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Cross Spectrum Switching in Mobility Scenario for Signaling Overhead Minimization in Het net

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I. Introduction

Heterogeneous network have up come as a new model for data exchange, where, multiple networks are integrated together to formulate a larger network, providing long range communication, with grouping of different wireless networks. With the development of such network, different architectures have been proposed in recent past [1], in which the network is incorporated with cognitive devices to achieve an efficient communication. The incorporation of cognitive devices has gained the advantage of utilizing frequency spectrum more efficiently in heterogeneous network. The radio devices are developed as a software defined radio unit [3], where the network user utilizes the spectrum by sensing its availability from other active users. The spectrums are shared to communicate data from free spectrum [2], sensing and allocating to exchange data with higher spectrum efficiency. The network [4]consists of users to share spectrum for data exchange[5],[6]. The objective of Het Net is to share the spectrum among users to exchange data without interfering the communication of any current user[7]. For interference controlling each secondary user process a spectrum sensing, spectrum allocation and spectrum utilization process. In the operation of cognitive network, the radio unit is defined for spectrum sensing of existing spectrum and utilizing for transmission rather to adding new spectrum. This usage helps in providing higher network performance with the exiting resources. Due to the advantage of providing higher service compatibility without additional spectrum, has made this network a new prospective architecture for next generation communication system. In Het Net, the radio unit improves the spectrum efficiency by implementing the approach of dynamic spectrum access approach (DSA). The users in such network operated as a secondary user, which uses the frequency bands allocated to a current user. This form of spectrum utilization is standardized under IEEE 802.22 and ECMA-392. Though spectrum sharing improves the performance of communication network, the mobility monitoring is also required. In this mobility driven spectrum sensing and allocation is focused. Even with a proper approach of spectrum sensing, the data exchange could face high degradation in mobility or in many a case may not meet the demanded quality of service. In the provisioning of mobility driven spectrum allocation in [1] an approach of joint optimization of energy efficiency and spectrum efficiency is proposed. An optimization problem of signaling overhead and spectrum allocation is formulated for a heterogeneous network. The problem of spectrum allocation is defined as a mutual interference model of spectrum efficiency (SE) and signaling overhead (SO) in this network. In the communication approach, detection of spectrum status is a prime issue. The vacant spectrum is used by the user for its communication and re-allocate to the current user when required. In practical scenario, two sensing error occurs, the misdetection error and the false alarm error. In the misdetection error the secondary user detect the current user spectrum as vacant, when actually used. Whereas, in false alarm condition, the user detect a spectrum as used, when the spectrum is vacant. These two errorsminimize the probability of detection in Het Net. The misdetection error result in co-channel interference and the false alarm minimizes the spectrum utilization efficiency and signaling overhead. In [8] to optimize the Het Net efficiency the optimization of SO to SE under this condition is proposed. The converging of this SO-SE approach was derived as a SNR based approach. In a similar approach in [9] an analysis to SE to SO for Het Net was developed. This approach defines an additional parameter of link information to optimize the SO-SE problem. This

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approach optimize the problem link fading condition is considered. The channel inference at the current user is considered to bound the derived interference margin in allocating the sensed spectrum. The mobility governance in this case is observed to be high due to interference limit of current user for spectrum allocation. With the constraint for SNR the throughput of the network is to be enhanced. In [10]a imperfect spectrum prediction based on the state condition of the current user. The Ideal state condition is used for spectrum sensing in this case. This provides a higher throughput performance in Het Net. In the spectrum utilization process, the spectrum sensing approach is carried out at the Medium access control (MAC) layer [11]. In such an approach, the spectrum utilization is performed to achieve the objective of efficient resource utilization towards solving the issue of un fairness problem in heterogeneous network. However, the approach of MAC layer oriented controlling is performed with a single objective of fairness provisioning measured via network throughput. To improve the network throughput during the spectrum sensing and allocation approach, a back off controlled spectrum utilization at MAC layer was presented in [11]. The issue of spectrum sensing at coexisting heterogeneous network [12],was addressed. The co-existing heterogeneous cognitive radio network was recently been presented in [11], where different clusters of network are defined with CR- devices to communicate. The basic issue of current user spectrum sensing [13], [14] by secondary user under such network was presented. To achieve the detection of free PU spectrum a collision based approach, using the concept of Jamming was suggested. The effect of jamming on the network throughput was addressed. However, the fairness metric was evaluated in terms of network throughput and no concern was given on the mobility of the user. No approach was suggested to control the data lost in case of observed distortion due to propagating channel is introduced. The node positioning in the utilization of resources for spectrum sensing or spectrum utilization is also not addressed. As, the mentioned limitations effect the service efficiency in heterogeneous network, the issue of distortion monitoring and mobility governance w.r.t. spectrum allocation is suggested. The global issue of node position in spectrum sensing is also addressed in this paper. To present the stated objectives, this paper is outlined in VI section. Wherein, section II outlines the issue of unfairness in heterogeneous network. The conventional modeling of decentralized MAC protocol for resource allocation is presented in section III. Section IV presents the proposed approach of multi objective coordination approach for co-existing cognitive heterogeneous network under mobility constraint.

II. Communication System

In general cooperative communication is that which allow single-antenna mobiles to achieve the benefits of multiple communication systems. The basic idea is that single-antenna mobiles in a multi-user scenario can "share" their spectrum in a manner to create a virtual network. The mobile wireless channel suffers from fading, meaning that the signal attenuation can vary significantly over the course of a given transmission. Transmitting independent copies of the signal generates diversity and can effectively combat the deleterious effects of fading. In particular, spatial diversity is generated by transmitting signals from different locations, thus allowing independently faded versions of the signal at the receiver. Cooperative communication generates this diversity in a new and interesting way. Figure 1 depicts an ideas behind cooperative communication. This figure shows two mobile agents communicating with the same destination. Each mobile has one antenna and cannot individually generate spatial diversity. However, it may be possible for one mobile to receive the other, in which case it can forward some version of "overheard" information along with its own data. Because the fading paths from two mobiles are statistically independent, this generates spatial diversity. In the course of the development of cooperative communication, several complicating issues must be addressed, including the loss of rate to the cooperating mobile, overall interference in the network, cooperation assignment and handoff, fairness of the system, and transmit and receive requirement on the mobiles. In the figures as is depicted the icons resembling base stations or handsets, but this is only a convenient graphical representation. The idea of cooperation is general, and perhaps even more suitable to Heterogeneous Network.

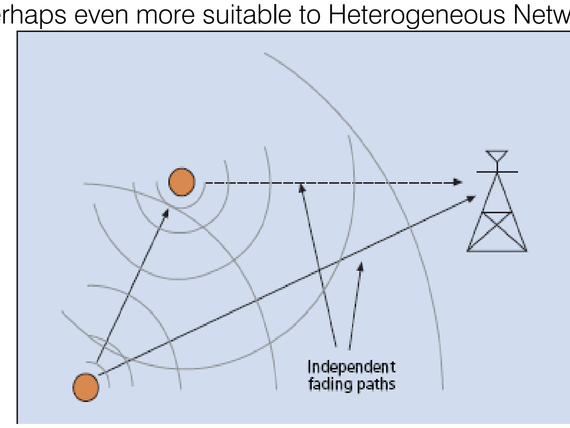

Figure 1: Cooperative Communication

In cooperative wireless communication, we are concerned with a wireless network, of the cellular or ad hoc variety, where the wireless agents, which we call *users*, may increase their effective quality of service (measured at the physical layer by bit error rates, block error rates, or outage probability) via cooperation. In a cooperative communication system, each wireless user is assumed to transmit data as well as act as a cooperative agent for another user (Figure 2). Cooperation leads to interesting trade-offs in code rates and transmit power.

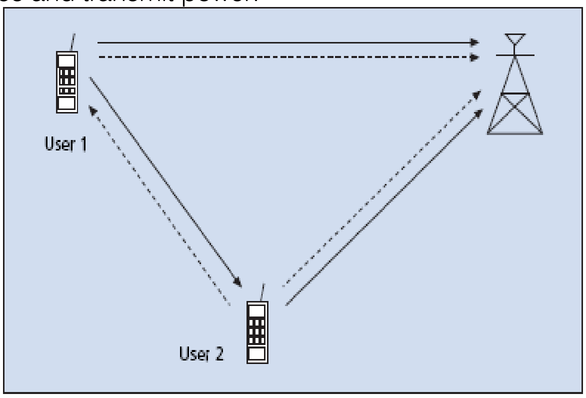

Figure 2: In cooperative communication each mobile is both a user and a relay.

In the case of power, one may argue on one hand that more power is needed because each user, when in cooperative mode, is transmitting for both users. On the other hand, the baseline transmit power for both users will be reduced because of diversity. In the face of this trade-off, one hopes for a net reduction of transmit power, given everything else being constant. Similar questions arise for the rate of the system. In cooperative communication each user transmits both his/her own bits as well as some information for his/her partner; one might think this causes loss of rate in the system. However, the spectral efficiency of each user improves because, due to cooperation diversity the channel code rates can be increased. One may also describe cooperation as a zerosum game in terms of power and bandwidth of the mobiles in the network. The premise of cooperation is that certain (admittedly unconventional) allocation strategies for the power and bandwidth of mobiles lead to significant gains in system performance. In the cooperative allocation of resources, each mobile transmits for multiple mobiles. If we assume there are two users U1 and U2 along with a single active user U, the unfairness problem arise if any one of the user don't have active user detection ability. For given U1 and U2, in the absence of active User, the channel will be occupied by U1 whereas the U2 also tries to occupy it. But due to the non-existence of active User detection ability, it can't occupy. This unfairness occurred due to the non active User detection capability, the throughput of the U2 will be reduced. In [11], this unfairness problem due to uncoordinated active User detection is solved through a MA layer approach which improves the performance of active User detection. The main objective of [11] is to identify if the user who occupies a busy channel belongs to a active User or an User from another by a low-overhead mechanism under mobility condition. It is an assistant function to improve the active User -detection ability to achieve a better Dynamic Frequency Selection (DFS) decision.

III. Proposed Coordinative Function

To achieve the objective of higher service compatibility the network throughput factor is considered with the offered channel interference in node mobility condition. The interference of the network impacts on the delivered service of the network. The throughput of the network is monitored by the traffic interference, wherein the processing overhead is observed at the process of signaling overhead. During the process of coding, which is initialized at the beginning of a communication. A Back off coding is used because this method is most widely used in computer network. It is a general agreement that the more the times of coding is, the higher the signaling level (SL) of coding is. For the same process, the SL is determined by which way it adopts. For example, process through Media access control (MAC) address has lower SL than one through credentials with a shared resource allocation of spectrum. To achieve the simulation of optimal resource utilization the SL optimization when a user switches from one network to other. In this case, the service quality is measured by the number of packets in unit time. In a given network, r_a is defined as arrival rate of packet request to measure times of packet in one minute. As the data rate changes, the SL of packet varies accordingly. For simplicity, it is assumed that data rate is proportional to the SL of coding, and a linear function is adapted to describe the relationship between coding and it's SL. The value of SL is just its relative. When the SL of packet is not lager than *lm*, it can be carried out as follow:

$$e = l_m/(r_m - r_{min}), \qquad (1)$$

$$l_a = (r_a - r_{min}) \times e. \qquad (2)$$

Here, l_a is the SUL of packet with the allocated rate r_a, eis proportional coefficient of data rate. r_{min} is the minimum data rate used in simulations and r_m is the allocated rate corresponding to l_m. When the SUL is higher than l_m, the additional SUL of service can be expressed as:

$$e = (L_{max} - l_m)/(r_{max} - r_m) \qquad (3)$$

$$\Delta l_a = (r_a - r_m) \times e \qquad (4)$$

Here, r_{max} is the maximum of offered data rate.

Once the data exchange is implemented successfully, the performance of the application is not basically affected by its offered service.

Back off delay is the time duration from sending an data request to receiving the reply. It is proportional to the data rate in network scenarios. Here, number of packages for transmission is used to measure the impact of service on QoS. The packet delay T_a as well as the data delay per package T_a can be denoted as follows:

$$T_a = c \times r_a + d \qquad (5)$$

$$t_a = r_a \times \frac{T_a}{\frac{1}{T}} = r_a \times T_a \times T \qquad (6)$$

Here, the parameter *c* is proportional coefficient, *d* and is a constant that is determined by network status. $ra \times Ta$means time of packet delivery in one unit. That is to say, how many packets for exchange were sent in one unit. At last, the end-to-end delay can be obtained by substituting (6) into (8), which is expressed by:

$$T = (t_{net} + t_k)/(1 - r_a \times T_a) \qquad (7)$$

and we can get the corresponding minimal end-to-end delay and maximum SUL by substituting (*klen*, *ra*) into (7). To observe the impact of exchange process over transmission operation, an analysis to the data exchange process of transmission and reception is proposed. In the process of data coding, data encoding and spectrum allocation are two main quality mechanisms used generally in various coding protocols. By this means, the evaluating model is setup directly from the two mechanisms. Note that data encoding just refer to the encoding of message in this research, while encoding and key exchange for data are all regarded as a part of communication. In this way, data exchange consists of initial measuring and data encoding. Generally, encoding algorithm translates the plain text into cryptograph before transmission according to key used in it, so that users without key cannot know the content of session, except for the valid receiver. It can also be used for data integrity. If the fragmented coding text is modified, the receiver end cannot decrypt. Although encoding provides information secrecy and integrity check, it also takes additional time delay and consumes power due to encoding and decoding. On the other hand, spectrum allocation is used as an initial process to authorize a user through coding credentials for communication. By rejecting blocked users, suggested approach can thus control resource access. At the same time, the back off can not only result in additional delay, but also increases call dropping probability that causes degradation in QoS.

It is well known that switching services can influence QoS metrics, such as end-to-end delay, call dropping probability and throughput of communication. In the paper, end-to-end delay is approximately taken as QoS because it is the most important among various QoS factors. We defined the end-to-end delay as the time that a packet is sent from one end to the other. If both encoding and quality encoding are applied, the time delay *T* can be written as:

$$T = t_{net} + t_k + t_a \qquad (8)$$

Here, t_{net} is the transmission delay, t_k is the encoding and decoding time, and t_a is the coding delay per packet. It is noted that although encoding is just implemented in initial stage of session, to describe its effect on end-to-end delay, we averagely add back off delay to every packet. By this means, packet transmission takes more time due to back off. In this way, the effect of data exchange on QoS can be reflected by the end-to-end delay.

IV. Experimental Results

For the simulation of the suggested approach a randomly distributed network, with the operational network characteristic as outlined in [1]. The network parameters used for simulation is given by,

Table 1: Network parameters used for simulation

Network parameter	Characteristic
Node density (N_d)	30,45
Network Area	N_d x N_d
Communication range	80 Units
Mobility	Non-static
Topology	Random
MAC	802.11
Power model	IEEE 802.11-NIC card

The Network is defined for a randomly distributed node, comprising of nodes with a power conservation unit. The devices are incorporated with solar radiation energy generation units. Each node is defined for an average radiation reception of about 0.2 KWh/m^2 [16]. The minimum power required for a node to drive is taken as 0.5mW [16]. The operational time period and data exchange times are set as per IEEE 802.11 standards [17]. These values are set to 10 and 20μs for energy request and data exchange respectively. The charging energy level is taken as E_{max} is taken as 10E, where E is taken as 100mW over a time slot period for communication [18]. The conservation approach when induced to a cluster based network, with optimal scheduling the overall network performances are improved. The observations made for the proposed approaches are as illustrated below;

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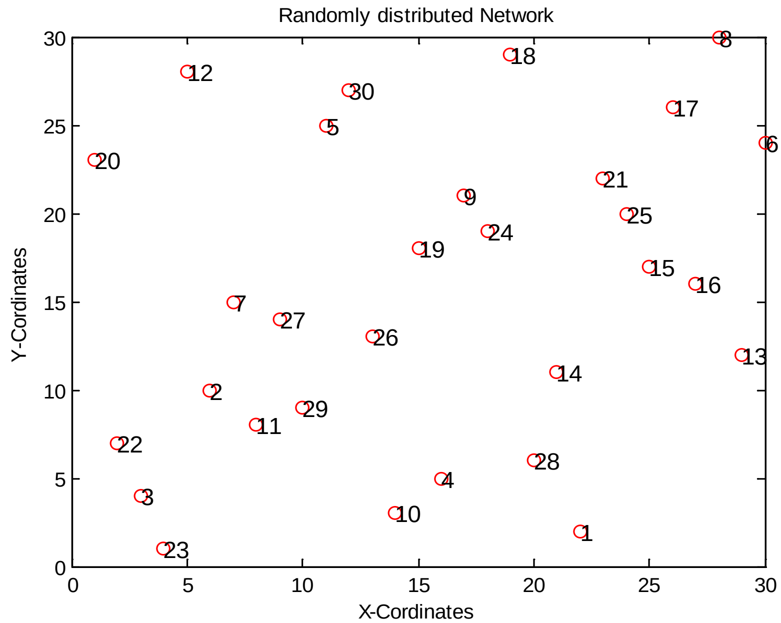

Figure 3: Random scattered Network topology

The randomly scattered network topology, for simulation is shown in figure 3. Each of the node is randomly placed in a network area of 30x30, with number of nodes as 30. Each node in the network is defined by its ID, geographical coordinates, defined by x and y coordinates, and a randomly defined power level at each node. These nodes process the routing protocol and select the optimal route for data communication using Multi hoping approach. At each of the hope, the node dissipates power based on the IEEE 802.11 standards for receiving, transmitting, and ideal condition. For the developed communication, the obtained parametric observations are as illustrated in following figures.

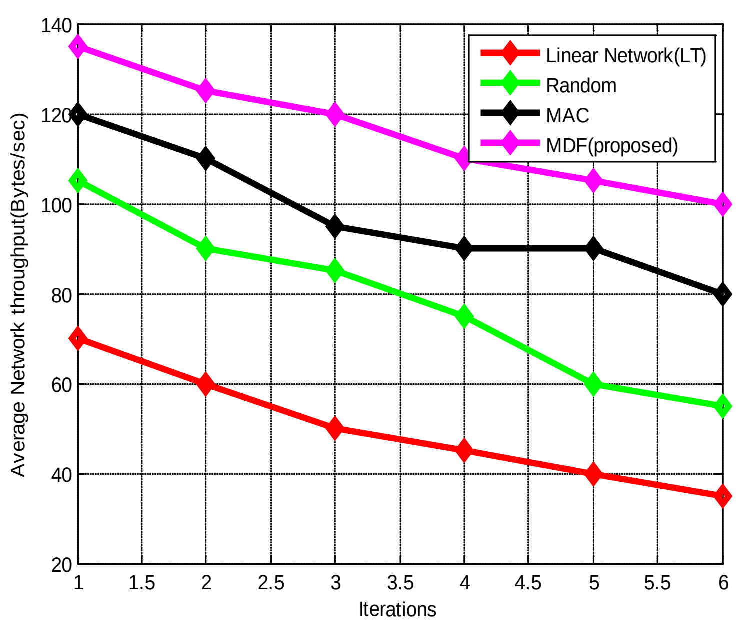

Figure 4: Average throughput with E=100mW and conservation time set to 10μs

The average throughput for the developed system is shown above. The average throughput for the proposed approach of energy conservation at master nodes result in higher throughput as, they are operable for more period. It is observed that the throughput for the linear network with energy conservation is also improved. However as with the increase in number of communication iterations, it is observed that throughput decrease due to the power dissipation per node and time taken to harvest energy. However, the throughput is comparatively observed to be improved in case of proposed MDF driven power saving scheme with energy conservation.

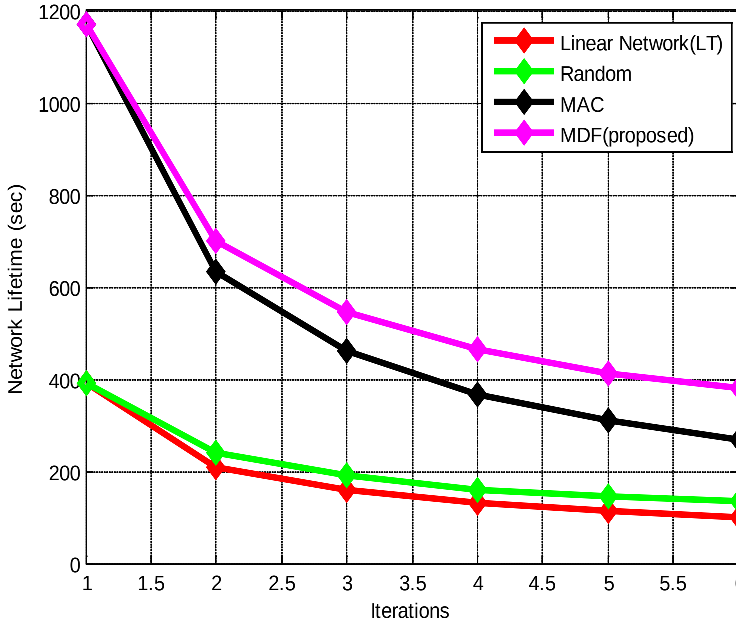

Figure 5: Network lifetime over communication period

The observed network life time for the simulated network is observed to be improved with the increase in communication iteration, using the approach of proposed MDF. The lifetime is computed as the number of nodes retained in the network in active path for data exchange. It is observed that, the network life time is increased by the incorporation of energy conservation at the node level.

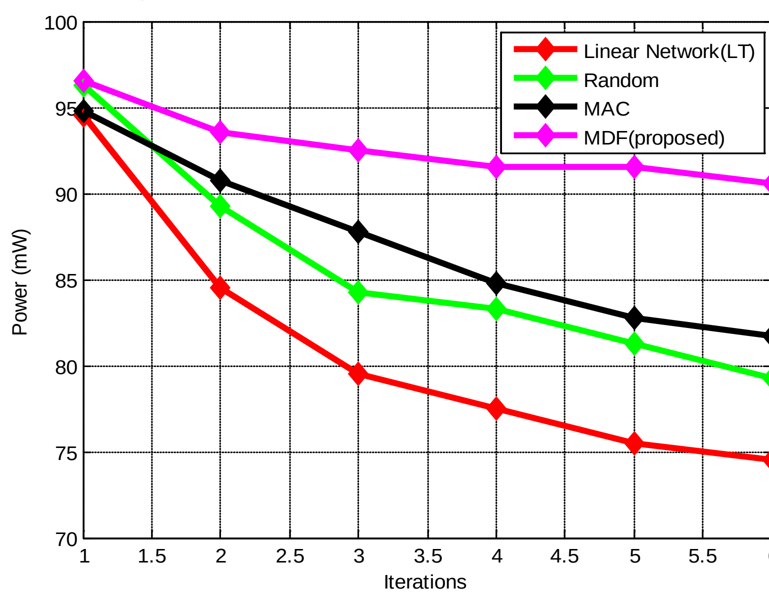

Figure 6: Power level with communication iteration with E=100mW and conservation time set to 10μs

Power at each node is measured and it is observed that, with the increase in the communication time period, the power level at each node is minimized, due to energy dissipation during transmission and reception operation. However, due to the incorporation of conservation approach to the developed network, it is observed that, the power level for active nodes is increased. This improvement is higher in the proposed MDF approach. As each node in such network remain in sleep mode, and master nodes are periodically been improved with energy conservation.

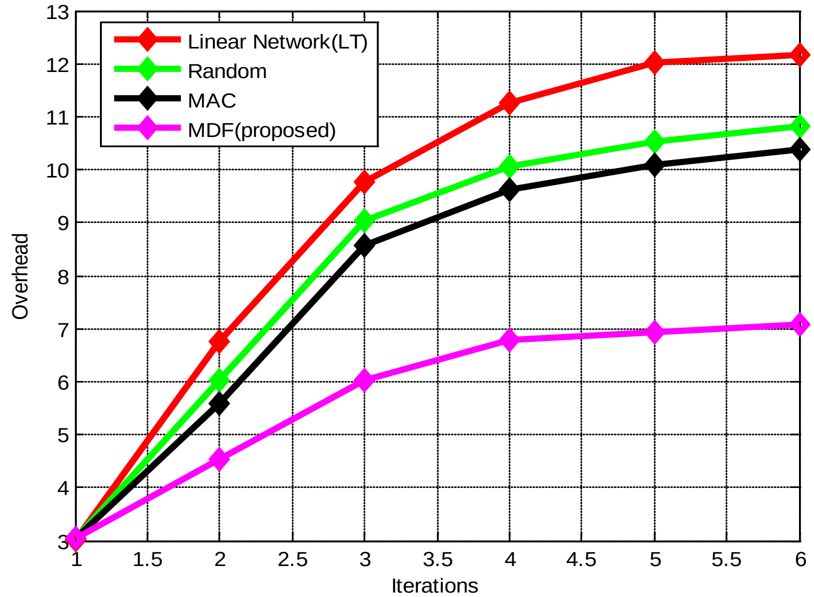

Figure 7: Network overhead over communication iteration

The Network overhead is observed to be minimized in case of the topology preserved with energy conservation. The concept of energy conservation makes more number of nodes available in the network, which results in higher throughput. Due to more traffic clearance the overhead is observed to be less in proposed approach. The effect of node density on the network performance is also evaluated for the simulation model. With the variation of node density fro Number of nodes varying from 10 to 50 in the network is evaluated.

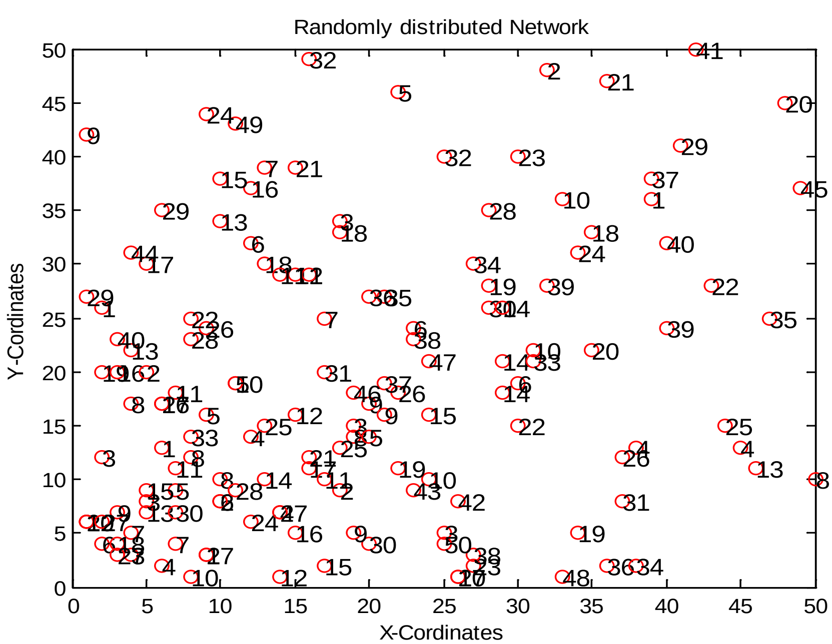

Figure 8: A randomly scattered network topology with Node density of 50 nodes

For the evaluation of variation in node density and its impact over network parameter, node density is varied from 10 to 50. The evaluative parameters observed for the simulated network is presented below. For the simulation a network with node density of 50 nodes is shown in figure 8. The scattering of nodes in such network can be seen in figure 8. Due to higher density the nodes are very near to each other. This leads to more route probability and more reliability. However, as number of nodes is more, probability of node participation in data forwarding also increases, resulting in faster power drain.

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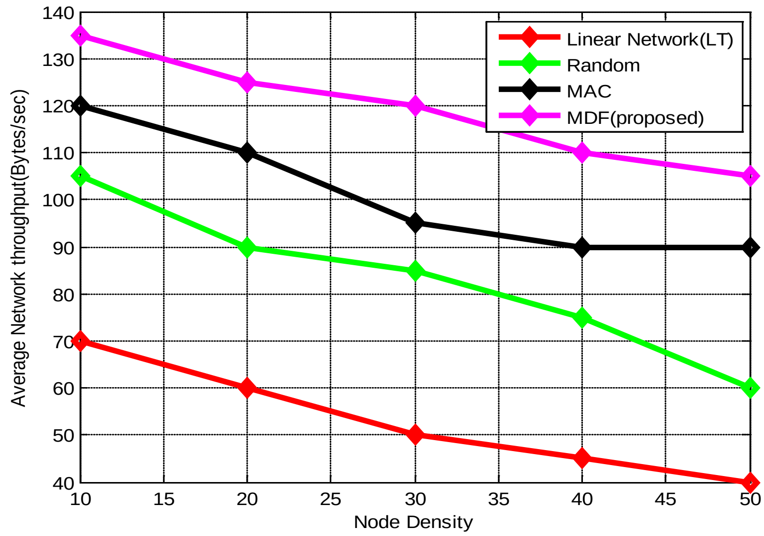

Figure 9: Average throughput with variant in node density

The average throughput w.r.t. Variation in node density is observed. It is seen that, throughput for the developed approach is improvised with increase in node density. The average node density available for the routing in such case increases, and due to faster processing and rescheduled conservation the nodes are processed for higher data transfer. As the data transfer is higher in such network the observing quality and intern the network reliability for Quality oriented service increases.

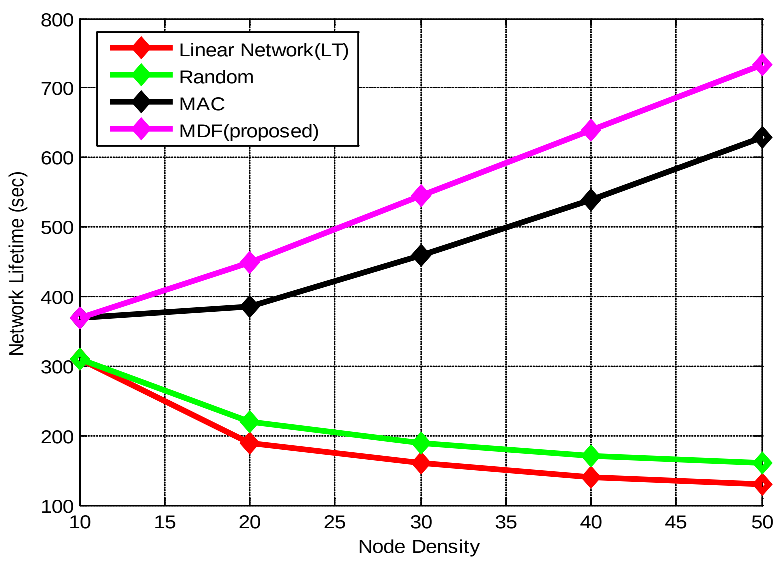

Figure 10: Network Lifetime over node density

The network life time is observed to be improved in such case. As the number of nodes are high, the network sustaining increases. In addition due to energy conservation, power is refreshed in a particular interval. These features increase the power per node in the network, hence resulting in longer life time. In comparison to the observation for network life time for a fixed node density as shown in figure 10, this network life time get increased; due to large number of node remain at higher energy level.

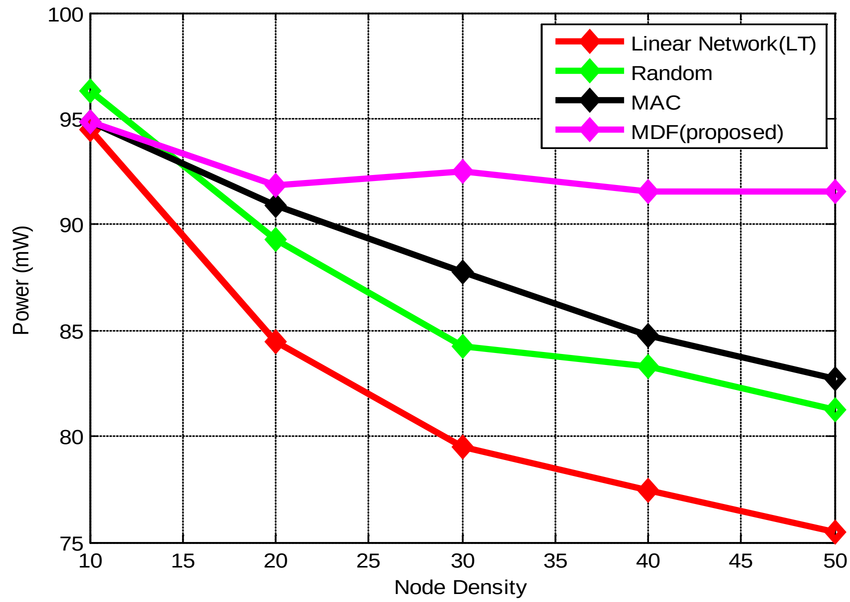

Figure 11: Power in the network over Node density

The power consumption for such network will be lowered and hence the power conserved per node gets improved. In the case of MDF driven power scheduling approach with energy conservation, the nodes are scheduled for sleep and wakeup period, as well the master node keep the energy refreshment, this result in higher power in the network, as observed in figure 11.

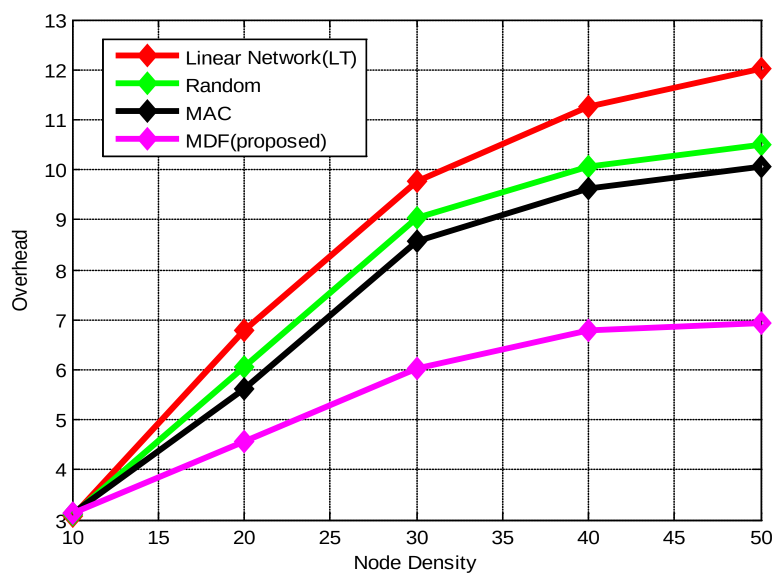

Figure 12: Network overhead with variation in Node density

The Network overhead in such case is observed to be optimized in case of the topology preserved with energy conservation. The overhead in such case is reduced, due to faster release of data, as due to availability of more nodes for data exchange as compared to its conventional counterparts.

V. Conclusion

This paper outlines a co-ordinate distribution approach to achieve the objective of fairness in heterogeneous network under mobility condition. The network is outlined with different devices of spectrum sensing with active users and junction users. To optimize the spectrum utilization in Het Net, a service level optimization coding is defined. A coding approach is used to sense free spectrum from other standing free users in other network cluster. The objective of spectrum sensing Is severed via multiple attributes monitoring, and the fairness is measured in terms of offered quality of service with higher throughput. The offered quality of service is observed in terms of service quality level, measured as a parametric value for offered service in heterogeneous network.

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