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An Improvement in Energy Efficiency for Small Cell Network Using PEGASIS

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ABSTRACT

Due to fast development of portable broadband activity, embracing little cell is a promising pattern. It helps administrators to enhance the quality of the cellular network with minimal effort. Be that, static small cells can't be adaptably placed to fulfill time/space-varying traffic. The fixed small cells might stay in idle or under-utilized mode during some time periods, which wastes the resources. Thus,this paper uses the small cell idea and concentrates the arrangement issue for portable small cells. The goal is to expand the provision/service time given by small cells to all the clients. If a limited number of portable small cells can serve more clients or users for more time, then the portable cell procedure will give more service. In particular, atarget problem for energy saving is firstly demonstrated. At that point, the objective is stated with the issue of productivity and efficiency for overwhelming it an efficient mobile small cell utilizationprocedure to deal with the trade-off to increase the entirefacility time is proposed. The paper shows the routing protocol i.e. PEGASIS protocol with realistic parameter settings to estimate the enactment of theprojectedprocess. Evaluation of delay, energy efficiency, no of active base station for N=25 and N=113 is shown and results arecompared with the earlier existing technique.

Keywords: Cellular Network, Small Cell, Small Cell Deployment, PEGASIS Protocol etc.

I INTRODUCTION

Smart cities are designed to meet user'sever-increasing requirements efficiently and environmentally.Till now, cell system is yet considered as the key framework togive wireless access with the popularization of 4G cellular networks. On other side, the present cellular networks are still unable of providingsuitable and economical services considering spectrum efficiency and energy efficiency concern [2].According to standards of LTE and desires of 5G, future cell systems are trusted upon to be heterogeneous or small cell systems [3].Heterogeneous system (HetNet) is characterized as acombination of macrocells & small cells, e.g., picocells, femtocells and relays. Small cells can possibly upgrade range reuse and scope while giving high information rate administrations and consistent availability [4].For now, small cell is also predicted as anexplanation to accomplishenvironmental sustainability. However, at the point when small cells create thick in a constrained zone, serious impedance would occur because of range reuse. Likewise, on the off chance that considers all user equipment (UEs) in a given urban range, the conveyance of UEs may oscillate one day, consequent in various activity states. For this situation, some base stations (BSs) may be stacked while some may be sitting without moving. Traditional cellular networks are calculatedbuilt on the projected highest traffic demand, which results in simple energy waste and causes massive cost for operators [5]. Therefore, new tools on energy efficiency should be applied in small cell networks, in direction to support abundant applications and services for citizens with better quality and lower cost. Tremendous existing works on energy efficiency focus on optimizing radio resources and transmit power [6], [7], [8]. The problem is the performance gains they achieved are still not significant enough without considering dynamic cell planning. An applicablethickness of small cells, neither too dense nor too sparse, is very significant for the completepresentation of the network. The query of how green the small cell scheme can be staticrequirements to be supplementarydeliberate. To explain these developingtasks, novel energy well-organized cell planning systems should be advanced for the future cellular networks [9]. It has been specified that BSs consume most energy in cellularsystem [10]. The energy depletion of a Base Station can be separated into two parts, which are the communicate power of radio frequency signals and pathcontrolingestioncorrespondingly [11]. Tocommunicate power of RF signals is only a small part of the power amplifier considering its alteration efficiency. The path control ingestion contains baseband processing, cooling, battery backup, etc. Once a Base Station is substituted off into rest mode, it just devours constrained energy to keep up essential operation with a specific end goal to be waked up again promising. As a result, switching the idle BSs off willdecreasebigquantity of power consumption. Green small cell planning belowactive traffic request has strained much attention recently considering the significant gain it can achieve compared with static cell planning. Some existing systems are built on stochastic model. In [12] a computerized little cell organization strategy is proposed to decide the areas of little cell BSs (s-BSs) in view of stochastic geometry and Monte Carlo reproductions. [13] Studiesthe consolidated issue of BS area and ideal power portion. In this work the creators expect a TDMA convention so that there is no impedance among the UEs. In [14] the author has proved that the whole energy ingesting can be condensedthrough introducing the sleep mode while the UE performance remains superior. In [15], a base stationprocess & UE suggestiondevice is obtainable to get a flexible tradeoff between flow-level performance and energy ingesting. This work present an energy efficient small cell planning system is proposed in small cell systemsallowing foractive traffic states. We deal with BS deployment, BS switching on/offstrategy & UE suggestion jointly in our scheme in order to enhance energy efficiency of the whole system while ensuring quality-of-service (QoS) necessities. First, we give an arrangement of applicant areas for s-BSs in a land region and produce every conceivable association amongst BSs and UEs. The predefined s-BSs can be sufficiently thick with a specific end goal to obtain more correct areas for s-BSs at last. At that point we embrace a heuristic to turn off s-BSs and refresh BS-UE association's iteratively.to switch off s-BSs and update BS-UE connections iteratively. At last we get an answer utilizing minimal number of s-BSs without reducing spectrum efficiency and connectivity quality.

II PEGASIS PROTOCOL

The PEGASIS is various leveled convention. It is a close ideal chain-based convention. The fundamental thought of the convention is that, so as to expand arrange lifetime, hubs require just to speak with their nearest neighbors and they alternate in speaking with the BS. To expand organize lifetime fundamental radio model is utilized with the BS.

To increase network lifetime basic radio model is used. Transmit to and receive from formula of radio model are respectively as follows:

$E_{TX}(k,d)=Eelec*k+Eamp*k*d^2$(1)

Where, k is a bit message at distance d[17]

$E_{RX}(k)=E_{elec} * k$ (2)

Where,

$E_{TX\text{-}elec}$=Transmitter Electronic

$E_{RX\text{-}elec}$=Receiver Electrionic

$E_{TX\text{-}elec}=E_{RX\text{-}elec}$=Eelec

$E_{TX\text{-}elec}$=50nJ/bit

PEGASIS has two main objectives:

1. Increment the lifetime of every hub, and accordingly increment the system lifetime.
2. Allow only local coordination between hubs those are near each other, with the goal that the transmission capacity expended in correspondence is decreased.

Working of PEGASIS

Basic PEGASIS utilizes one hub in a to transmit to the BS and maintain a strategic distance from duplication transmission. To get the data about nearest neighbor hub in PEGASIS, every hub utilizes the flag quality to quantify the separation to every single neighboring hub or nodes. After change of the signal quality just a single hub can be heard. The chain in PEGASIS will comprise of those hubs which are neighbor hub from way to the base-station. For instance following figure demonstrates hub 0 associating with hub 3, hub 3 interfacing with hub 1, and hub 1 interfacing with hub 2 in that order. When a hub passes on, the chain is recreated in a similar way to sidestep the dead hub. At the point when the round of all hubs speaking with the BS closes, another round will begin et cetera. This decreases the power required to transmit information per round as the power depleting is spread consistently finished all hubs.

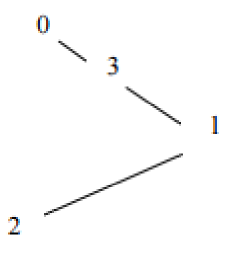

Fig. 1: Chain construction [16]

PEGASIS is ready to expand the lifetime of the system twice as much the lifetime of the system under some other various leveled convention. The grouping overhead is stayed away from, PEGASIS still requires dynamic topology alteration since a sensor hub has to think about vitality status of its neighbors so as to know where to course its information. Such topology alteration can present noteworthy overhead particularly for very used systems. Moreover, PEGASIS expect that every sensor hub can have the capacity to speak with the BS. Sensor hubs utilize multi-bounce correspondence to achieve the base station. It likewise accepts that all hubs keep up an entire database about the area of every single other hub in the system. PEGASIS assumes:

- All sensor hubs have a similar level of vitality and they are probably going to bite the dust in the meantime.
- Sensors will be settled or stable, a few sensors might be permitted to move and hence affect the protocol functionality.

III PROBLEM STATEMENT

PEGASIS is a close ideal chain-based convention. The fundamental thought of the convention is that so as to broaden organize lifetime, hubs require just speak with their nearest neighbors and they alternate in speaking with the base-station. At the point when the first round of all hubs speaking with the base-station closes, at that point additionally another round will begin in network. This decreases the power required to transmit information per round as the power depleting is spread consistently finished all hubs. As previously discussed the PEGASIS mainly works in the scenario like nodes have same properties or characteristics that mean the nodes are homogeneous. So it is so easy to maintain this kind of homogeneous environment. But with the help of heterogeneous nodes, energy can be saved. It is one way or anothercompound to maintain that kind of environment.

IV SYSTEM MODEL

Architecture for smart cities based on small cells

As outlined in the previous sections, future Smart Cities will be mainly based on offered services in fig 2. In order to enable these services, the network will need to hold the concepts of broadband wireless, green communications, re-configurability, replication, Machine to Machine communications and quality of experience.A key role in this kind of network is played by the wireless access, specifically by LTE-A, even if other technologies could and will be used in fig 3. Main LTE-A abilities heading toward this innovation are distinctive cell sizes (full scale, Pico, femto), machine-to machine and gadget to-gadget interchanges, efficient spectrum utilization, etc.It should be stressed that the Smart City scenario cannotbe based just on one technology. As an example, Sensor and Actuator Networks (SANs) might use completely different technologies, e.g., RFID, IEEE 802.15.4, etc. However, these networks should be integrated in the Smart City. The coordination is made conceivable by the IoT worldview, and LTE-A can assume a critical part as access innovation for the SAN gateway.

Small cell networks

Smart City remote systems administration prerequisites can't be met with conventional full scale just systems. This is due to a number of reasons ranging from spectrum efficiency and regulatory issues to indoor coverage. TheSmall Cell and, more generally, the Heterogeneous Network concepts are gaining wide acceptance. An example of heterogeneous network is shown in Fig. 2) [19]. Due to the peculiarities mentioned in Section 3, small cells are able to fulfill Smart City requirements in terms of interoperability, robustness, limited power consumption and multi-modal access with improved quality of experience.

The role of small cell technology in future smart city applications

Fig. 2: Service Driven Architectures

Small cells architectures enable mobile service providers to leverage network capabilities (e.g., location, presence, quality of service, trusted security, etc.) for applications' development, either by the operator or third parties. By providing application programming interfaces (APIs) that can be integrated with applications and service frameworks, small cells enhance the potential for innovative service creation. As an example, they have presence information APIs, making it possible to build services like One Family Number, Home Notes,Child Tracking, Emergency support, location based advertisement, product search, augmented reality, etc. Other features allow clients to divert information sessions from the center system to their nearby home system, giving higher throughput to media sharing applications and gaming. They may likewise empower secure installment exchanges by using secure access over licensed spectrum.From the point of view of operation and maintenance, site visits are avoided and, besides physical installation, many of this radio equipment, after installation, automatically come into service without any further intervention. At registration, location is determined and constantly kept up-to-date, allowing the mobile service provider to control it. This is critical for emergency calling and other location-associated services. Auto-arrangement diminishes the cost of little cells organization and abatements the requirement for vast client bolster groups. It likewise decreases the requirement for monstrous re-provisioning following large scale organizesre-planning. In this way, quick organization and adaptability prerequisites can be completely fulfilled

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V METHOD

For this research work chain based PEGASIS protocol is proposed. Since some hops of a PEGASIS chain are longer than other hops, the network lifetime is limited due to these long hops. For prolonging the network lifetime and balancing the energy consumption, data gather scheme (called as chain-based PEGASIS) which has a novel chain constructionmethod to decrease the variance of hop-distance is proposed. The proposed scheme can decrease the probability of creating long hops and consume less energy.

Thus, the network lifetime can be improved. Basically, if the spread area of sensors is small, the probability of creating long hops in a chain will be small. So, the idea of the proposed chain construction is to divide the sensing area into several small grid cells as shown in Figure 3. Then the start node of each cell chain will connect with the end node of the cell chain in neighbor cell. For example, the start node of the cell chain in cell 5.2 will connect with the end node of the cell chain in cell 5.1. By cascading all cell chains, all sensors will form a chain termed as area chain in the rest of this work). After constructing the area chain, the chain based -PEGASIS select an area chain head. Then, the area chain head collects the data from other nodes and sends the data to the BS. In the following sections, the details of the chain construction algorithm will be presented.

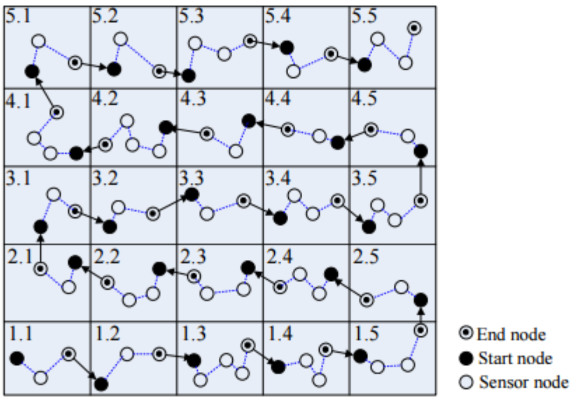


Fig. 3:PEGASIS-Network

First, we make the following assumptions in this study:

(1) The base station and sensing nodes are immovable.

(2) The sensing area is divided into small grid cells and each cell has its unique cell ID.

(3) Each node has its unique ID, n_i, and knows which cell it located.

(4) Each node will transmit the sensing data to the base station periodically.

(5) All nodes are homogeneous and have the same initial energy.

As shown in Fig. 5, we assume the sensing area is divided into $G_x \times G_y$ grid cells. Each cell has a unique ID, X.Y, where $1 \le X \le Gx$ and $1 \le Y \le Gy$.

Let N is the number of all sensing nodes. $R_{X.Y}$ and $L_{X.Y}$ be the rightmost node and the leftmost node in cell X.Y, respectively. $m_{X.Y}$ is the number of nodes in cell X.Y. $d(n_i , n_j)$ is the hop distance from node n_i to node n_j . $Node_{X.Y}$ is the set of sensing nodes in cell X.Y. Fig. 3 shows the flowchart of the area chain construction algorithm. The cell-chain construction algorithm is shown in Fig. 6. After constructing an area chain, in the i^{th} round, $n_{(i \bmod N)}$ will become the area chain head which is responsible for transmitting the data to the BS.

Step 1: Network Initialization

- Base Station broadcasts a low cost control messages for header selection to all nodes.
- All nodes send location and energy information to Base Station.

Step 2: Cluster Head - Set Selection

- BS selects a node with the greatest remaining energy becomes the first header for Cluster Head Set.
- Header Send the Advertisement
- Other Nodes reply to the header with Ack.
- Three Nodes with Maximum Energy are selected as a head set member.

Step 3: Path Chain Formation & Leader Selection

- End Cluster active head sends the message to next Cluster.
- Leader sends the message to Base Station
- Base Station broadcasts the 'chain completion' message.

Step 4: Data Transfer

- Member nodes of each cluster send data to Active Cluster Head.
- Active Cluster Heads collect the data.
- Active Cluster Heads send the collected data to the leader through the chain.
- Leader node sends the final gathered data to Base Station.

Step 5: Changing Active Header

- If E of Active Cluster Head < Eth, the Head set member with Maximum energy becomes a new header.
- If E of the three members is less than Eth, go to Step 2.

At Step 1, the BS sends a message to each node in the network, the member nodes reply with their location and remaining energy information, and the nodes transfer the requested data to the BS. Next, in the Step 2, the BS selects the headers based on the remaining energy information transferred in the Step 1. The selected headers spread the TDMA schedule to the neighbor nodes. However our new mechanism selects one header and the header send the advertisement to all other nodes,

The nodes reply with the ACK, from that ACK the active head selects the Cluster Head set members, and hereafter when a new header needs to be selected, one of the head set member becomes a header without re-running the header selection algorithm. The Step 3 is a process to form a chain along the headers decided in the previous steps. For this, the Greedy Algorithm used in PEGASIS is used. The chain is formed in the order from the furthest to the nearest node from the BS, and nearer nodes have better opportunities to be the leader. In the Step 4, through the chain of the headers formed in the Step 2 and 3, the collected data from the member nodes of each cluster are transferred by the their header, and the headers pass the data to their leader.

Continuously in the Step 5, when all members of head set have minimum energy than the threshold then a new header is selected using the header selection as in Step 2. However, since this protocol assumes that every node has the ability to directly transfer its data to the BS and that nodes have no mobility, it is realistically ineffectual. In Opposite to this, our new protocol can guarantee the mobility of the nodes as it periodically re-arrange the clusters over the whole network and the headers continuously report the state of their clusters to the BS.

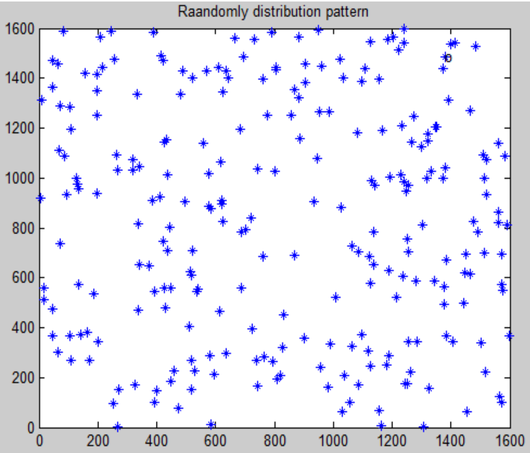
Table 1.Simulation Parameter (Input) -: Below mentioned is simulation parameter that are configured in the proposed simulation

Parameters	**Value**
Packet size	240
User equipments	250
Max no. of UE served by MBS	80
Max no. of UE served by SBS	30
Battery capacity	1000
Number of nodes	250
Size of network environment	1600
Cooperative channel	15
Threshold	3
Simulation	MATLAB

VI RESULT AND DISCUSSION

In this section, using MATLAB evaluation of the performances of chain based-PEGASIS discussed. This section, compares the performance of the proposed protocol with orthogonal and co-channel parameter. For performance comparison, it is considered that the energy efficiency of reception and transmission for the sensor nodes is equal to the case of a radio transceiver, nodes which move according to Random and uniform mobility model.

Fig. 4 shows a random distribution pattern of the sensor nodes. Fig. 5 shows uniform pattern for the same. Fig. 6 shows clustered distribution pattern for the sensor nodes. Fig. 7 shows the chain formation in PEGASIS. Fig. 8 shows the delay for the proposed scheme. Fig. 9 shows the no. of active s-bts for N=25. Fig. 10 shows the no. active s-bts for N=113. Fig. 11 shows no. of served UE for N=25. Fig. 12 shows no. of served UE for N=113. Fig. 13 shows the comparison graph for No of active s-BS at N=25 for proposed and base paper[18] technique. Fig. 14 shows the comparison graph for No of active s-BS at N=113 for proposed and base paper[18] technique. Fig. 15 shows the No of Served UE at N=25 for proposed and base paper [18] technique.. Fig. 16 shows the comparison graph for No of Served UE at N=113 for proposed and base paper [18] technique.Fig.17: shows the comparison graph for Energy efficiency at N=25 for proposed and base paper [18] technique.Fig.18: shows the comparison graph for Energy efficiency at N=113 for proposed and base paper [18] technique.



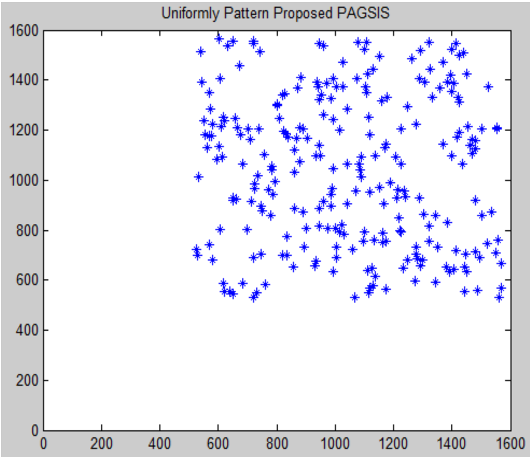
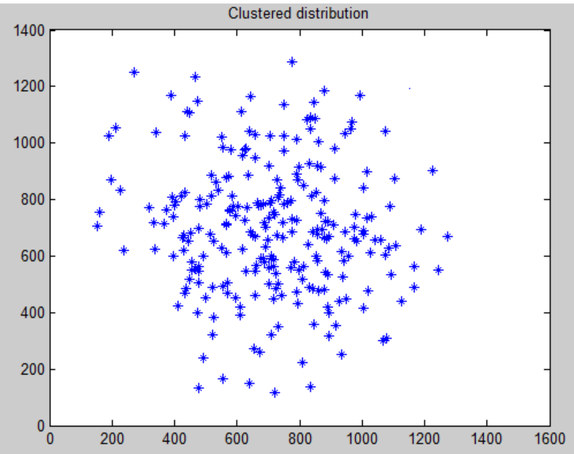


Fig. 4: Random distribution pattern   Fig. 5: Uniform distribution pattern



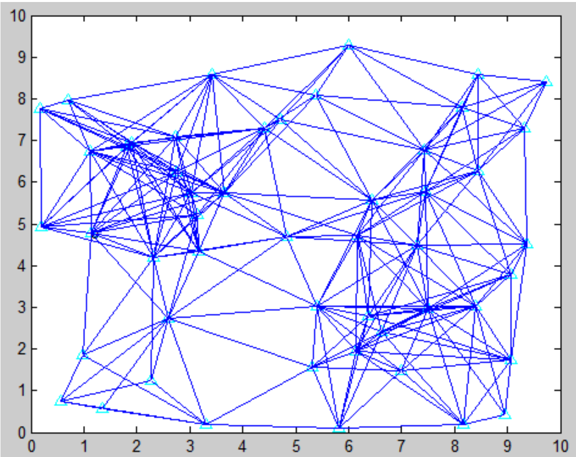


Fig. 6: Clustered distribution pattern   Fig. 7: PEGASIS chain creation

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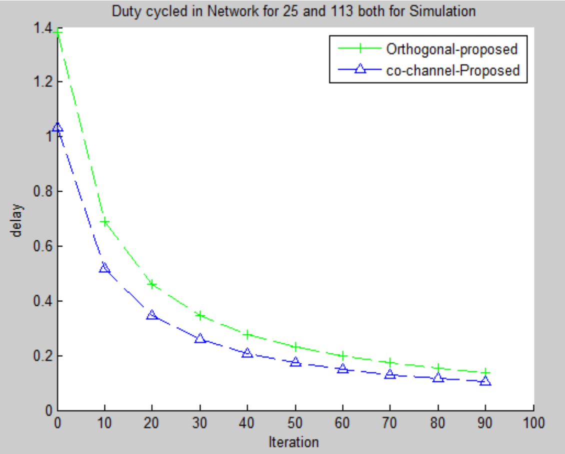


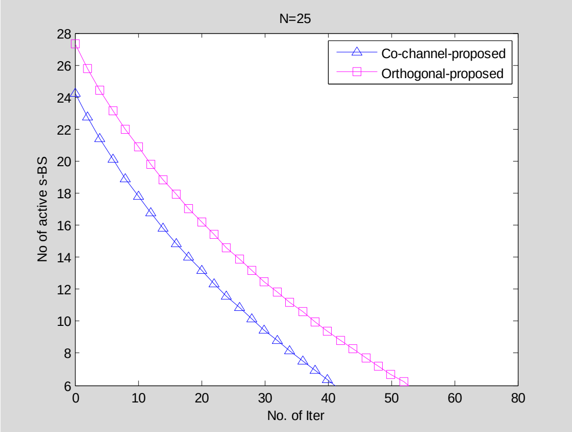
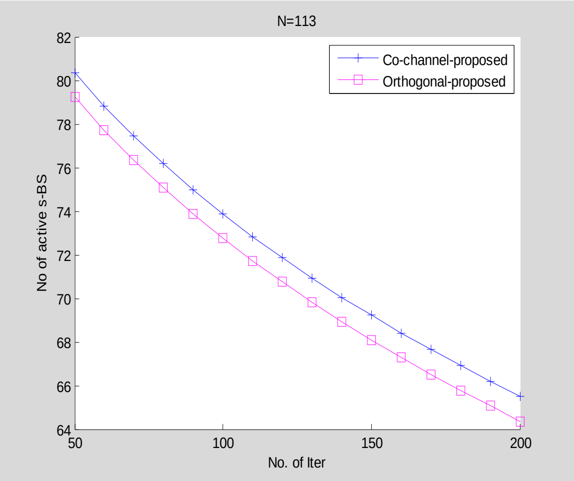


Fig. 8: Duty cycle in Network for 25 and 113 for delay   Fig. 9: No of active s-BS at N=25



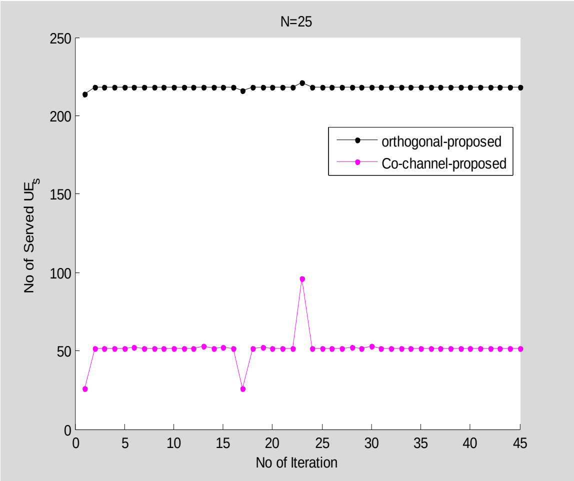
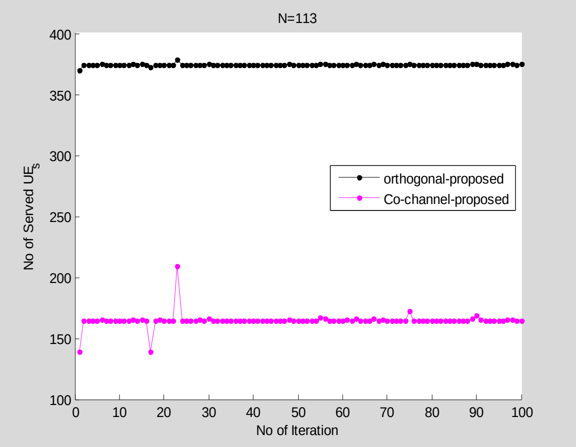


Fig. 10: No of active BS at N=113   Fig. 11: No of Served UE at N=25



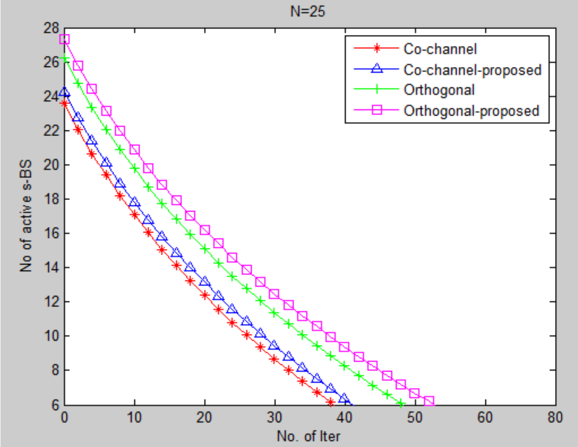


Fig. 12: No of Served UE at N=113   Fig. 13: No of active s-BS at N=25 for proposed and base paper[18] technique.

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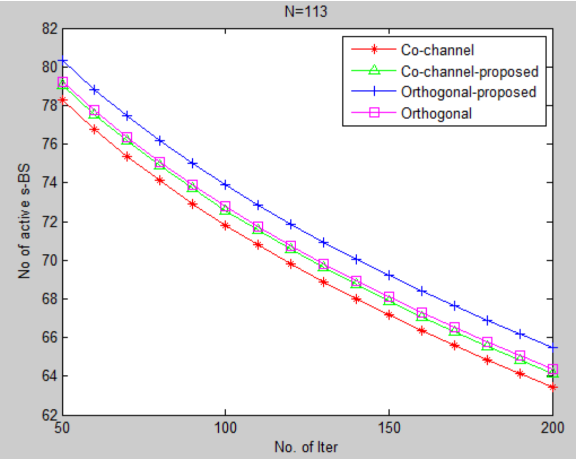

Fig. 14: No of active BS at N=113 for proposed and base paper[18] technique.

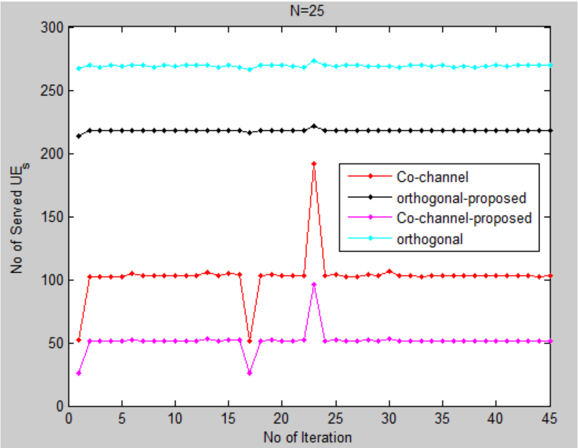

Fig. 15: No of Served UE at N=25 for proposed and base paper[18] technique.

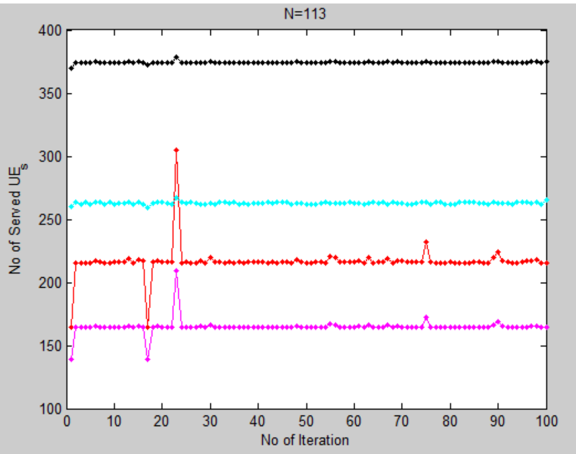

Fig. 16: No of Served UE at N=113 for proposed and base paper[18] technique.

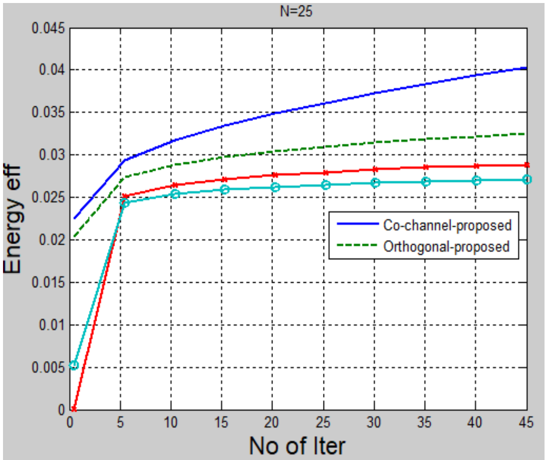

Fig.17: Energy efficiency at N=25 for proposed and base paper[18] technique.

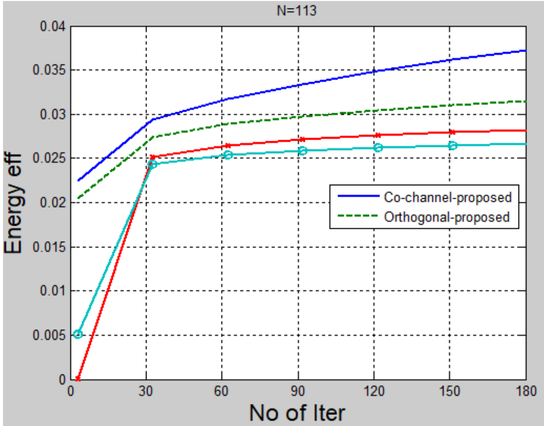

Fig.18: Energy efficiency at N=113 for proposed and base paper[18] technique.

Table 2. -: Below mentioned is comparison table for simulation result proposed technique and for base paper[18] technique

Parameters (cochannel clustered pattern)	**Values by Zhou et.al [1] for N=25**	**Values achieved for Proposed Method**
Active s-BTS	8.39	7.50
Energy efficiency	0.0336	0.0400
Delay (sec)	1.54	0.60

VII CONCLUSION

In this research, it isexamined that the design of energy efficient cellular networks through the service of base station chain mode strategies as well as small cells, and investigated the tradeoff issues associated with these techniques. Using a PEGASIS protocol, the paper shows the derivation of the success probability and energy efficiency under changing strategies in small macrocell and small cell networks. In addition, theorthogonal problems in the form of power consumption minimization and energy efficiency maximization and determined the optimal operating frequency of the macrocell base station. Specifically, the paper shows the effect of uniform and vital chain on the power utilization and energy efficiency.

Numerical results confirmed the effectiveness of chaining strategy in small macrocell networks but the gain in energy efficiencyrelies upon the kind of binding methodology utilized. What's more, the sending of little cells for the most part prompts higher vitality productivity however this pick up immerses as the thickness of little cells increments. Future work may incorporate the extension of the above model to the case where base stations have multiple antennas and may perform opportunistic user selection. It would likewise bear some significance with investigate how arbitrary spatial arrangements of base stations that model shock or hindrance influence the outcomes as far as throughput and vitality proficiency. At long last, the vitality effectiveness metric examined here is just subject to the power utilization and the coverage within the network, and does not take into account the infrastructure cost and backhaul overhead associated with implementing small cell networks.

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