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Interference Mitigation in Heterogeneous Networks by Fuzzy Logic Based Coverage and SSMCR Approach

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Abstract*: The main purpose of this paper is to reduce or mitigate interference caused due to different conditions that arise in an heterogeneous networks. The LTE-A uses the concept of HET-NET, which consists of different eNB's with different service coverages. The heterogeneous network consists of macro, micro, pico and femto together in same geographical region.To provide maximum service coverage,LTE-A uses multihop relay networks,where RS'S are used along with the base stations.Here in this paper SSMCR-site selection with maximum coverage ratio approach is used, which considers the required no. of serving nodes,their types and placement locations in order to obtain maximum service coverage by mitigating the interference.Here the site selection should be in such a way that it should consume less power and provide high datarate by using RS'S to avoid interference between the nodes in the heterogeneous networks.
***Keywords*: Het-Net,RS.**

I. INTRODUCTION

Many factors includes path losses ,noises ,and interferences between different cells will decrease or degrade the quality of the signals and also reduces the coverage accordingly. By keeping voice communication as main parameters, the service providers must also keep in mind that they should try to provide higher bandwidths in order to support less video streaming and to provide HD in television and to provide online games and to provide even the teleconference service for the requested users. The network capacity has to be increased in order to provide maximum coverage even to the dead areas.The LTE-A proposed many aspects like MIMO, aggregation of carrier in order to improve the spectral efficiency of the network. The spectrum efficiency of the 3G and 4G standards are according to their fixed standards.So it is difficult to change the spectrum efficiency of that systems.In 4G and beyond this,the capacity of the channel is increased by increasing the density of the nodes serving in the network.The placement of UMTS and E-UTRAN,eNB's in the required area is ultimately costly. The placement of all these not only increases the intercell interference but also degrades the allocation of bandwidth for that network. The main idea about heterogeneous network was introduced in LTE-A technology in order increase the signal quality and to extend coverage to maximum extent. Four types of eNB's are described in LTE-A. They are namely macro, micro, pico and femto. And all these together in one geographic region forms a heterogeneous network. Here macro, micro and pico are used and installed by the operators of the networks.And femto eNB is installed by the customer itself. The LTE and IEEE 802.16e are promoted mainly for higher packet rates.The UE'S present near the boundaries experiences poor data rate and poor QoS due to pathloss and attenuation at the boundaries. The placement of small eNB's is the most useless thing, where the wired connections are most costlier. Apart for HetNet, the LTE-A uses the concept of MHR networks, where the RS's are placed along with the BS's inorder to increase coverage and to increase its capacity of the network. The placement of these small eNB's and RS's will reduce the distance between the communicating nodes in the network. And these sizes should be less than macro eNB. Due to this the pathloss gets reduced and this increases the quality of the signal transmitted. The improper placement of these may lead to high transmission delay's,PC and very high interference which in turn degrades the transmission quality and service coverage. The conventional 2G and 3G standards used macro cell deployment(MCD) approach ,where all the BS's have same coverage ranges.In order to provide coverage to the edge users,the macro eNB needs to increase its transmitting power level and there by the total power consumption increases. In this approach the macro eNBs are placed irrespective of the available UEs.This increases the inter eNB interference and increases the placement cost. Keeping in mind the end goal to determine these previously mentioned issues, HetNet has been presented in the long haul development progressed (LTE-An) institutionalization. In a HetNet, macrocells and low-control hubs, for example, picocells, femtocells, and transfers, exist together with a specific end goal to convey the system nearer to the end clients. Among the low-control hubs, the picocells are a standout amongst the most critical hubs to be presented in a HetNet; the presentation of picocells empowers the productive settlement of high-volume movement in neighborhoods., hotspots, and in addition the improvement of the general framework limit. In spite of a critical increment in the system execution expected with the organization of picocells, various testing specialized issues still exist, which should be tackled. One of these significant issues incorporates obstruction or interference administration between neighboring picocells and amongst picocells and macrocells in a HetNet. When all is said in done, the accompanying two kinds of obstructions are watched: (a).C0-tier interference: This type of interference occurs among the network elements that belongs to the same tier of the network.In case of a pico cell network it occurs between the neighbouring picocells. (b).Cross-tier interference:This type of interference occurs among the network elements that belongs to the different tiers of a network.i.e interference between pico and macrocells etc Cross-tier interference issues are altogether testing on account of a co-channel HetNet deployment. For instance, the client (UE) associated with a picocell through CRE experiences serious interference from an assailant macrocell, because the received signal energy of the macrocell is higher than that of the interfacing picocell for such UE. Accordingly, between cell interference administration is difficult to HetNet arrangement In the third era partnership project (3GPP) with its REL-8/9, the interference administration technique did not consider a HetNet, and it doesn't give an appropriate predominant interference situation in the HetNet. Along these lines, REL-10 has presented a period domain ¬based interference management conspire. The fundamental idea basic this time-domain ¬based impedance administration plot is that an attacker layer makes "ensured" subframes for a casualty layer, by lessening its transmission action in certain subframes. For this reason, the attacker eNodeB decreases the transmission energy of some of its downlink signals (or on the other hand, quiets their transmission) amid an arrangement of low interference subframes assigned as the relatively clear subframes (ABSs), whose events are known from the earlier at the organizing eNodeBs. At the point when person on foot UEs to-picocell UE impedance.

Keeping in mind the end goal to accomplish the offloading impact, a high counterbalance an incentive for fulfilling the handover criteria should be utilized, for example, the reference signal received power (RSRP). At the point when a high balance esteem is utilized, extra assets should be ensured for the offloaded UEs associated with the picocells. In this way, keeping in mind the end goal to acquire an ideal framework execution, the balance an incentive for CRE and the quantity of assets should be successfully controlled. In any case, it doesn't generally apply to the HetNets where large scale and pico-eNBs have diverse transmission powers. In this way, to address the issues coming about because of the difference in the transmission control and the impedance in HetNets, it is basic to build up another cell selection technique.

A. Requirements And Targets Of Lte

Discussion of the key necessities for the new LTE framework prompted the creation of a formal 'Concentrate Item' in 3GPP with the particular point of 'advancing' the 3GPP radio access innovation to guarantee aggressiveness over a 10-year time period. These prerequisites can be expressed as:

1) Reduced postponements, as far as both association foundation and transmission latencies.
2) Increased client information or data rates
3) Increased cell-edge bit-rate, for consistency of administration security;
4) Reduced cost per bit, inferring enhanced spectral efficiency;
5) Greater adaptability of spectrum use, in both new and pre existing bands available
6) system architecture.
7) Seamless mobility, including between various radio technologies
8) Reasonable power utilization for the portable or mobile terminal.
9) To address these objectives, the LTE framework configuration covers both the radio interface and the radio system design.

B. Long Term Evolution-Advanced

LTE-Advanced is expected to help facilitate development of LTE and to build up EUTRAN as an IMT-Advanced innovation. LTE-An otherwise called LTE release 10 is set to give higher bitrates in a cost effective manner and in the meantime likewise center around higher capacity:

1) Increased peak information rate DL 3Gbps, UL 1.5Gbps
2) Increased number of simultaneously active subscribers.
3) Improved execution and higher spectral efficiency.
4) Worldwide network roaming and functionality.
5) Compatibility of network services.
6) Inter working with other radio access frameworks

To accomplish these objectives, a few upgrades are being considered. At the physical layer, LTE is relied upon to give significant change in peak, normal and cell-edgespectral efficiencies, under the supposition of 8x8 recieving wire arrangement in the downlink and4x4 in the uplink. Under similar presumptions, peak spectral efficiency of 30 and 15bps/Hz should be met for the downlink and uplink individually. A portion of the physical layerenhancement systems are Carrier Aggregation, Co-OrdinatedMultipoint, Relays, uplink and downlink spatial multiplexing up to 4 and 8 transmit antennas separately.

Small cells, for example, picocells and femtocells convey the system nearer to clients and give a major jump in execution. Be that as it may, LTE-Advanced enhances small cell execution through highlights, for example, 'Range Expansion' to make the jump much more critical. Basically adding small cells to a system just advantages clients near the cell, however LTE-An upgrades the clients encounter for every one of the clients including those on the cell edge with higher information rates, notwithstanding when the small cells are not situated in ideal areas. Also, the propelled recipients enables recievers to find small cells early and additionally increment execution of range extension.

To obtain the requirements set by LTE-A, support for more extensive transmission bandwidths,other than the 20Mhz data transfer capacity put aside for LTE indicated in 3GPP release 8/9, is required.The prescribed answer for this is Carrier Aggregation (CA). It is a standout amongst the most particular highlights of LTE-A. CA permits the extension of successful data transfer capacity conveyed to a client terminal through simultaneous usage of radio assets over different carriers. Different carriers are then combined to shape a bigger transmission bandwidth. LTE-A can total up to 5 carriers (up to 100MHz) to build client information rates and limit with regards to full figured applications. The Aggregation(s) when joined with higher request MIMO can give to a great degree high information rates.

II. NETWORK ARCHITECTURE

A. *Proposed System Description*

The conventional 2g and 3g models utilize base stations with similar coverage ranges. lte-a presents the idea of hetnet, which bolsters enbs with various coverage. lte-a characterizes four unique sorts of enb, in particular, macro, micro,pico, and femto, which all can exist together in the same geographic area as appeared in figure 1. macro, micro, and pico enbs are administrator sent and needs a wired backhaul association with the core network. femto enbs are deployed by the customer and it needs digital subscriber line (dsl) modem and internet for backhaul. the mobile switching centre (msc) in core n/w system goes about as an entryway amongst wired and wireless systems. all these enbs share a similar spectrum range. the arrangement of more number of small cells conveys ues nearer to the serving enbs. this limits the way pathloss and attenuation and expands the framework limit per unit territory. to decrease the power utilization, the macro enbs with less number of customers are made to microenb by powerfully altering the transmitted power level. pico enbs are typically set in the hotspots . whenever there is a traffic demand request from a specific territory, the macro enb offloads bit of the movement of traffic to pico enbs. pico enbs are more suited for open air applications. femto enbs are more suited for high capacity indoor applications. since this work centers around the enb arrangement by the n/w administrators, the situation of femto enb isn't considered here.

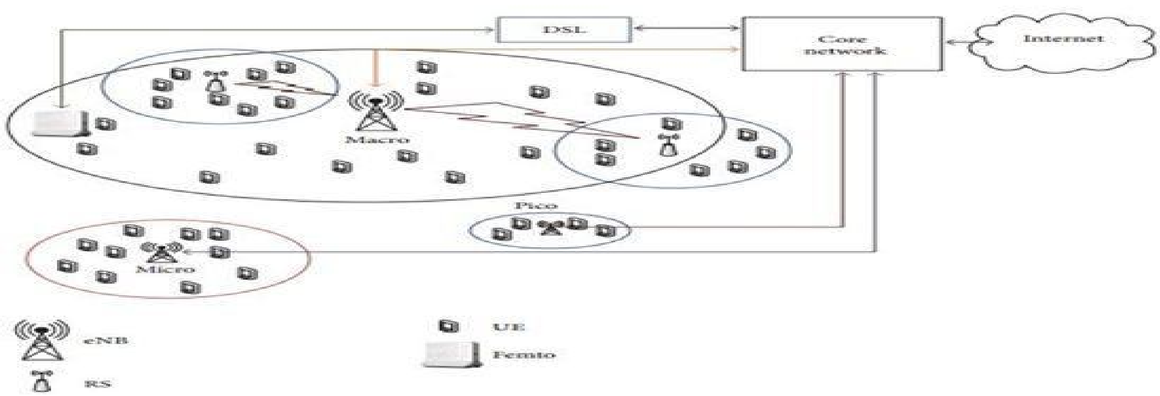

Figure.1 : LTE-A HET-NET and MHR architecture

The UEs situated close to the cell limit encounter poor signal quality and information rate. IEEE 802.16 j and LTE-A suggests relay technology for extending the service coverage and to increse its capacity [23, 24]. RS is the most suited small cell arrangement for the coverage and capacity maximisation issues, where the wired backhaul connect is expensive and inaccessible. Be that as it may requires a backhaul connect to its donar eNB. The spectrumused to get to the UEs is likewise utilized by the RSs for backhaul connection. RSs use bit of the radio assets from its donar eNB. The coverage range, cost, and limit of RS are bigger than pico eNB.

Thus, in this work, we use RS for benefit of coverage maximisation and pico eNB for placement cost minimization. The distinctive kinds of eNB and RS characterized in LTE-A are looked at in Table given below.

Cell type	Location	Installation	Backhaul	Ideal cell radius	Number of Cells
Macro	Outdoor	operater	Operater	>1km	>256
Micro	Outdoor	operater	Operater	250m-1km	32-200
Pico	Indoor/outdoor	operater	Operater	100m-300m	32-64
Femto	Indoor	customer	Customer	10m-50m	8-10
RS	Indoor/outdoor	operater	operater	250m-1.125km	32-120

Table1:Comparision of LTE-A eNB's and RS

B. Fuzzy Logic For Hetnet And Placement Of RS

Here in this proposed approach we have used fuzzy logic mainly in order to choose the available candidate sites for macro,micro and pico eNB's.Here mamdani based fuzzy system was used and input parameters are given to the fuzzy and corresponding output is obtained by using crisp relation.

Here the SCI,OI and DTI are the three inputs given to the FIE and corresponding site selection index SSI is obtained as an output. We have developed three trapezoidal membership functions for SCI,OI , DTI and SSI.based on these factors 27 rules were formulated. The ssi is calculated based on these rules and FIE diagram is as shown below.

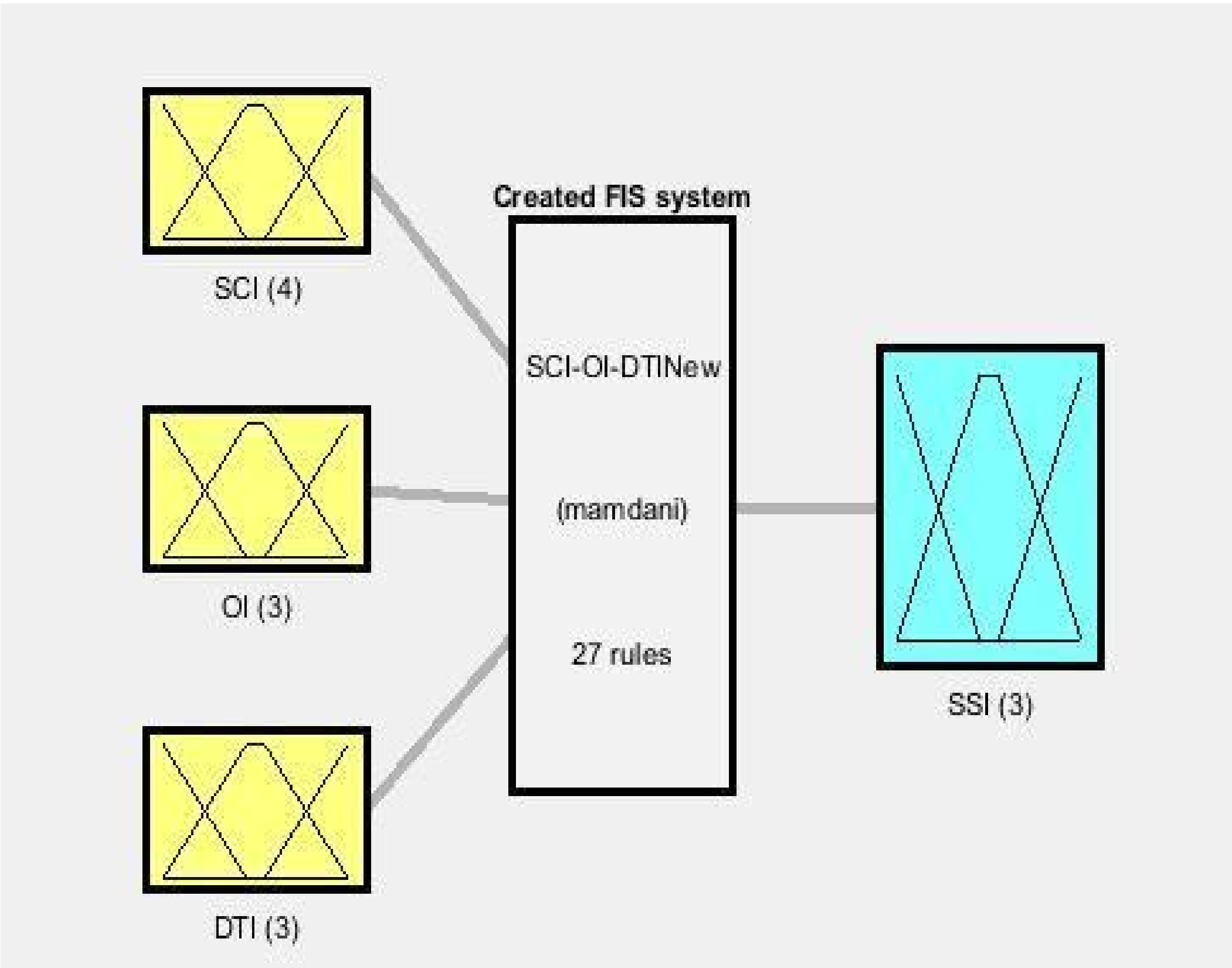

Figure2: proposed FIE block diagram

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SCI:The service coverage index or coverage ratio of nth candidate site is defined as the ratio between the number of UE's covered by the eNB (macro,micro and pico) placed in nth site to the total number of UE's in the selected geographical region.

$$SCI_n = S_n / T \qquad ....(1)$$

Where S_n is the no.of UE's covered by the eNB and T is the total no.of UE's available in the geographical region.The coverage range may be minimum i.e zero or it may be maximum i.e fully covered and it is one. This is taken as an fuzzy input so that the output can be obtained for various coverage ranges.The coverage ratio is taken in to account as low,medium,high based on its coverage percentage in particular area The utilization of single serving node requires tremendous radio resources to offer full n/w coverage over a given geographic territory. It requires huge transmission energy to reach every single potential clients in that area. The restricted radio assets accessible limit the aggregate number of users supported. This makes a single serving node supporting huge number of portable clients unrealistic. With a specific end goal to build the coverage also, capacity and to utilize radio assets effectively, the geographic region is separated into numerous cells. Every cell is supported by one serving node. Since the radio assets are reused at every cell, the aggregate number of clients supported is in a perfect world scaled with the aggregate number of deployed cells. The decreased separation between the serving node and UE increments the connection quality yielding high signal to noise ratio (SNR). In homogeneous cell structure, the plan determinations like cell measure and transmit power budget plan assigned are basic for all cells. This isn't productive particularly in extremely thick, urban, what's more, indoor conditions in offering high throughput. In heterogeneous cell structure, small cells are covered with the traditional macrocell in both frequency and space. At the point when a few serving nodes transmit their signals on the same recurrence in the same geographic territory, the UEs may not have the capacity to recognize to which serving nodes they are listening.The flawed cell structures prompt extreme intercell interferences at the cell edges.The interference decreases the connection nature of cell edge UEs. This corrupts the client encountering information rate and increases the outages. The interference circumstance is erratic and more extreme in HetNets. There exist two conceivable kinds of obstruction in small cells. The cotier interference happens between a similar cell types and the cross-tier interference happens between various cell types. The cross-tier interference is hard to control.

$$OI_n = \frac{y^2 \cos^{-1}((\delta^2+y^2-x^2)/2\delta y)+x^2 \cos^{-1}((\delta^2+x^2-y^2)/2\delta x)-(1/2)\sqrt{(-\delta+y+x)(\delta+y-x)(\delta-y+x)(\delta+y+x)}}{\pi y^2}$$

.....(2)

Where Nr is the overlapping area

x,y → are the radius of two overlapping cells

δ → is the distance between the center points of the overlapped cells.

The range is from 0→1 because the overlapping may be completely zero or in maximum cases it is one.It is represented by less,moderatye,more.

DTI is the difference between the average achievable data transmission rate and the average traffic demand of all the MS's covered by the BS or RS.The difference is normalized by the average achievable data txn rate or by the average traffic demand.Due to poor channel conditions,the avg achievable data txn rate may become zero.this can be leads to a normalized TR of -1.If the average traffic demand of all the MS's covered by the BS or RS of nth candidate becomes zero,then this situation leads to a normalized TR of 1. So,the range of TR is between -1 to 1 in membership functions. The average information rate of UE's covered by the eNB placed in nth candidate site is given by

$$\beta_{d,n} = \frac{1}{s_n}\sum_{o=1}^{s_n} T_o$$

Where T_o is the datarate of Oth UE

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The DTI of nth candidate site is given by

$$DTI_n = \frac{\beta_{d,n}-\beta_{t,n}}{max\{\beta_{d,n},\beta_{t,n}\}} \quad ....(3)$$

Where $\beta_{d,n}$ is the average achievable data traffic rate

$\beta_{t,n}$ is the average traffic demand by MS's.

It is represented by negative ,center and positive in membership functions. The membership function diagrams of different inputs is as shown below.

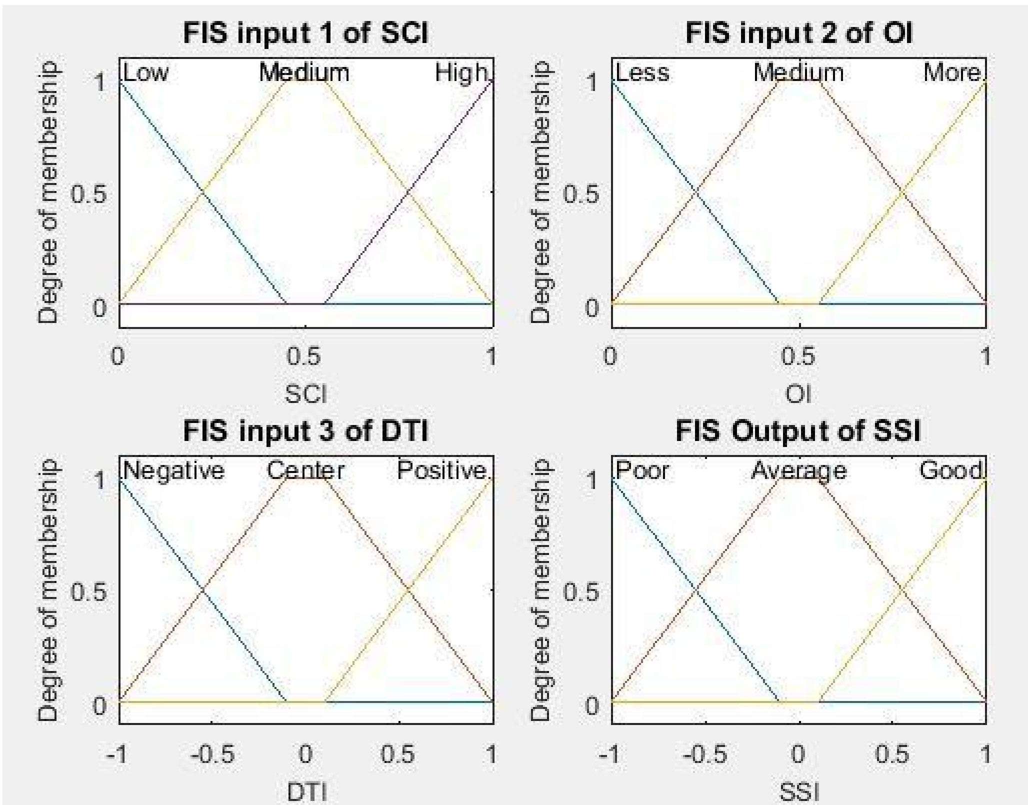

Figure3:membership function diagrams of SCI,OI,DTI&SSI

The inputs and output fuzzy sets described above are responsible for delivering the rules for FIE.The fuzzy rules framed in this proposed approach are as follows.

Rule 1:If SCI_n is low and OI_n is Less and DTI_n is negative then SSI_n is poor.
Rule 2:If SCI_n is low and OI_n is Less and DTI_n is positive then SSI_n is good.
Rule 3:If SCI_n is low and OI_n is Less and DTI_n is center then SSI_n is average.
Rule 4:If SCI_n is low and OI_n is moderate and DTI_n is center then SSI_n is average.
Rule 5:If SCI_n is low and OI_n is moderate and DTI_n is negative then SSI_n is poor.
Rule 6: If SCI_n is low and OI_n is moderate and DTI_n is positive then SSI_n is average.
Rule 7:If SCI_n is low and OI_n is more and DTI_n is positive then SSI_n is poor.
Rule 8:If SCI_n is low and OI_n is more and DTI_n is negative then SSI_n is poor.
Rule 9:If SCI_n is low and OI_n is more and DTI_n is center then SSI_n is poor.

Rule 10:If SCI_n is medium and OI_n is Less and DTI_n is negative then SSI_n is poor.
Rule 11:If SCI_n is medium and OI_n is Less and DTI_n is center then SSI_n is average.
Rule 12:If SCI_n is medium and OI_n is Less and DTI_n is positive then SSI_n is good.
Rule 13:If SCI_n is medium and OI_n is moderate and DTI_n is negative then SSI_n is poor.
Rule 14:If SCI_n is medium and OI_n is moderate and DTI_n is centre then SSI_n is average.
Rule 15:If SCI_n is medium and OI_n is moderate and DTI_n is positive then SSI_n is good.
Rule 16:If SCI_n is medium and OI_n is more and DTI_n is negative then SSI_n is poor.
Rule 17:If SCI_n is medium and OI_n is more and DTI_n is center then SSI_n is average.
Rule 18:If SCI_n is medium and OI_n is more and DTI_n is positive then SSI_n is good.
Rule 19:If SCI_n is high and OI_n is less and DTI_n is negative then SSI_n is good.
Rule 20:If SCI_n is high and OI_n is less and DTI_n is center then SSI_n is good.
Rule 21:If SCI_n is high and OI_n is less and DTI_n is positive then SSI_n is good.
Rule 22:If SCI_n is high and OI_n is moderate and DTI_n is negative then SSI_n is average.
Rule 23:If SCI_n is high and OI_n is moderate and DTI_n is center then SSI_n is average.
Rule 24:If SCI_n is high and OI_n is moderate and DTI_n is positive then SSI_n is good.
Rule 25:If SCI_n is high and OI_n is more and DTI_n is negative then SSI_n is poor.
Rule 26:If SCI_n is high and OI_n is more and DTI_n is center then SSI_n is average.
Rule 27:If SCI_n is high and OI_n is more and DTI_n is positive then SSI_n is good.

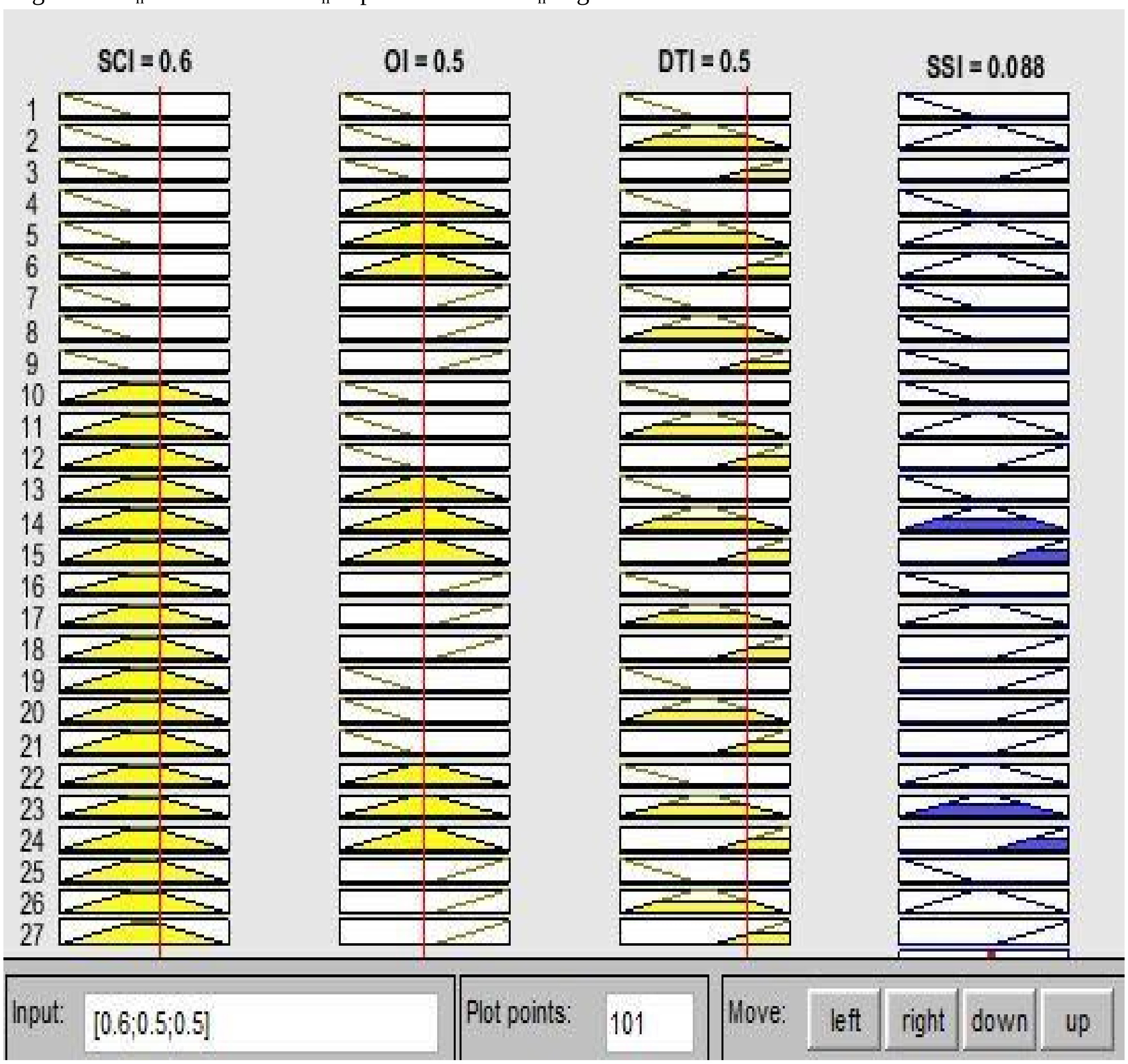

Figure4:Illustraring SSI calculation using Rule viewer diagram.

From the above figure,the calculation of SSI from SCI,OI &DTI was explained with the help of rule viewer diagram.For example the values of Sci,Oi and DTI are given as 0.6,0.5,0.5 respectively then the value of ssi obtained based on all these rules is 0.088 respectively.Among all the input output fuzzy sets developed above,their membership functions and rules given are applicable for RS's and pico eNB's.

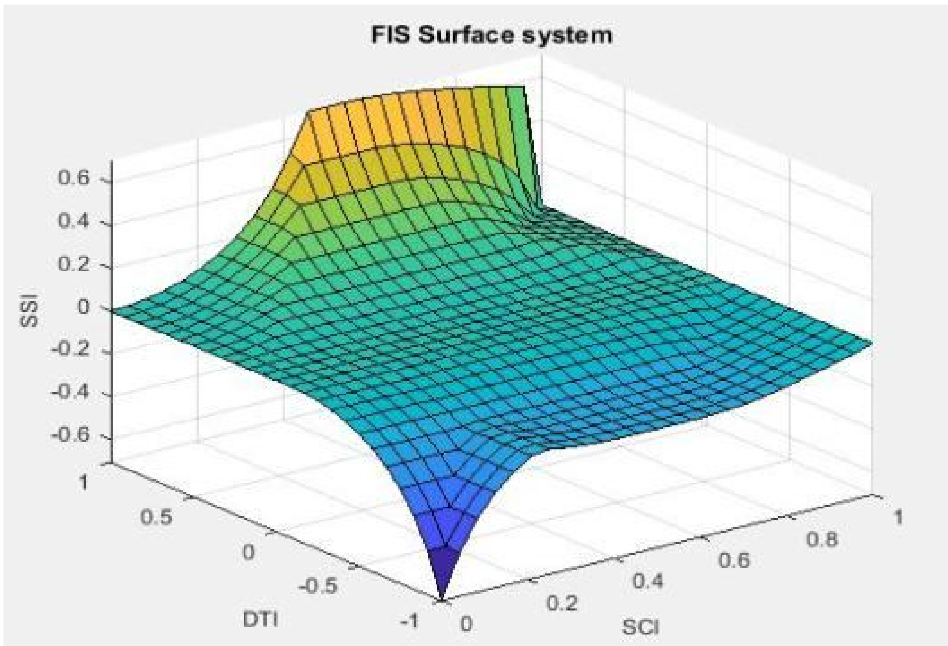

Figure5:surface plot of SSI versus SCI-DTI combinations

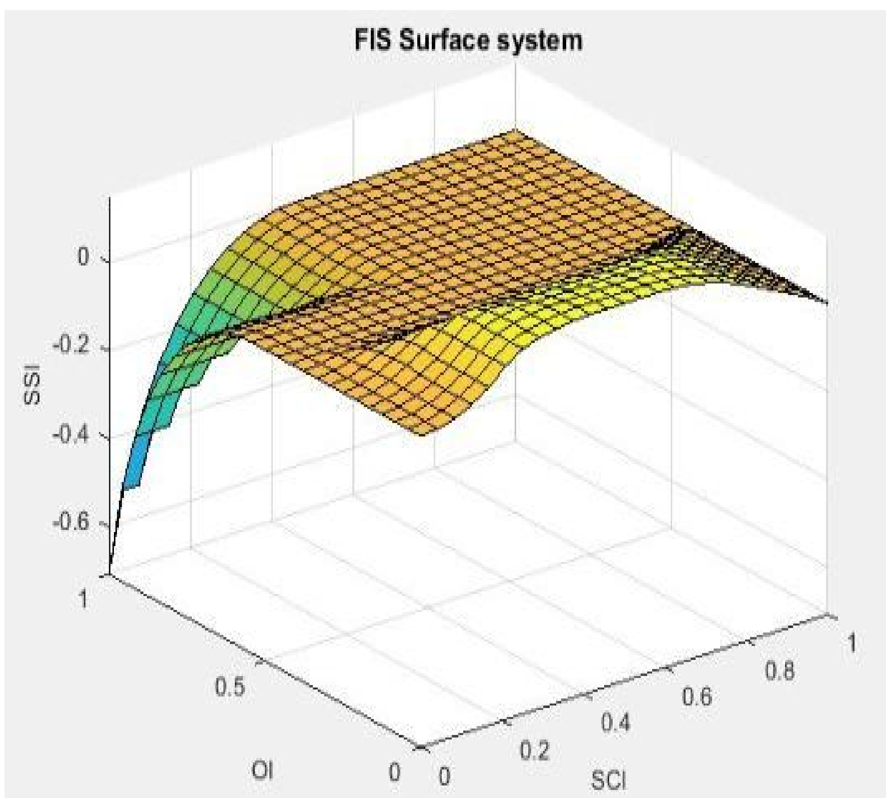

Figure6:surface plot of SSI versus SCI-OI combinations

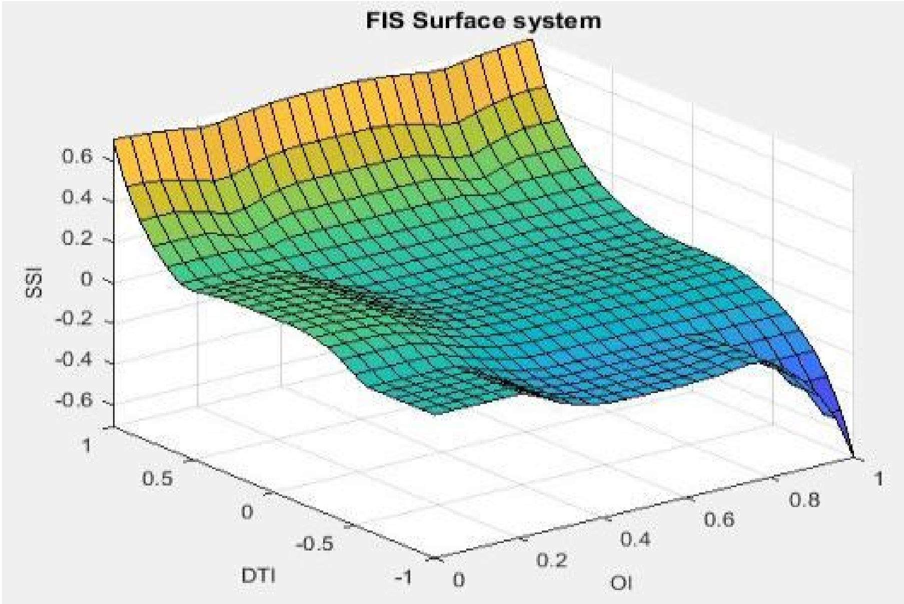

Figure7:surface plot of SSI versus OI-DTI combinations

C. The Proposed Heterogeneous N/W & Multi Hop Relay Placement Approaches

The proposed approach should be capable of choosing different eNB and RS based on especially the service and budget constraints.The main condition to be satisfied is that the UE's should be provided the proper radio resources in order to achieve high coverage.The proposed approach should also be in a position to provide or balance the traffic load between eNB's and RS's,so that the total power consumption and the overloading due to higher traffic conditions gets minimized.The main approach proposed here in order to meet the above said criteria is as follows.

D. SSMCR Approach

The SSMCR is nothing but site selection with maximum coverage ratio.Here in this approach, it should identify the total required number of serving nodes and their types to which they belong and the placement locations in order to achieve higher SCI than the target SCI.Normally the coverage range of RS is much higher than the pico eNB's.Here mainly in this SSMCR approach we are using RS along with different eNB's in order to provide maximum coverage.

This is mainly executed in four stages in order to satisfy the following objective

$P_{n,o}$ and $p_{n,m}$→are the txd power allocated to oth UE and mth RS by nth Enb

s_r^m→is the rth UE by mth RS.

$p_{m,r}^n$→is the txd power allocated to rth UE by mth RS in nth eNB.

T→coordinates of UE's in the given geographic area.

$P_{n,o}$, $P_{n,m}$, $p_{m,r}^n \geq 0$………..(7)

The OI for the eNB and RS should be less than the OI threshold(I):

OI^{eNB}, OI^{RS}<I………(8)

E. Stage 1:Candidate site selection and placement of macro eNB's

The set of potential candidate sites for macro eNB and set of UE's covered by nth macro eNB and target SCI are given as inputs at this stage.The identified candidate sites of macro eNB is the output from this stage.Initially,the SCI is made zero.then SCI,OI and

DTI are given as inputs for FIE.then corresponding output of SSi is obtained.Then candidate with greater SSI is identified and then the candidate who has higher SSI and those candidate SCI is upgraded.Then check whether the obtained SCI is equal to target SCI or not.If target SCI is not achieved then the coordinates of the identified candidate sites with maximum SSI are stored in select-eNB.Ten later corresponding SSI is made to zero,so that next SSI candidate site will be chosen for next iteration.This procedure is rehashed until the condition SCI>T_{sci} is achieved.Thus all the candidate sites with highest SSI are stored in select-eNB.

F. ALGORITHM-1

Stage1:candidate site selection and placement of macro eNB's
Inputs:E, T_{SCI}, s_n
Outputs:select-eNB→candidate sites selected for macroeNB placement.
Initialization: select-eNB=Null,SCI=0
→for n=1 to E
→ Find SCI_n,OI_n,and DTI_n using (1)(2)and (3)
→ Identify SSI_n using FIE.
→end for
→for n=1 to E
→ [Val Int]=max(SSI)
→ SCI= SCI+ SCT_{Int}
→ If SCI>T_{SCI}
→ break
→ else
→ select-eNB=E_{Int}
→ end if
→ SSI_{Int}=0
→end for

1) Stage2:power resource availability check in Macro eNB and Micro eNB

$$d_{k,l}^{DL} = B_{k,l}^{DL}\log_2\left(1+\frac{p_{k,l}^{r}|h_{k,l}|^2}{B_{k,l}^{DL}\gamma N_0}\right), \quad \text{……(9)}$$

Where $|h_{n,o}|$→multipath ading channel gain
N_o→noise power

γ→SNR gap

$B_{n,o}^{DL}$→BW allocated to oth UE by nth eNB.

To obtain the required target down link rate,the minimum reqd received signal power is given by

$$p_{k,l}^{r} = \left(2^{d_{k,l}^{DL}/B_{k,l}^{DL}}-1\right)\left(\frac{B_{k,l}^{DL}\gamma N_0}{|h_{k,l}|^2}\right). \quad \text{…..(10)}$$

The required transmit power from nth eNB to oth UE in order to meet the target downlink rate is given by

$$p_{n,o}(db)=p_{n,o}^{r}(db)+PL(db) \quad \text{…..(11)}$$

Where PL(db)$\in\{PL\ macro\ eNB(db), PL\ micro\ eNB(db), PL\ pico\ eNB(db), PL\ RS\ eNB(db)\}$ …(12)

$PL\ macro\ eNB(db), PL\ micro\ eNB(db), PL\ pico\ eNB(db)$→txn pathloss in db

And these transmission path losses are given by:

$PL\ macro\ eNB(db)$=128.1+37.6$\log_{10}$(v)….(13)

Where v is the distance from eNB to UE(or)RS

$PL\ micro\ eNB(db)$=140.7+37.6$\log_{10}$(v)= $PL\ pico\ eNB(db)$…(14)

The transmission loss for RS in dB is given by

$PL\ RS\ eNB(db)$=103.8+20.9$\log_{10}$(v)……(15)

Here in this stage,the selected candidate sites from first stage,noise power,SNR gap,target downlink information txn rate,Bw supported per UE,UE supported by kth macro eNB,maximum RS capacity(u) are taken as inputs.Identified macro & micro eNB's placement& UE's that are not covered by any of the placed eNB's are the outputs.Initially the transmit power reqd to serve all the UE's covered by nth eNB is initialized to zero. Then the distance between nth eNB & oth UE is calculated. Based on identified distance v(o),pathloss is calculated by using eqn(11).then the transmit power reqd to meet the target data rate is calculated using eqn(9). This method is rehashed until all UE's covered under kth eNB and aggregate power required to bolster all these UE's is calculated using $p_n=p_n+p_{n,o}$. If $p_n>p_{macroeNB}$;then the outermost UE's are expelled from the serving eNB one by one until the power constraint gets fulfilled. Then the expelled UE's are made to zero.This procedure is rehashed for all recognized macro eNB's.

G. Algorithm-2

Stage2:power resource availability check in Macro eNB and Micro eNB Placement

Inputs: select_eNB,N_o, γ, $B^{DL}_{n,o}$, $d^{DL}_{n,o}$,S_n,u

Outputs: identified sites for macro and micro placements,Ŝ.

→ for n=1 to length(select_eNB)
→ $p_n=0$
→ for O=1 to S_n
→ substitute v(o) in (11) to obtain PL
→ calculate $p_{n,o}$ using(9)
→ $p_n=p_n+p_{n,o}$
→end for
→If $p_n>p_{macroeNB}$
→ [Val Int]=max(v)
→ $p_n=p_n-p_{Int}$
→ Ŝ←s_{Int}
→ v(Int)=0
→end if
→ Repeat steps (9) to (14) until(12) gets satisfied
→ Cell shrinking(p_n)
→end for

H. Algorithm-3

1) *The idea of cell shrinking.:* Here after all the recognized macro eNB's fullfil the power constraint,the idea of cell shrinking is carried out.The aggregate power required to bolster all UE's under each macro eNB is is compared with $P_{microeNB}$.i.e $p_n<p_{microeNB}$.If it is true then macro cell is shrunk in to microcell by dynamically adjusting the power level.E_n→ $p_{microeNB}$.Due to cell shrinkage,some of the UE's in the outermost regions gets discard from the service.If still the condition is not achieved then do not go for cell shrinking.This procedure of expelling the outermost UE's is to be done just for certain predefined no.of UE's.(S_n-M_n)≤u.The expelled UE's are stored in Ŝ and their distances v(Int)is made zero.This procedure is rehashed until the

condition $p_n < p_{microeNB}$ is obtained.The algorithm is as follows:

-->If $p_n < p_{microeNB}$

→ E_n→ $p_{microeNB}$

→else if .$(S_n\text{-}M_{n)} \leq u$

Where M_n is the no. of UE's covered by nth ENB

→ [Val Int]=max(v)

→ $p_n = p_n - p_{Int}$

→ $\hat{S} \leftarrow s_{Int}$

→V(Int)=0

→end if

→Repeat step(4) to (7) until (12) gets satisfied.

2) *Stage3:candidate site selection inorder to place RS's* Here similar to stage one the site selection for RS is done. The similar type of algorithm is used here but for RS site selection purpose.Before macro eNB is placed now we are placing RS by choosing the site.The same procedural steps are followed here as stage one algorithm.

I. ALGORITHM

Stage3:candidate site selection inorder to place RS'

Inputs:SCI,R→the set of candidate sites for RS placement,T_{SCI},$\hat{S}$

Outputs:Select_RS=RS candidate sites selected for placing

Initialization: Select_RS=Nu

→for m=1 to

→ Identify SSI_m using FIE.→end for→for m=1 to

→ [Val Int]=max(SSI)

→ SCI= SCI+ SCT_{In}

→ If SCI>T_{SCI}

→ brea

→ else

→ select-RS=R_{Int}

→ end i

→ SSI_{Int}=

→end for

1) *Stage4:checking for the availabity of power resources for RS's and selection of RS's.* Here the selected candidate site for RS's from the third stage,noise power,SNR gap,expected downlink information txn rate,BW allocated per UE by mth RS and UE's supported by nth RS are given as inputs.The RS's selected to offer requested service demand are the outputs of this stage. The transmit power required to serve all UE's covered by mth RS p_m is initialized to zero. Then the distance between mth RS and rth UE is calculated.v(r).Based on identified distance,the PL and txt power reqd to meet the target datarate are observed.$p_{n,r}$ is also calculated. Then the aggregate power reqd to bolster all the UE's is calculated i.e $p_m = p_m + p_{m,r}$.If the aggregate power reqd by the mth eNB exceeds p_{RS} i.e $P_m > p_{RS.}$ Then the outermost UE's are identified and expelled from present serving Rs one by one until the power constraint gets fulfilled.

This process is repeated for all the selected RS's.When all the selected RS's satisfy the power constraint,the idea of RS selection is carried out by the donar macro eNB.The services of UE's which are discarded by the current serving RS and are handed over to the neighbouring RS based on the availability of radio resources. Then their distances v(Int) is made to zero. This process is repeated until v(Int)=0 condition is satisfied.

J. ALGORITHM5

Stage4:checking for the availabity of power resources for RS's and selection of RS's**.**

Inputs: **select_RS**,N_o,γ, , $B_{m,r}^{DL}$, $d_{m,r}^{DL}$,S_n.

Outputs: Rs's selected in order to provide requested service on demand.

→ for m=1 to length(select_RS)

→ p_m=0

→ for r=1 to S_m

→ substitute v(r) in (13) to obtain PL

→ calculate $p_{m,r}$

→ $p_m=p_m+p_{m,r}$

→end for

→If $p_m>p_{RS}$

→ [Val Int]=max(v)

→ $p_m=p_m-p_{Int}$

→ Based on the existing radio resources,S_{Int} is assigned to the neighbouring RS,such that that RS€ select_RS.

→ v(Int)=0

→end if

→ Repeat steps (9) to (14) until(13) gets satisfied

→end for

III.RESULTS AND SIMULATIONS DISCUSSIONS

A. Simulation results and Discussions

The performance of the proposed approach is simulated by using Matlab 2017a tool. The simulation is rehashed for 100 different UE's distributed and the aggregate power required by all the serving nodes and the power proportion used by different eNB's and the datarate experienced by the UE's was explained clearly in this work.

Assumptions:

→Here the candidate placement sites for Diverse eNB's and RS are selected randomly with in the geographical area that is to be covered.

→The proposed approach is only tested for downlink traffic demands.

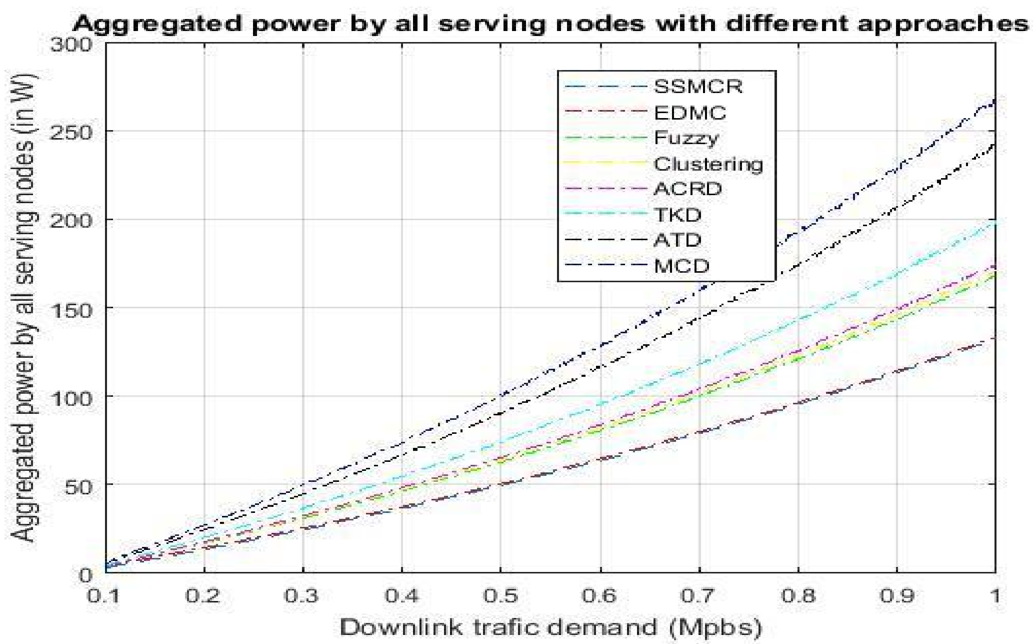

Fig.8:Aggregate power by all serving nodes vs downlink traffic demand.

In the above simulation , the total powers required by all serving nodes (in W) are compared about between various HetNet/MHR arrangement approaches for the target SCI of 90%. As the activity request of every UE is shifted between 0.1 and 1 Mbps. To meet the target data rate, eNB what's more and RS need to disperse particular transmit control levels to every UE considering the noise, interference, pathloss and fading channel conditions. Increase in the traffic demand request will in like manner manufacture the transmit power level, which in like manner expands the total power required by all serving nodes. MCD approach uses extensive transmit energy to cover more number of UEs. To cover the cell edge clients, the set macro eNBs need to build the transmit power levels, which likewise expands the total transmission power. Since this approach dependably put macro eNBs, the total transmission power required to help the customers request is continuously higher than alternate methodologies. In ATD approach, the revealed UEs are upheld by micro eNBs. This will diminish the total power necessity of ATD approach contrasted with MCD approach. To help the revealed UEs, pico eNBs are utilized alongside micro eNBs, which makes TKD approach preserve more power than ATD approach. ACRD, uniform clustering, and fuzzy methodologies use RSs to help the uncovered UEs. Since a RS can cover more number of UEs than micro scale and pico eNBs, the total transmission power required by these methodologies is dependably not as much as MCD, ATD, and TKD approaches. In EDMC approach, the range alteration based micro eNB and MGDC based pico eNB arrangement strategies are used, which lessens the total power consumption.The use of something beyond number of micro and pico eNBs to reinforce the uncovered UEs with nonuniform activity requests decreases the transmission power. Our proposed SSMCR approach places mix of macro eNB, micro eNB, and RS sufficiently, which makes serving nodes nearer to UEs. In this approach, the underutilized macrocells are made to microcells, which additionally limit the total power utilization. From Figure , it is clear that the power utilization execution of our proposed approach is better than the other ordinary methodologies. To meet the objective data rate of 1 Mbps, the total power required by all the set serving nodes of SSMCR approach is 130W.Thus the power constraint is satisfied in our approach.

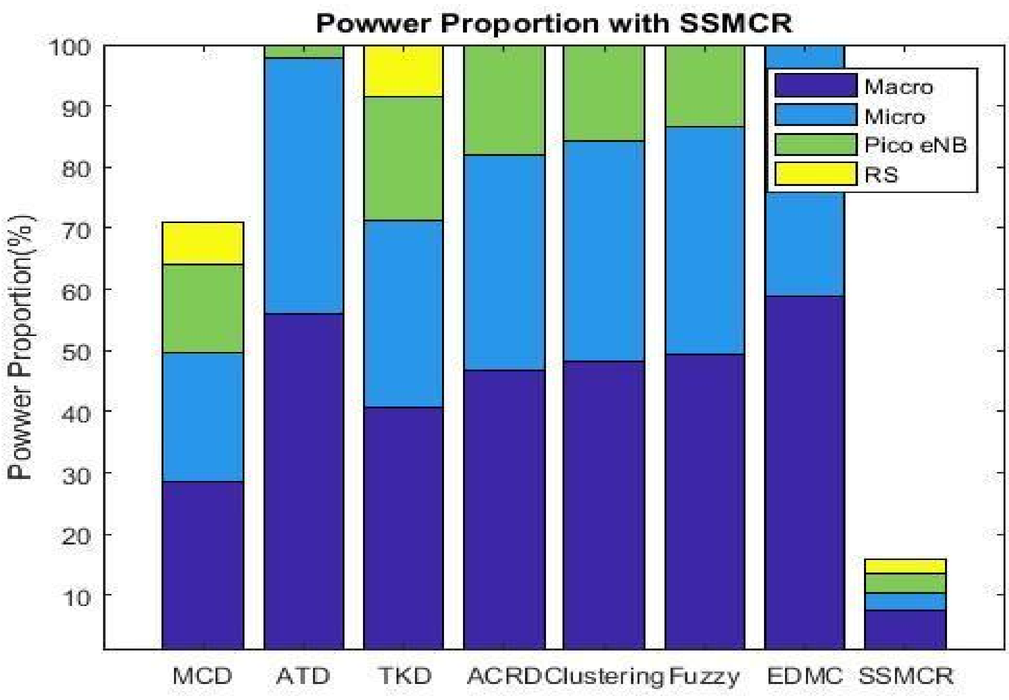

Fig.9 power proportion with SSMCR approach.

The target SCI of 90 percent.The power proportion includes the measure of over all power required by macro,micro,pico and RS eNB's in order to satisfy the target traffic demand. Here the site selection plays a major role in the utilization of power so that it helps to consume less power compared to the different proposed approaches.The proposed approach uses very little power when compared to other approaches so that we can able to conclude that the proposed SSMCR approach is able to provide maximum service coverage and reduces the interference to maximum extent.So less power is used in this approach due to proper site section and proper interference mitigation. Therefore this approach uses very minimum power due to less interference than compared to every previous approaches.

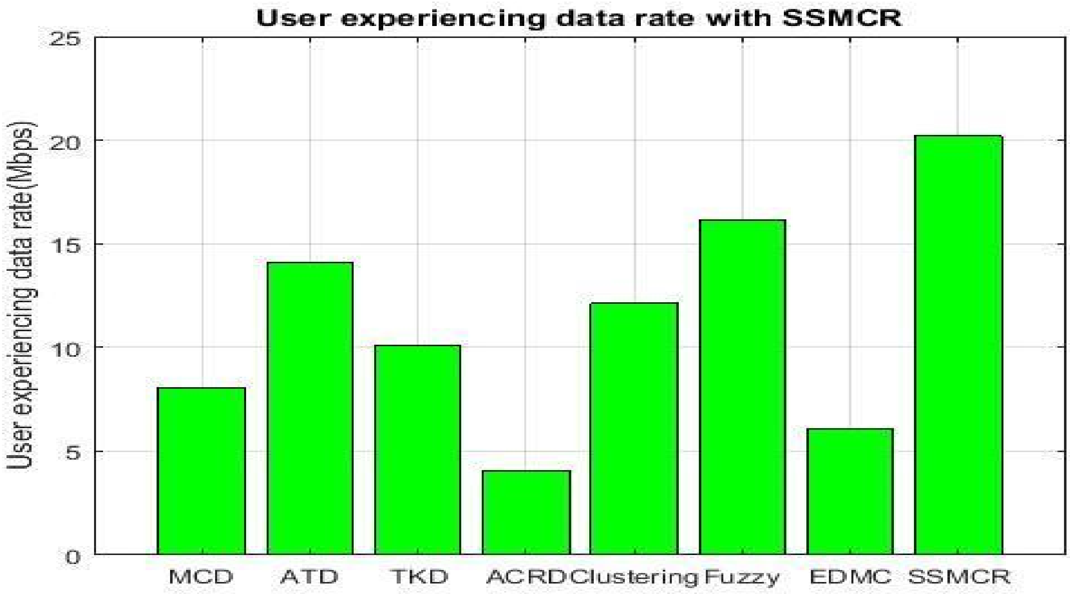

Fig.10: User experiencing data rate with SSMCR Approach.

The above figure demonstrates the user encountering information rate comparision between different HetNet/MHR placement approaches for the target SCI of 90%. This outcome is gotten by utilizing the interference display proposed in LTE Rel-10 . MCD approach places number of macro eNBs to accomplish the target SCI. This expands the interference between the serving nodes, particularly for the UEs on the cell edges. This diminishes the SINR and in addition the user encountering information rate. Due to the consideration of small cells, ATD, TKD, and EDMC approaches offer higher information rate than MCD approach. Due to the consideration of RSs, ACRD, uniform clustering, and fuzzy based placement approaches offer higher information rate than the MCD approach. The fuzzy based approach accomplishes the normal SCI with less number of RSs than the uniform clustering and what's more, ACRD approach. This prompts lessened interference.Thus, the information rate experienced by the clients of the fuzzy based position approach is bigger than ACRD and uniform clustering based methodologies. However, all these methodologies do not think about the interference imperative. They permit more overlapping between the coverage areas of the placed serving nodes. This prompts expansive cotier and cross-level interference what's more, lessens the user encountering information rate. Obviously the OI for all the set serving hubs of SSMCR approach is lower than the thought about interference edge. SSMCR approach offers a normal information rate of 20.30 Mbps, though the traditional fuzzy approach offers 16.28 Mbps. The minimum interference nature of SSMCR approach expands the information rate roughly by 20% contrasted with fuzzy approach.

Thus we can clearly observed from these simulations that here the power consumption used by all the aggregating nodes was less when compared with the output that was obtained in base paper and the power proportion was also less in case of placed eNB's in proper sites. The data rate achieved was very high ,so that we can able to say that the interference is mitigated and improved outputs were obtained.

IV. CONCLUSION AND FUTURE SCOPE

As more no. of users increases, the coverage area should also increase accordingly. i.e the users should be provided particular coverage range so that they can avoid interfering with one other. In order to avoid these interference in this proposed approach we have selected the candidate sites and provided coverage in maximum and obtained simulation outputs in such a way that the data rate is maximum and power consumption is minimum and the aggregate power used by all the nodes is less. These parameters indicates that here the interference happened in proposed system is very low i.e interference is mitigated to maximum extent.

A. Future Scope

Here in this work, four stages is used and three- input fuzzy logic based approach is proposed by considering coverage ,power and interference constraints mainly. The proposed approach mainly supports the decisions on the number of serving nodes,and their heterogeneolity and the placement sites to fulfill the coverage expected and traffic demands. The total power devoured by all the set serving nodes of SSMCR approach is lesser than the other customary scope requirement approaches. To satisfy the objective data rate of 1 Mbps, the total power required by all the put serving nodes of SSMCR approach is 130 W which is much lower than the total power apportioned, that is, 232 W. Subsequently, the proposed approach additionally satisfies the power imperative.

This exhibits our proposed SSMCR approach successfully use LTE HetNet and MHR to comprehend the movement request and scope issues experienced by the UEs in the hotspots and dead areas.It is moreover clear that the proposed approach is computationally less complex than a significant number of the other traditional methodologies. The proposed approaches likewise limit the between eNB and between RS interferences by keeping up adequate separation between the placed nodes. The incorporation of ICIC and FFR will expand the normal client encountering information rate. The proposed methodologies can likewise be adjusted by considering the restriction in transmission capacity.

The procedure of cell contracting or shrinkage and radio resourse accessibility check is computerized. This is done occasionally. Due to these reasons, the UEs upheld by the small cells get expanded, which additionally diminishes the system load of macrocells. This additionally builds the power extent of the proposed plot. As a future work, with a specific end goal to completely damage the advantages of the self-organizing, the fuzzy framework can be supplanted by adaptive neuro-fuzzy interface framework system (ANFIS). The neurofuzzy frameworks are versatile, precise, and learn without anyone else's input.

V. ACKNOWLEDGMENT

This paper was completely done based on my own effort and has not taken from any sources but just reffered from many papers.

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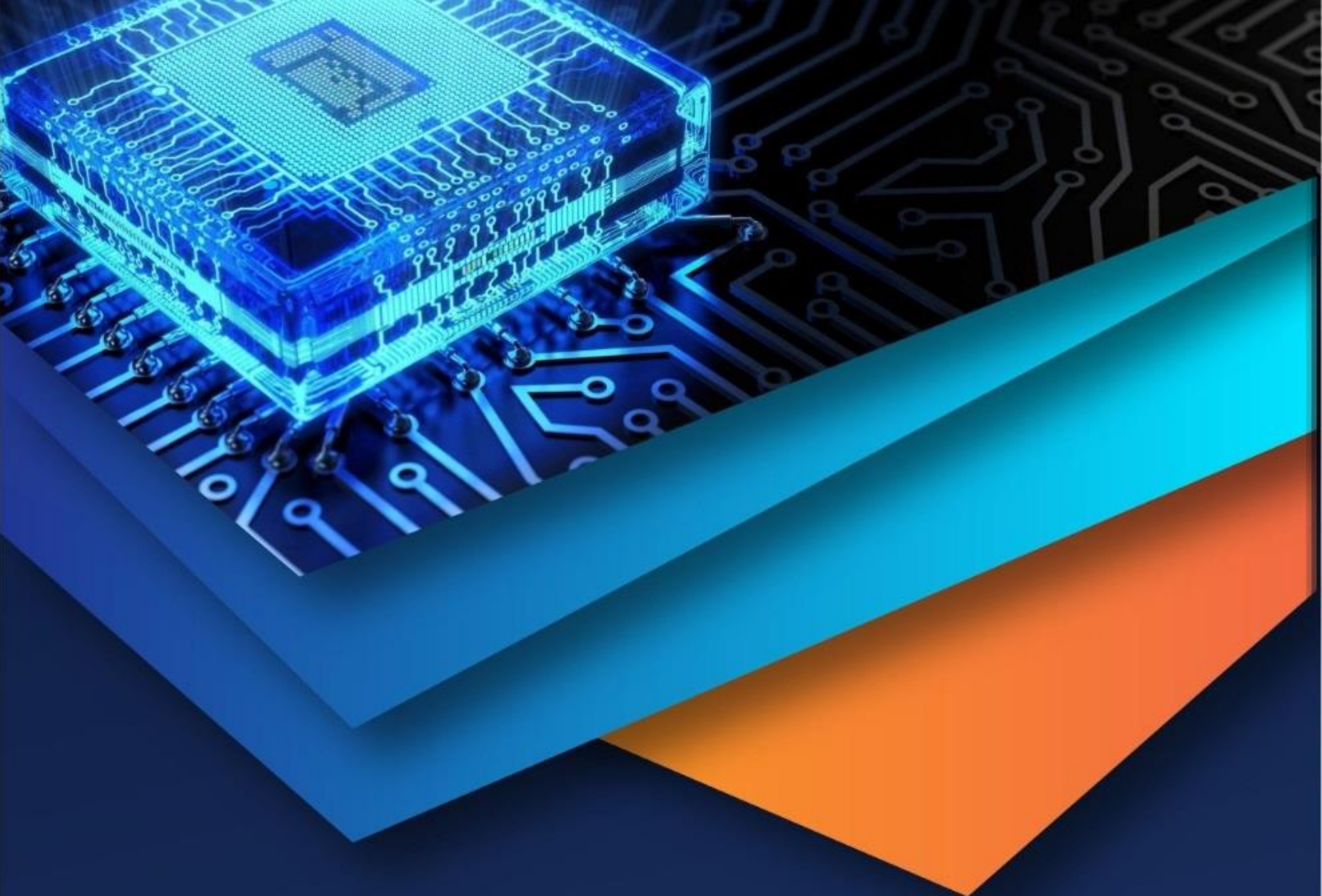

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