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Optimization of Femtocell Network Using Estimation Techniques

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Abstract— In this work, femtocell based clustered communication optimization is defined using three layered approach. In first layer, the femtocell generation under cluster formation approach is defined. The cluster formation is here performed based on the node distance level analysis and based on the cluster size adaptive frequency sharing model is defined. The requirement analysis is performed to perform the cell based division. Once the cells are formed, the channel estimation is performed using hybrid approach. This hybridization is achieved using MMSE and MLS methods. In final stage of work, the parallel sensing on multiple channels is performed to equalize the signal. The block adaptive method is applied to equalize the signal and improve the signal features

Keywords—"Femtocell networks"; "Cluster communication"; "Estimation"; "Equalization techniques"; "Cognitive networks"

I. INTRODUCTION

Femotocells are one of the most recent communication networks that are quite popular in mobile cellular network. This network is effectively used in mobile network with broadband connectivity. This network also includes the macrocell formation at the base station level. The network is here defined with femtocell point and access point specification. The femtocell provides the architectural formation to improve the resource utilization and to improve the network throughput [1]. The macrocell specification is here defined under maximum range specification with offloading criteria in macro cell. The technical coexistence in the network is identified along with technical diversity so that the source interference and the performance criteria for the communication will be mapped. This network form also includes the network interference analysis under resource allocation scheme. The shared spectrum and split spectrum are the basic criteria applied by the macro cell generation. This network form also provides the coordination mechanism between the FAP and cell generation with access mode specification. This architectural form also provides the restriction for registered or subscribed users with capacity and link evaluation. The arbitrary users are here defined with restriction specification so that the resource utilization over the network will be improved. This network form is also defined as group formation and evaluation to increase the network reliability under user time identification.

A. Channel Optimization

Channel Optimization is an essential component of CR networks. So, when the time CR networks came into existence, Channel Estimation and Equalization being an essential part of it, many Channel Estimation and Equalization techniques came into existence.

B. Cluster Communication

In this communication approach, the secondary users are defined in different cluster form to share the information along with locality. The similar area nodes here form a group called cluster and the cluster is here controlled by a cluster head. This cluster head is actually responsible to manage the communication within cluster. The cluster the formation is here based on the primary user specification along with its integration to the network cluster form[1]. This equalization vector is defined with network specification. The clustered architecture is here shown in figure 1

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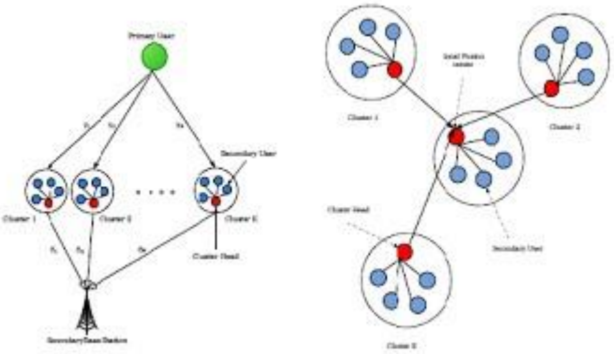

Fig.1. Clustered Architecture

It is observed that in traditional Communication techniques during a particular Estimation and Equalization period either one or multiple secondary users can sense only one channel. To overcome this limitation cooperative Channel Estimation and Equalization was introduced in which during a single Estimation and Equalization period multiple channels can be detected or sensed simultaneously [2].

II. RESEARCH METHODOLOGY

The work is here defined to optimize the communication by using the concept of femtocell. This kind of communication network is defined in the form of clusters where spectrum division is required for each cluster. The spectrum range can be defined according to the requirements of specific cluster. The interference analysis is also performed between the clusters so that effective channel communication will be done. In this work, a layered framework is defined for effective cooperative communication in network. This layered model is given here in figure 2.

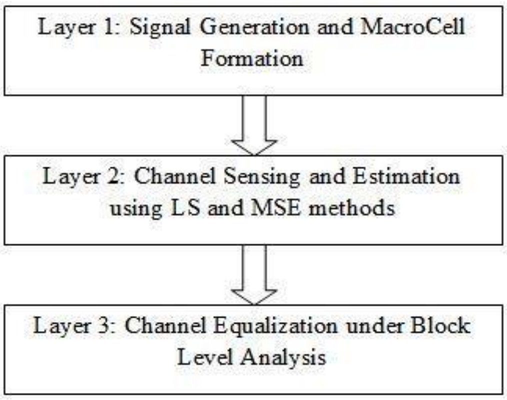

Fig.2. Layered Model

A. Signal Generation

The first stage of this model is to generate the signal under the specification of different associated parameters. These parameters includes the number of channel, number of symbols, frame size etc. These parameters are collectively used to define the overall channel or the communication strength. Once the overall signal form or capacity is obtained, the next work is to divide the signal among available channels or users. The parameters for generation of the signal under defined structural elements are given in this section.

1. Symbol Size

The symbol size actually affects the communication respective to the available number of carriers and users. The symbol size if the criteria based on which the time division based decisions can be taken. This also includes the delay level analysis so that the channel cause and the subcarrier generation can be obtained. The specification also improved based on FFT size and sub carrier spacing. This kind of analysis also includes the sub carrier division and space integrity so that the effective signal level derivation will be obtained.

2. Number of Carriers

As the communication is performed, the subcarriers over the channel also set based on the various communication or channel vectors. These vectors include channel bandwidth, communication requirements, and communication rate and bandwidth analysis. This carrier specification is here defined along with symbol duration specification. This size estimation based on time vector is given by

$$N=1/T$$

The carrier identification is also dependent on FFT size, FFT module specification and number of symbol

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B. Communication Impurities

The signal is when generated it is in raw form but in real environment, the signal suffers from different kind of interferences and noise. These noise vectors degrade the signal quality so that the higher chances of communication delay. In this work, the signal estimation and equalization is performed on impure signal. The noise vectors included in this work are described here under

1. Impulse Noise

The impulse noise is considered as the common signal impairment characterized as the energy burst applied in time specific domain. This burst is based on the event specification. The frequency spectrum based spectrum generation is here performed with time period specification. The communication properties are here control along with the specification of FFT algorithm. The signal change analysis along with frequency spectrum specification is here performed with time dependent vector.

2. Uniform Noise

This kind of noise defined as the Gaussian noise vector identified as Gaussian Noise (AWGN). This kind of noise vector analysis is here performed with source specification. This noise is defined under frequency range specification. The atmospheric source based radiation analysis is here defined along with noise vector. The AWGN noise is carrier system based noise defined signal vector. The noise power based estimation is here performed as the aggregative noise vector. In this work, Gaussian noise is taken as the main interference to the signal.

3. Modulation

Once the signal is generated in raw form, before communicating this data, the encoding of the signal is done using modulation scheme. In this work, BPSK modulation scheme is applied based on channel, data rate and bandwidth analysis. The signal estimation and the transformation is done based on modulation scheme.

C. Channel Estimation

Once the signal is transmitted with inclusive noise vectors, the requirement is to perform the signal equalization so that the impurities over the signal will be reduced. To perform this equalization, the estimation of signal is performed in terms of associated errors [2][5]. The signal quantization is here performed under different algorithmic approaches. The estimation parameters are given here under

OutptuMat = SignalHMatr x Signal + Noise

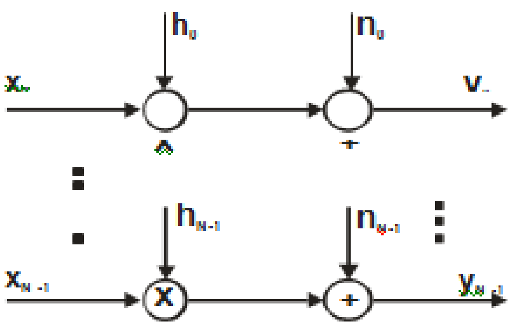

Fig.3. Transfomed Signal Generation

1. LS (Least Square)

The estimation is here performed under the specification of zero forcing method [3]. This method is called least square method. In this method, the impulse signal response is here minimized with signal ratio specification. The estimator formula is given by

$$Q_{ls} = (F^H X^H XF)^{-1}$$

The effective form of this formula is

$$h'_{LS} = X^{-1}y$$

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2. MMSE (Modified Mean Square Error)

The channel estimation is here defined under the structural anlaysis defined with uncorrelated channel vector with noise specification [4]. The formula for this estimation is given here under

g'MMSE = Rg y R-y y y

The g and y are the co-variance matrix deifned with the MMSE form. The vector form for this estimation is given here under

h'M MSE = F g'M MSE=F Q'M MSE FH XH y

III. ALGORITHM

A. Clustering Algorithm

The first phase of the work is here defined to generate the clusters so that the effective cluster formation will be defined:
ClusterFormation (Nodes, Threshold)
/*Users is the list of n nodes defined with sensing capability and the positional aspects, threshold is the limit defined to generate the adaptive neighbor*/

```
{
1.      For i=1 to N [Process all nodes]
        {
2. if(Nodes(i).SesningCap>Threshold     And Nodes(i).InterfereingDegree=Low And Nodes(i).Type=Normal)
[The normal node with high sensing capability and low interfering problem can be set as the cluster head]
        {
3.      Clusters.Add(Node(i)) Nodes(i).Type='Cluster'
        [Set the adaptive node as cluster head]
        }
        }
4.      For i=1 to length(Clusters) [Process all clusters]
        {
5.      Node=Cluseters(i)
        [Obtain the cluster head from cluster list]
6.      For j=1 to N [Process all nodes]
        {
7.      if(Dist(Node,Nodes(j))<SensingRange)
        [if node is within cluster range, identify the cluster members]
        {
8.      Nodes(i).Clustr=Node
        [Set the cluster head of a node]
}
}
}
```

B. Equalization Algorithm

```
Algorithm(Nodes,N)
/*the network is here defined with N number of nodes*/
{
1.   Set the channel parameters for the network such as carrier freq, fft size, number of channels, symbol size etc.
2.   Define the network with N nodes at random positions
3.   ClusterFormation(Nodes,N, Threshold)
[Divide the network in N number of clusters for equalized clustered communication]
4.   GenerateSignal(Signal, Channel)
[Generate the signal under specification of different frequency vectors for all associated channels]
5.   Signal=EncodeSignal(Signal,Modulation)
[perform the signal level encoding to tansform the signal so that the transmission can be performed]
6.   Signal=AddPhaseVariation(Signal,phasechange) [Add the signal level distortion in the form of phase change over the signal]
7.   Signal= AddNoise(Signal, Noise, SNR)
[Add noise to signal to show distoration at distortion at different SNR values]
8.   Signal=TranformH(Signal)
[Generate the H matrix over the signal to obtain the matrix adaptive analysis over the signal]
9.   Signal=AddGaurds(Signal,pos)
[Include the guards over the signal to perform signal estimation]
10.  Divide the Signal in L levels
[Define the measurement levels in the signal for effective signal estimation]
11.  For i=1 to L
[Read the Signal respective to defined blocks]
```

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{
12. SBlock=GetSignalBlock(Signal,i) [Get the Signal Block]
13. EstimatedLS=EstimateLS(SBlock)
[Perform least square estimation over the signal to identify the signal impurities]
14. For j=1 to length(EstimatedLS) [Identify the Signal Error]
{
15. If (EstimatedLS(j)<> SBlock (j))
[if the actual and estimated blocks are not same, the error will be considered]
{
16. countLS=countLS+1
17. }
18. }
19. EstimatedMMSE=EstimateMMSE(SBlock)
[Perform Modified Mean Square Error over the signal to identify the signal impurities]
20. For j=1 to length(EstimatedMMSE) [Identify the Signal Error]
{
21. If (EstimatedMMSE (j)<> SBlock (j))
[if the actual and estimated blocks are not same, the error will be considered]
{
22. countMMSE=countMMSE+1
23. }
24. }
25. EstimatedModifiedLS=EstimateModifiedLS(SBlock
)
[Perform Modified Least Square Estimation over the signal to identify the signal impurities]
26. For j=1 to length(EstimatedModifiedLS)
[Identify the Signal Error]
{
27. If (EstimatedModifiedLS (j)<> SBlock (j))
[if the actual and estimated blocks are not same, the error will be considered]
{

28. countMLS=countMLS+1
29. }
30. }
31. EstimatedModifiedMMSE
=EstimateModifiedMMSE(SBlock)
[Perform Modified Least Square Estimation over the signal to identify the signal impurities]
32. For j=1 to length(EstimatedModifiedMMSE)
[Identify the Signal Error]
{

33. If (EstimatedModifiedMMSE (j)<> SBlock (j))
[if the actual and estimated blocks are not same, the error will be considered]
{
34. countMMMSE=countMMMSE+1
35. }
36. }
37. EstimatedProposed =EstimateProposed(SBlock) [Perform Modified Least Square Estimation and MMSE based combined model to identify the signal impurities]
38. For j=1 to length(EstimatedProposed) [Identify the Signal Error]
{

39. If (EstimatedProposed (j)<> SBlock (j))
[if the actual and estimated blocks are not same, the error will be considered]
{

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40. countProposed=countProposed+1
41. }
42. }
43. SBlock =Equalize(SBlock,countProposed,EstimatedPropose d)

[Reduce the Impurities over the signal and transform the signal values respective to the error estimation]
}

44. Return Signal

[Return the equalized improved signal]
}

IV. RESULTS

In this work a multiple channel and multiple user based signal analysis is here defined to estimate and equalize the signal. The signal level parameters included in the work are shown in table 1.

Table.1. Communication Parameters

Parameters	Values
Carrier Frequency	2.5e9
FFT Size	512
Number of Transmitters	10
Number of Receivers	10
Network Area	100*100
Number Of Channels	7
Numbers Of Symbols	1000
Bit per Symbols	2
Guard Interval	8

Here figure 4 is showing the nodes distributed in the network at random positions. These random positions are defined in given geographical area.

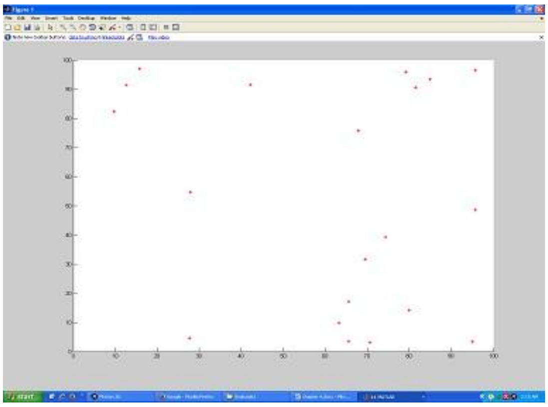

Fig.4. Network Scenario

Here figure 5 is showing the channel matrix defined to perform the network communication. It is the raw signal form that does not have any inclusive or additive noise. Here x axis represents frequency and y axis represents signal magnitude.

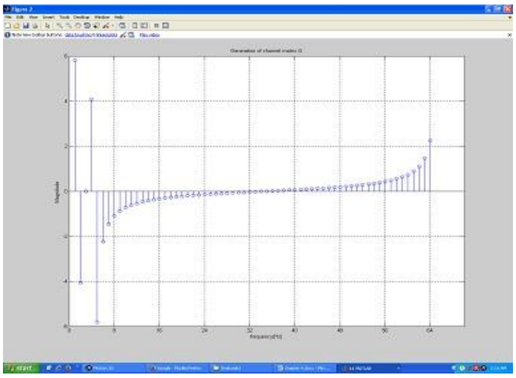

Fig.5. Channel Matrix

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Here figure 6 is showing the H matrix generated for the channel level communication. The distribution of the signal among the channels is shown in the figure. Here x axis represents the frequency value and y represents the magnitude value.

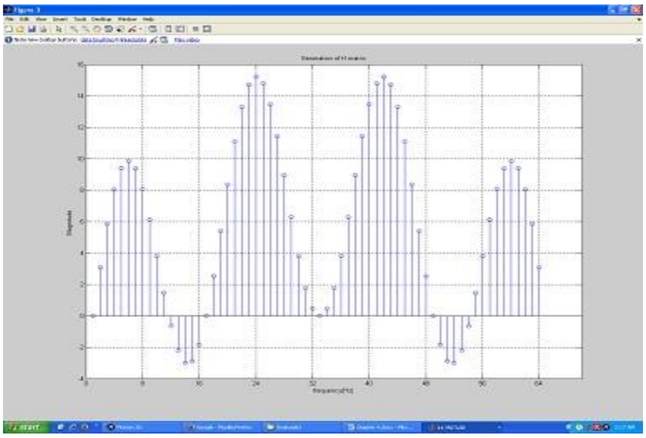

Fig.6. H Matrix Generation

Here figure 7 is showing the transformed signal value transmitted over the channel. Here x axis represents the channel frequency and y axis represents the magnitude v

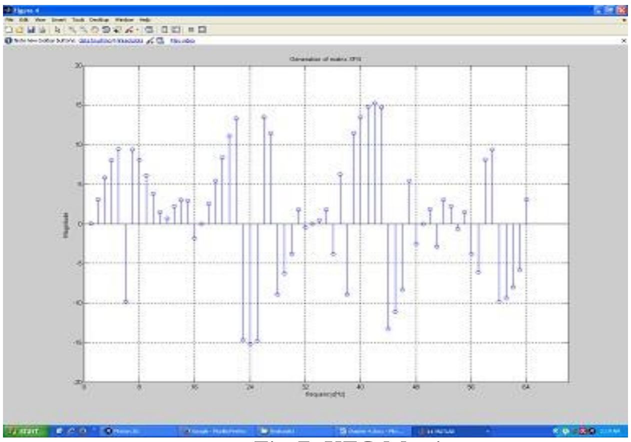

Fig.7. XFG Matrix

Here figure 8 is showing the noise value included in the signal. The noise vector is here considered as the additive signal vector. Here x axis represents the frequency of noise signal and y axis represents the noise magnitude

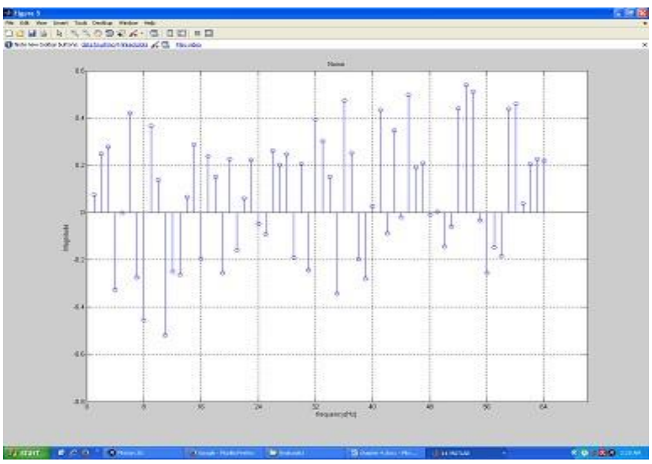

Fig.8. Noise Value

Here figure 9 is showing the noise inclusive signal generated from the work. The noise inclusive signals is here formed by adding the noise instances in the raw signal instances. Here x axis represents the signal frequency and y axis represents the noise magnitude

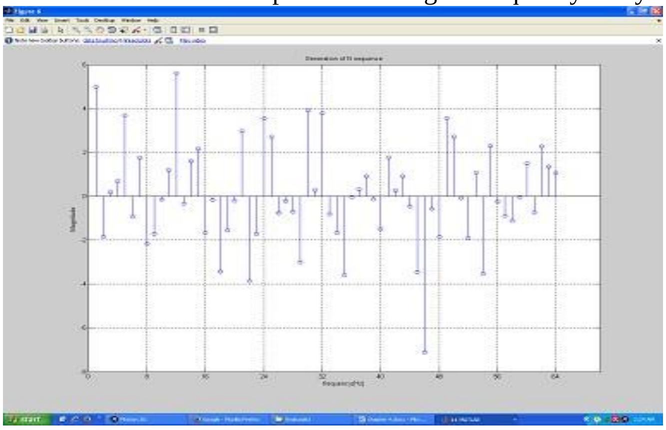

Fig.9. Noise Inclusive Signal

Here figure 10 is showing the channel response vector generated for the signal. This response vector is here identified as the communicating vector respective to signal and channel characterization

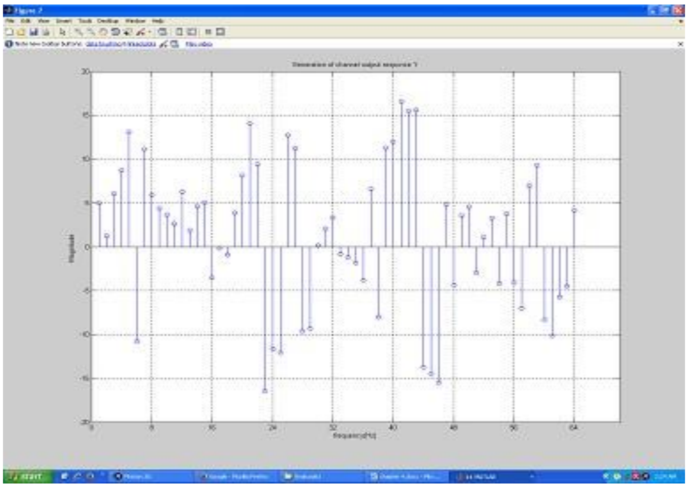

Fig.10. Channel Output Response Vector

Here figure 11 is showing the estimated signal form in blocked form. Here the x axis represents the frequency and y axis represents the magnitude value

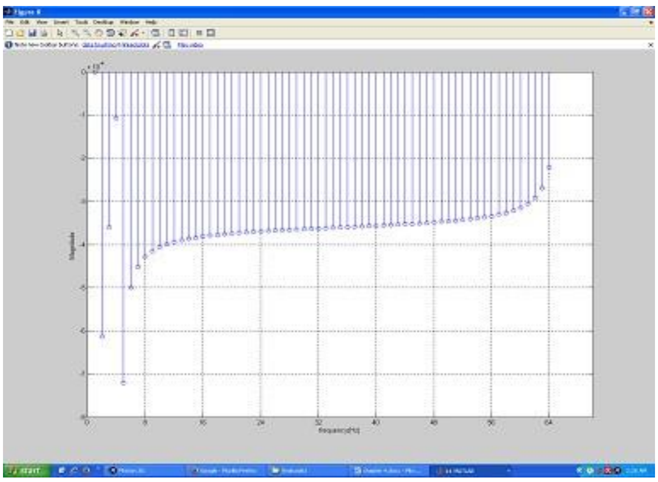

Fig.11. Block Estimated Signal Form

Here figure 12 is showing the formed matrix to perform channel level estimation. The intervals are included in block form for this channel estimation so that the channel impurities can be identified

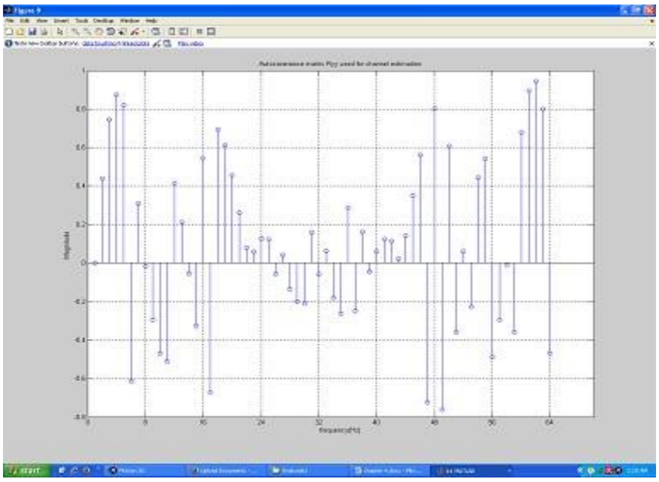

Fig.12. Channel Estimation

Here figure 13 is showing the MMSE value obtained from the signal analysis. Here x axis represents the frequency and y axis represent the MMSE vector.

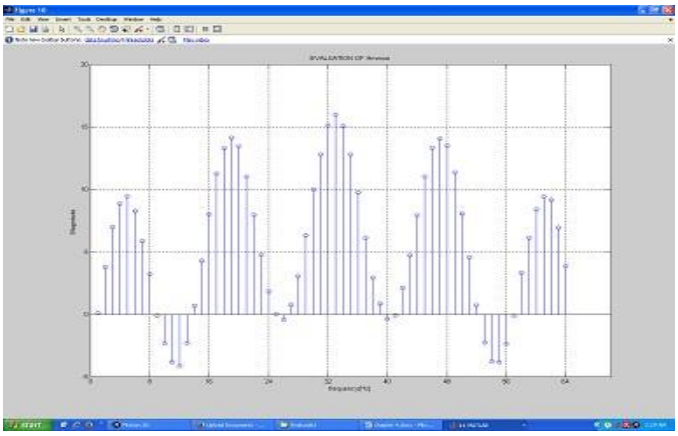

Fig.13 MMSE Evaluation

Here figure 14 is showing the channel estimation under four different methods. These methods are MMSE, LS, Modified LS and Modified MMSE. The results shows that the modified MMSE is most effective among all methods

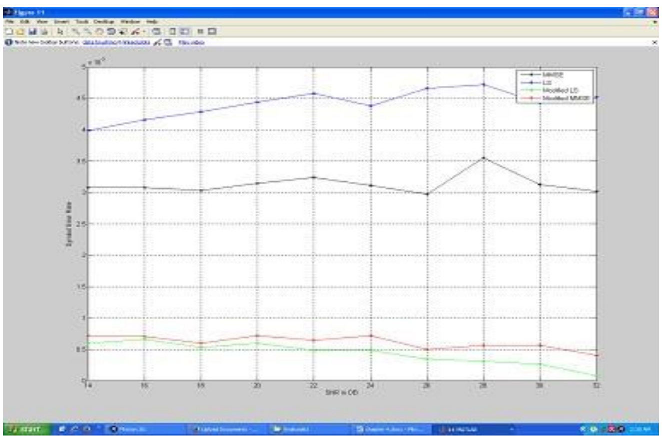

Fig.14. Channel Estimators

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Here figure 15 is error value analysis in equalized signal. The equalized signal is here identified as the most effective signal form

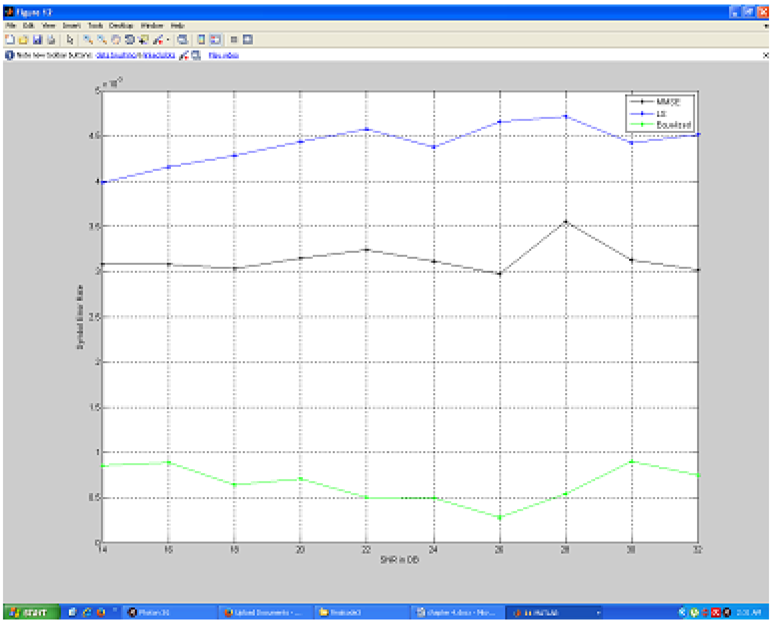

Fig.15. Equalized Signal Error

V. CONCLUSION

In this present work, an improvement to the communication network is defined using femtocell formation and equalization method. The work is here defined as a three stage model. In this work, the signal is generated with specific parameters and inclusive impurities. In first layer of this model, the femtocell formation is performed. This cell formation is based on the distance adaptive clustering method. Using this method, the users are divided in the clusters. Now the cluster sensing is performed to perform signal estimation. To estimate the signal significance modified least square and Modified Mean Square Error based hybrid method is defined. After signal estimation, the block adaptive channel sensing is performed to equalize the signal. The results are here obtained in terms of error estimation at different SNR values. The results show that the adaptive signal equalization is obtained from the work.

VI. FUTURE SCOPE

The work can be improved in future in different aspects. The associated aspects in which improvement can be obtained includes

- In future the signal optimization algorithm can be applied to improve signal integrity.
- More noise vectors or fading vectors can be defined to improve the signal integrity and algorithmic robustness.

REFERENCES

[1] A.Hatoum, R. Langer, N. Aitsaadi, R. Boutaba and G . Pujolle, "Cluster- Based resource management in OFDMA femtocell Network with Qos gaurantee,"in IEEE trans. Vehicular tech.,vol.63, no. 5,pp.2378- 2389,june.2014

[2] J .Ylioinas, J. Karjalainen , O. Piiraien, "Scheduling of the activation in iterative detection,decoding, and channel estimation for MIMO-OFDM,"in IEEE trans. IN communication.,vol. 61,no.2,pp638-647,feb.2013

[3] J. Ketonen, M. Junti, J. Ylioinas J. Cavallaro,"Implementation of LS, MMSE and SAGE channel Estimation for mobile MIMO-OFDM,"in IEEE. Asilomar,pp1092-1096,2012

[4] Md. N I Khan, Md. J. Alam,"Noise reduction Algorithm for LS channel Estimation in OFDM system,"in IEEE conferece,pp310-315,feb 2012

[5] M. Zamani, C. Li, C. Chen, Z. Zhang, "An adaptive decision –feedback channel estimation for coherent optical OFDM,"in OFC/NFOEC, Technical digest , OSA , june2013

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