Fuzzy logic based traffic management

Fuzzy Logic has been generally connected to control hypothetical issues, empowering the execution of cutting edge information based processing methodologies for complex powerful frameworks. Control hypothesis gives a wide measure of procedures that are beneficial to autonomic and versatile system administration frameworks, where the early interests have been connected, e.g., to stream control queueing hypothesis [86], TCP's operational advancement, and in various information numerous yield (MIMO) control [87]. Control hypothesis gives a structure to break down and configuration shut circle frameworks [88] in view of the properties of strength, precision, settling time, rise time, undershoot and overshoot. The control circles in frameworks' administration as depicted by Len Fehskens in 1989 [89] officially incorporated the center parts in particular for control, observing, policing and applying information. IBM presented the autonomic registering standards in 2001 which had solid correlations with natural frameworks that likewise utilize control circles [20]. Control circle screens the condition of the oversaw assets, breaks down the information, e.g., about when and where the system clog happened, and acts as indicated by the control arrangements by adjusting the system accordingly. Autonomic computing leads to self-managed, i.e., self-configuration, self-healing, self-optimization and self-adaptive functionalities. A control system is accurate if the measured output converges to the reference input [88], while ensuring that, e.g., throughput, delay or packet loss is maximized without exceeding response time constraints. For dynamic systems the output may not converge to a certain value but rather utilize operating regions, under which system operation is acceptable. A control system has short settling times if it converges quickly to its steady-state value, which is often important if there are time-varying workloads. Accurate systems are essential for guaranteeing that the control objectives are fulfilled, for instance differentiating between prioritized and best-effort service classes. The system should also achieve its control objectives without undershoots or overshoots. LotfiZadeh initially proposed fuzzy set theory [90]. Fuzzy logic was later developed from fuzzy set theory to present systems with uncertain information. Communication frameworks, and particularly remote frameworks, have nonlinear activity qualities that muddle the planning of exact scientific models because of transmission medium vulnerabilities.The fuzzy control approach is very useful for systems where it is difficult to precisely quantify information. In fuzzy control applications, a rule base (knowledge base) includes a control policy that is usually presented with linguistic conditional statements, i.e., if-then rules thatcan be converted into matrix equations. Fuzzy reasoning can be done either usingcomposition-based or individual-based inference. In the former all rules are combinedinto an explicit relation and then fired with fuzzy input whereas in the latter each of therules is individually fired with crisp input and then combined into one overall fuzzyset.

5. Cooperative Green Hetnet Framework

As an effective way to address the future needs on high SE, EE, and QoS, a new radio access architecture that consists of remote radio heads (RRHs) and centralized baseband units, as shown in Fig. 2, has been proposed recently [11]. A traditional radio access node normally uses passive antennas connected via thick and noisy feeder cables to the cabinet containing the RF modules and baseband processing. A RRH places the RF module next to the passive antenna to reduce cable losses. Further different from the traditional architecture, the new architecture allows the dynamic coupling between RRHs and baseband units so that the baseband unit pool can be shared among a large number of cells. As such, a much higher utilization rate of processing resources can be achieved and centralized resource coordination is made possible. The new architecture also greatly reduces the number of sites and equipment rooms to host baseband units so that the power consumption from air conditioners can be largely cut back [11]. Moreover, the separation from RRHs to the end clients can be diminished since the agreeable radio innovation can decrease the obstruction among RRHs and permit a higher thickness arrangement of littler cells. The energy used for signal transmission will be reduced, which is especially helpful to prolong the mobile battery life and to reduce the power consumption at the radio access nodes. The new architecture enables centralized baseband processing, cooperative radio and energy savings, which greatly facilitates SE and EE HetNet technology development and deployment.

A new design framework of centralized, cooperative, and green HetNets is studied. More specifically, we present a multi-layer cooperative green HetNet framework, with each layer comprising nodes with a similar level of transmission power and serving a similar coverage need. This multilayer cooperative green HetNet framework provides a promising solution to meet the future capacity and green needs and it opens a large number of new research avenues, ranging from the silicon design to the applications. In this article we mainly focus on the radio resource management schemes for heterogeneous networks that can address the ever-increasing SE, EE, and QoS demands for 5G wireless communication systems. We address the technical challenges of the cooperative green HetNets in the following:

- Mobile association with SE, EE, and QoS in cooperative green HetNets.
- Multi-layer interference management and power control in cooperative green Het-Nets.
- Cooperative dynamic resource allocation in cooperative green HetNets. Mobile association and interference coordination mainly address radio resource management in the wireless environment with large scale channel conditions and pseudo static user distribution information, while cooperative dynamic resource allocation achieves efficient radio resource management by considering fast fading and multiuser diversity.

5.1 Technical Challenges

i) Mobile Association With Se, Ee, And Qos

Supporting QoS and SE/EE in 5G wireless communication systems is a key performance promise to real-time applications. Due to the ubiquitous applications of real-time services such as video streaming, online gaming, mobile computing, etc., which are all delay sensitive and power consuming, spectrum/energy efficient transmission under QoS constraints over wireless channels is becoming increasingly important. How to address these three performance metrics at the mobile association stage is the first defense line provided by the wireless networks.

ii) Mobile association with SE and Qos

Our preliminary mobile association study [12] mainly addressed SE but did not consider the QoS requirements. Effective capacity was proposed as a metric to measure the wireless fading channel performance in the presence of statistical QoSneeds [13]. Effective capacity can be considered as the maximum link layer data rate that can be served by the wireless fading channel subject to the link layer buffer violation probability. Effective capacity models the physical layer wireless channel with three QoS parameters related to mobile association: source data rate, delay bound, and delay-violation probability. The newmobile association scheme can consider all these related parameters, besides the SE, when making a decision on the best node to attach to, in order to better accommodate QoS needs before the connection is physically set up.

iii) Mobile association with EE

Most of the existing mobile associationsschemes in the traditional homogeneous wireless network have been developed either based only on the downlink information or only on the uplink information, but not both. In helpful green HetNets, because of the transmission control distinction among different hubs, there will be a substantial scope contrast among hubs having a place with various layers. If only downlink information is used for association decision, most of the MSs may associate themselves to the HPNs due to the larger coverage areas of the HPNs. As a result, MSs may not associate with the nodes that are the closest. Thus, excessive MS uplink transmission power will be needed in order to maintain the target received uplink signal level, which will cause a higher uplink interference floor and consequently lead to a shorter MS battery life. On the other hand, if mobile association is done based only on the uplink information, MSs will be able to attach to the closer nodes and save their battery life. But MSs associated with LPNs may receive a strong interference from the neighboring HPNs on the downlink, especially for MSs at the coverage edge of LPNs. To make the most EE association decision, a new mobile association scheme that will consider both downlink and uplink channel information is desirable.

5.2 Multi-Layer Interference Management And Power Control in Mobile Radio Cellular Network

Due to multi-layer deployment in the cooperative green HetNet design framework, more advanced interference coordination and radio resource management schemes are required than in the traditional wireless network in order to achieve high SE, EE, and QoS. In a cooperative green HetNet, in addition to inter-cell interference, nodes from different layers, i.e. macro, micro, and pico layers, have different transmission powers and are overlaid on each other, resulting in new and complicated interference scenarios [7]. Interference coordination involves intelligent coordination of physical resources among nodes belonging to different layers and/or to different cells. Each layer and/or each cell may need to give up some resources, in a coordinated fashion, to improve performance, especially for cell-edge users who experience the highest impact from multi-layer interference. Different cells and different layers usually also need to coordinate transmission powers across various resource blocks. Due to the high power of the HPNs and the lower power of the LPNs, the MSs located at the edge of the LPN cells are most vulnerable to interference, which in turn leads to the low coverage range of the LPNs. To mitigate the inter-layer interference while still achieving high spectrum efficiency, the entire frequency band F can be divided into two parts, denoted as $F1$ and $F2$, denoting b as the portion of the frequency band assigned to the F1 part, i.e. $F1 = bF$and $F2 = (1 - b)F$. In $F1$, HPNs transmit at a reduced power aPH($0 < a < 1$) to the cell center MSs, while LPNs transmit at its full power to the MSs located at their cell edge. In $F2$, both HPNs and LPNs transmit at their respective full powers, with the HPNs transmitting to the cell edge MSs and the LPNs transmitting to the MSs located at their cell center. In order to optimize the performance of the proposed scheme, the values of a and b need to be chosen properly. Upon achieving the requested minimum rate requirement, MS k can be assigned with more resources to get a better QoS. A good frequency resource allocation scheme should achieve a high spectrum efficiency and fair resource allocation among the MSs. To design an optimal scheme that can maximize the long-term system throughput as well as ensure a good user experience. The optimization of the scheme is closely related to the mobile association scheme. It can either jointly optimize the interference control scheme and the mobile association or optimize the interference control scheme separately from the mobile association scheme. In both cases, It needs to decide the optimal partition of the frequency sub bands $F1$ and $F2$, i.e. the value of b; The optimal transmit power of the HPNs in the F1 sub-band, i.e. the value of a.

i) Joint interference management and mobile association

Most of the existing works on interferencemanagement and power control optimizationare based on a pre-determined mobileassociation scheme. The system performance canbe further improved by jointly optimizing mobileassociation and the dynamic fractional frequencyreuse (FFR) scheme. Such extension is notstraightforward due to the high dependence ofthe FFR and resource allocation outcome on themobile association scheme.

ii) Interference management and mobile association in an *L*-Layer cooperative green HetNet

It is a challenging task to extend the studies to a general L-layer ($L>= 2$) cooperative green Het-Net with each layer having a distinct transmission power level and/or coverage/capacity need. It assume nodes from layer 1 have the highest transmission power while nodes from layer L have the lowest transmission power. It needs to develop the similar interference management scheme but with coordination from all L layers. Each layer l, except the last one, will have its corresponding al and bl, so the general interference coordination rules by giving the mathematical relationship among all al and blshould be established. The optimization formulation can be used to solve the optimal al's and bl's.

5.3 Cooperative Dynamic Resource Allocation In Mobile Radio Cellular Network

The dynamic radio resource allocation in cooperative green HetNets. Dynamic cooperative transmission has been considered as a promising technique to increase cell average SE and cell-edge user SE. It can also reduce the energy consumption in cell-edge communications. The cooperation is more effective if the feasible groups of nodes to cooperate are carefully selected in advance and information from the cooperative set can be timely exchanged with a low overhead. Cooperative transmission naturally increases the system complexity in a distributed architecture. With multiple RRHs attached to the centralized baseband unit pool, it is easier to implement coordinated beamforming and cooperative processing in the baseband unit pool. Multiple baseband units can coordinate with each other to share the scheduling information, channel status and user data efficiently to improve the spectrum efficiency and energy efficiency. In a cooperative green HetNet, different RRHs could transmit at different power levels, forming a general L-layer cooperative green HetNet. Cooperative transmission is particularly useful among nodes from different layers. For example, for a cell edge user of a node belonging to layer l, the cooperative transmission from a node belonging to layer l' with $l' < l$ could help greatly to eliminate the dominant interference. Each node is assumed to have only one antenna. *N* cooperative nodes and N cooperative MSs form an $N \times N$ network MIMO. In order to maximize the total throughput in a network MIMO system, It select *N* MSs to simultaneously receive from the *N* nodes by applying a precoding algorithm [14], which can alleviate inter-user interference among these *N* MSs that receive from the same cooperative nodes on the same radio resources. In order to apply the precoding scheme, the channel information and user data need to be shared among these *N* nodes, which can be greatly facilitated by cooperative green HetNets.

6. CONCLUSION

Thus this work efficiently manages network resources in heterogeneous communication networks utilizing adaptive traffic management methods. It also strives a balance between network utilities, e.g., the average traffic delivery latency, and the green energy utilization.Which significantly reduces the communication overheads between users and BSs. In order that the different architectural parts and available networks are utilized in the most efficient way, it is necessary that the networks are monitored, performance indicators are measured and traffic load is optimized.The reenactment results demonstrate that the proposed movement stack adjusting structure empowers a movable exchange off between the on-lattice control utilization and the normal activity conveyance dormancy, and recoveries a considerable amount of on-grid power, e.g., 20%, at a cost of only a small increase, e.g., 5%, of the average traffic delivery latency and also address the technical challenges of the cooperative green HetNets.

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