GROUP HANDOVER MANAGEMENT IN MOBILE FEMTOCELL NETWORK BASED ON ART MAP CLASS1

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Abstract—In the telecommunication, a femtocell is small, low power cellular base station which always used in a home or small business. When we design the heterogeneous wireless environment then it involves several internetworking issues, such as seamless handoff or roaming, mobility management, security and accounting problem etc. The bandwidth utilization is the percentage utilized off the total bandwidth available. In this we propose a resource management scheme that contains bandwidth adaption policy and dynamic bandwidth reservation policy .The essential work carried in our research paper concern approach define the group handover using bandwidth utilization in mobile femtocell network based on adaptive resonance theory class 1 which reduces the handover call dropping probability by bandwidth utilization.

Index Terms— Mobile femtocell, group handover, call dropping, adaptive resonance theory class 1.

1. INTRODUCTION

In the telecommunication, a femtocell is small, low power cellular base station which always used in a home or small business. When we design the heterogeneous wireless environment then it involves several internetworking issues, such as seamless handoff or roaming, mobility management, security and accounting problem etc. The bandwidth utilization is the percentage utilized off the total bandwidth available. In this we propose a resource management scheme that contains bandwidth adaption policy and dynamic bandwidth reservation policy .The essential work carried in our research paper concern approach define the group handover using bandwidth utilization in mobile femtocell network based on adaptive resonance theory class 1 which reduce the handover call dropping probability by bandwidth utilization. When we deploy a mobile femtocell network then it generates the lot of handover calls and also the number of group handover scenarios is found in mobile femtocell network deployment. The benefits of using femtocell are better coverage, higher capacity, lower transmit power, prolog handset battery life and higher signal to interference plus noise ratio. Femtocell is assuming an increasingly important role in cellular coverage. Femtocells can be configured as open access or closed access. In this paper we use the adaptive resonance theory for find out the winning node .Adaptive resonance theory describe the number of neural network model which used supervised learning and unsupervised learning methods, and address problem such as pattern recognition and prediction. Adaptive resonance theory nets are designed to allow the user to control the degree of similarity of patterns placed on the same cluster. Femtocell are the way to deliver the benefits of fixed mobile convergence(FMC).The most FMC architectures require a new (dual mode) handset which work with existing unlicensed spectrum home /enterprise wireless access points, whereas the deployment which is based on the femtocell will work with existing handset but requires installation of a new access points that uses licensed spectrum .Adaptive resonance theory 1 is

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the simplest variety of adaptive resonance theory network, accepting only binary inputs. The simulation result show that how we minimize the call dropping when lot of handover calls generates and also how we utilize the bandwidth.

In literature there are various techniques are used in femtocell network .In the literature we learned about the Uplink capacity and interference avoidance for two tier femtocell network[2] , In this technique ,we derive exact outage probability at a Macrocells and tight lower bounds on the femtocell outage probability .CDMA uplink capacity in both open and closed access two tier femtocell network [3],In which we discuss about the CDMA uplink interference in open and closed femtocell networks was analytically evaluated in, showing that tier based. Service quality improvement of mobile user in vehicular environment by mobile femtocell network deployment [6], in this the mobile femtocells will be the new paradigm of the femtocellular network deployment. The successful deployment of mobile femtocell network will provide the enhance quality of service for the mobile user inside the vehicle .The Price based uplink resource allocation for hybrid – spectrum femtocell network [7] comes in Hybrid spectrum, including the shared spectrum and the dedicated spectrum, is considered here. Coexistence in Two-tier Femtocell Networks: Cognition and Optimization [8], in which we proposed a cognitive femtocell approach to find the optimal spectrum sensing and channel training time for the FAP. Inter-tier Handover in Macrocell /Relay/Femtocell Heterogeneous Networks [9] comes, In which we focus on the topic of handover decision in macrocell /relay/femtocell networks and an effective handover algorithm is proposed to reduce the redundant handovers .Advanced Handover Techniques in LTE- Advanced system [10]in which we show the handover process in LTE (long term evolution) which reduce architecture and handover procedure complexity. Group Handover Management in Mobile Femtocellular Network Deployment [11] in which we discuss about the deployment of mobile femtocells will create huge handover calls with the macro cellular networks. The group handovers need to be managed carefully. Otherwise huge number of running calls will be dropped.

The rest of the paper organized as follows, the paper is divided into three section .In section 1 we describe introduction and literature. In section 2 we discuss about the Group handover, Femtocell Network, ART map. In section 3, Main Contribution of The Paper, the Proposed Model, Simulation Result, Conclusion and Future Work are describe.

2.1. Group Handover

Handover is a process where a mobile radio operating on a particular channel is reassigned to a new channel. The process is often used to allow subscribers to travel throughout the large radio system coverage area by switching the calls (handover) from cell-to-cell (and different channels) with better coverage for that particular area when poor quality conversation is detected. Handover (also called handoff) is necessary for two reasons. First , where the mobile unit moves out of range of one cell site and is within range of another cell site. Second, a handover may be required when the mobile has requested the services of a type of cellular channel that different capabilities (e.g. packet data). This might mean assignment from a digital channel to an analog channel or assignment from a wide digital channel to a packet data channel.

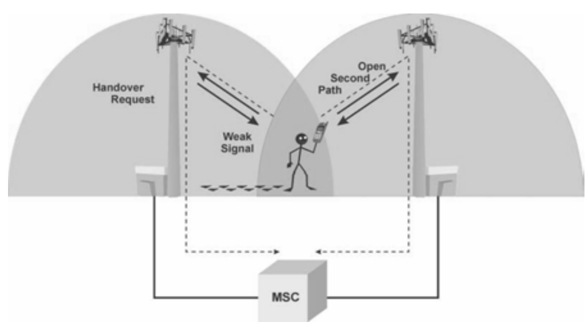

Figure.1: Handoff process in mobile telephone system

Figure.1, shows the basic handoff process that occurs in a mobile telephone system. In this example, the system has determined that the radio signal strength of mobile telephone has fallen below a predefined level. When this occurs, the serving base station sends a control message to the system indicating that the signal quality of the mobile's radio signal is declining and a handover may be necessary. The system determine that an adjacent cell sites are the candidate for the handoff and it sends command messages to the adjacent cell site to prepare to receive a new connection. Messages are exchanged between the base stations and the mobile device that informs it to change to a new channel and the MSC switches the audio path to the new cell site when necessary.

2.1.1. Handover procedure

EPC is not involved in Handover (HO) procedure and all the necessary message share directly exchanged between the eNBs. The handover procedure is illustrated in Figure.2[17], and is considered in the following:

1. Based on the area restriction information, the source eNB configures the UE measurement procedure.
2. MEASUREMENT REPORT is sent by the UE after it is triggered based on some rules.
3. The decision for handover is taken by the source eNB based on MEASUREMENTREPORT and RRM information.
4. HANDOVER REQUEST message is sent to the target eNB by the source eNB containing all the necessary information to prepare the HO at the target side.
5. The target eNB may perform an Admission Control dependent on the received E-RAB QoS information. Performing admission control is to increase the likelihood of a successful HO, in that the target eNB decides if the resources can be granted or not. In case the resources can be granted, the target eNB configures the required resources according to the received E-RAB QoS information then reserves a Cell Radio Network Temporary Identifier (C-RNTI) and a RACH preamble for the UE.
6. The target eNB prepares HO and then sends the HANDOVER REQUEST ACKNOWLEDGE to the source eNB. There is a transparent container in the HANDOVER REQUEST ACKNOWLEDGE message which is aimed to be sent to the UE as an RRC message for performing the handover. That container includes a new C-RNTI, the target eNB security algorithm identifiers for the selected security algorithms, it may include a dedicated RACH preamble, and possibly some other parameters like RNL/TNL information for the forwarding tunnels. If there is a need for data forwarding, the source eNB can start forwarding the data to the target eNB as soon as it sends the handover command towards the UE.

Steps 7 to 16 are designed to avoid data loss during HO:

7. To perform the handover the target eNB generates the RRC message, i.e. RRC Connection Reconfiguration message including the mobility Control Information .This message is sent towards the UE by the source eNB.

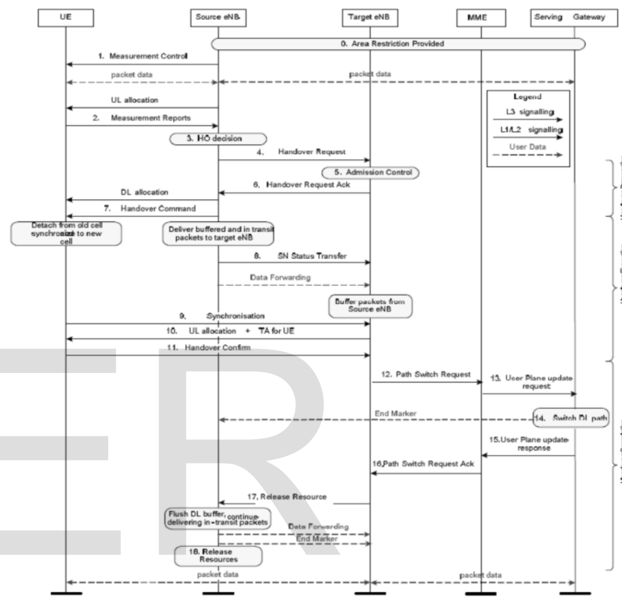

Figure.2: Handover Procedure

8. The SN STATUS TRANSFER message is sent by the source eNB to the target eNB. In that message, the information about uplink PDCP SN receiver status and the downlink PDCP SN transmitter status of E-RABs are provided. The PDCP SN of the first missing UL SDU is included in the uplink PDCP SN receiver status. The next PDCP SN that the target eNB shall assign to the new SDUs is indicated by the downlink PDCP SN transmitter status.
9. After reception of the RRC Connection Reconfiguration message including the mobility Control Information by the UE, the UE tries to perform synchronization to the target eNB and to access the target cell via RACH. If a dedicated RACH preamble was assigned for the UE, it can use a contention-free pro28 cedure; otherwise it shall use a contention-based procedure. In the sense of security, the target eNB special keys are

derived by the UE and the selected security algorithms are configured to be used in the target cell.

10. The target eNB responds based on timing advance and uplink allocation.

11. After the UE is successfully accessed to the target cell, they sends the RRC Connection Reconfiguration Complete message for handover confirmation, The C-RNTI sent in the RRC Connection Reconfiguration Complete message is verified by the target eNB and afterwards the target eNB can now begin sending data to the UE.

12. A PATH SWITCH message is sent to MME by the target eNB to inform that the UE has changed cell.

13. UPDATE USER PLANE REQUEST message is sent by the MME to the Serving Gateway.

14. The Serving Gateway switches the downlink data path to the target eNB and sends one or more "end marker" packets on the old path to the source eNB to indicate no more packets will be transmitted on this path. Then U-plane/TNL resources towards the source eNB can be released.

15. An UPDATE USER PLANE RESPONSE message is sent to the MME by the Serving Gateway.

16. The MME sends the PATH SWITCH ACKNOWLEDGE message to confirm the PATH SWITCH message.

17. The target eNB sends UE CONTEXT RELEASE to the source eNB to inform the success of handover to it. The target eNB sends this message to the source eNB after the PATH SWITCH ACKNOWLEDGE is received by the target eNB from the MME.

18. After the source eNB receives the UE CONTEXT RELEASE message, it can release the radio and C-plane related resources. If there is ongoing data forwarding it can continue.

2.2. Femtocell Network

A Femtocell is a cell in a cellular network that provides radio coverage and is served by a Femto-BS (FBS). FBS also known as a Home-BS or a Femto-Access Point (FAP)**,** is a mini low-power BS installed by end users. FBSs are typically deployed indoors residential, Small Office Home Office (SOHO) and enterprise to offer better coverage, especially where Macro/Micro networks. Femtocells operate in the licensed spectrum, and basically have tens of meters of coverage range and can support up to ten active users in a residential setting. FBSs are connect to standard cellular phones and similar devices through their wireless interfaces [13].

2.3. ART Map (class -1)

ART 1 is designed to cluster binary input vectors, allowing for great variation in the number of nonzero components, and direct user control of degree of similarity among pattern placed on the same cluster unit .The architecture of an ART 1 net consist of two fields of units – the F1 units and the F2 (cluster) units—together with a reset unit to control the degree of similarity of pattern placed on the same cluster unit .The F1 and F2 layers are connected by two set of weighted pathways. The learning process is designed so that it is not required either that pattern be presented in a fixed order or that the number of patterns to be clustered be known in advance .It is assuming that ART 1 net is being operated in the fast learning mode in which the weight reach equilibrium during each learning trial(presentation of pattern) .In the ART 1 we discuss about the architecture ,in which we discuss about computational units ,supplemental units and algorithm ,description ,training algorithm .

2.3.1. TRAINING ALGORITHM

The training algorithm for an ART1 net is presented next. A discussion of the role of the parameter and an appropriate choice of initial weights follows.

Step 0. Initial Parameter:

$L>1,\ 0<P<=1.$

Initial Weight:

$$0<b_{ij}(0)< L/L-1+n$$

$$t_{ij}(0)=1.$$

Step1. While stopping condition is false, than do steps 2-13.

Step2. For each training input, do steps 3-12.

Step3. Set activation of all F2 units to zero.

Set activation of F1(a) units to input vector s .

Step4. Compute the norm of s:

$||s|| = \sum s_i$.

Step5. Send input signal from F1 (a) to the F1(b) layer:

xi=si

Step6. For each f2 node that is not inhibited:

If $y_i \neq -1$, then

$yi = \sum_i b_{ij} x_i$.

Step7. While reset is true ,do steps 8-11.

Step8. Find J such that $y_J >= y_j$ for all nodes j.

If y_J=-1, then all nodes are inhibited and

The pattern cannot be clustered.

Step9. Re-compute activation x of F1(b):

$X_i = s_i t_{Ji}$.

Step10. Compute the norm of vector x.

Step11. Test for reset:

if $||x|| / ||s|| < p$,then

y_J = -1(inhibit node J) (and continue executing step 7 again).

if $||s|| / ||x|| >= p$, then proceed to step 12.

Step12. Update the weight for node J (Fast learning):

$b_{ij}(new) = Lx_i / L-1+||x||$,

$t_{Ji}(new)=x_i$.

Step13. Test for stopping condition.

3.1. Main Contribution Of The Paper

Although the performance of the femtocell network is good but this creates some problems related to handover, for example when we do handover then there creates the problem of efficient handover delivery between more than two devices. If there is more than two devices than they first prefer the call which first come and after this if another call is come then if there is no space for that call then it will be destroy.

To improve such type of problem we use the artificial intelligence technique which is adaptive resonance theory(class 1), by which we can easily manage the handover call and we can do the efficient handover delivery using bandwidth utilization in femtocell network and also we can utilize the bandwidth which assign to each class which is connected to the handover process .By using the group handover management we can do the efficient handover management using bandwidth utilization .For example, suppose we design three classes that is A, B, and C. Now we have to design directory for each classes .Now we define the limit of bandwidth for each class .Suppose the highest limit of class B is 10 and lowest limit is 6.The highest limit of class C is 10 and lowest limit is 4.But class A have some reserved bandwidth because when more users come than we use that bandwidth .When data is transfer from system to another or one class to another then the bandwidth of that data which come ,add to the directory .After that when the more users come they use the bandwidth of class A .After complete this process we apply the adaptive resonance theory class 1 which find out the winning node from the classes .the meaning of winning node is that when there is extra data then we remove those data from the class which is their from long time that is known as winning node .

3.2. PROPOSED MODEL

In this section we have shown, the system model to deploy the femtocellular network inside the vehicle. A FAP is located inside the vehicle example bus /car /train /ship or others. A transceiver is situated outside the vehicle to transmit /receive data to / from the backhaul networks (example, Macrocell network, satellite network etc.) The FAP are install inside the vehicles to make wireless connection between the user and the FAP. The FAP and transceiver are connected through the wired networks. The overall FAP –to – core network connectivity is shown in below figure. In this system, the FAP works like a relay station (RS). In the proposed model, the existing macro cellular networks or the satellite networks are used for backhauling the femtocell traffic of the mobile users inside the vehicle. The antenna of the outside transceiver is relatively stronger compared to the antenna of the MS. The better quality received signal from FAP provides enhanced quality of services in terms of capacity, signal quality, and outage probability. The whole model is design for the improvement of the handover process in the network, when the classes are design for handover process in the femtocellular network than we initialize the bandwidth for minimizing the loss of handover calls. After that we use the artificial intelligence technique adaptive resonance theory class 1 for find out the winning node .The winning node find out when there is lot of handover calls

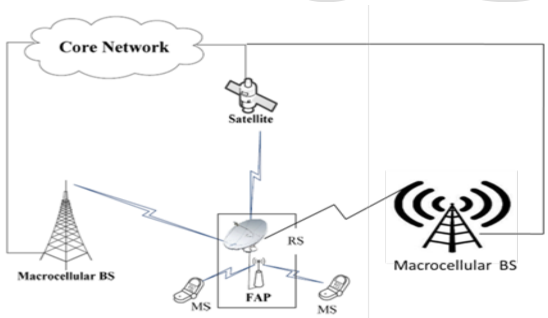

Figure.3: Proposed model

In this proposed model(figure.3) , this show the two base station which are connected to the core network and the both station are connected to the satellite ,the data is transfer through one macro cellular base station to another macro cellular base station . By using the adaptive resonance theory, we minimize the call dropping when lot of handover calls generates and also how we utilize the bandwidth .By using the adaptive resonance theory the call dropping problem is decreases and improved the scalability of group handover mechanism sin femtocell network .Scalability is the ability of any system, network or process which handle a growing amount of work in a capable manner. By which the performance of the network is improved.

3.3. Simulation & Result

The software used for creating the simulation environment was Matlab 6. The simulation was run in Matlab 7 in Windows XP environment.

Table1: Values Used In Simulation Model

Items	Value
Bandwidth per cell	10000 Kbps
Average length of a voice user	180 Sec.[16]
Average length of a data user	300 Sec. [16]
Average length of a video user	1800 Sec. [16]
Average arrival rate of users	.15 [16]

3.3.1 Existing User Dropping Probability

Existing user dropping probability is the most important performance measure for any Admission Control mechanism. With the development of multimedia compression and coding technologies, more and more multimedia applications have the bandwidth adaptive capability. Wireless multimedia applications on the Internet can exploit the adaptability of such applications to improve the efficiency of resource utilization.

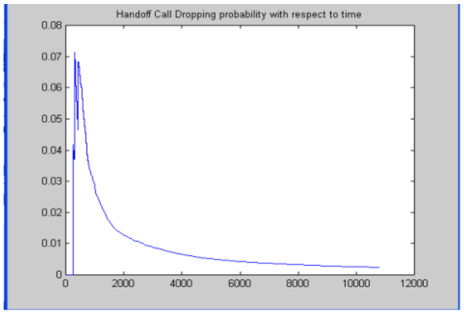

Figure.4: The handoff call dropping probability with respect to time

3.3.2Average Bandwidth Utilization

The algorithm gives two kinds of bandwidth utilizations, first is the conventional one in which algorithm calculates the percentage of bandwidth utilization and the second type of utilization comes in to picture due to degradation of users. Because there can be situations of high traffic load where the total bandwidth of the cell can be less than the sum of maximum bandwidths of all the running users this bandwidth utilization is user perceived bandwidth utilization.

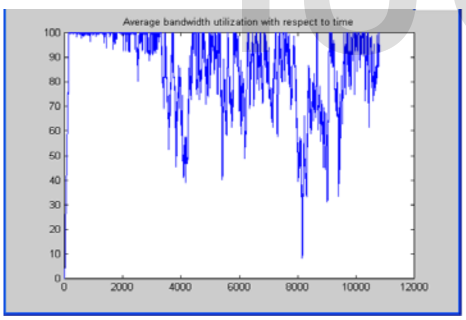

Figure.5: The average bandwidth utilization with respect to time

3.3.3.New User Dropping Probability

Maintaining a low existing user dropping probability generally results in a higher new user dropping probability. This is because few channels are always reserved for existing users, which can't be used by new users even if there are no existing users present. Because the proposed algorithm does not maintain any such pool of resources but depends on reclaiming of resources from existing users this problem does not arise in proposed algorithm and it maintains satisfactorily low value of new user dropping probability also, which lies in the range of .02 to .04 once the system stabilizes.

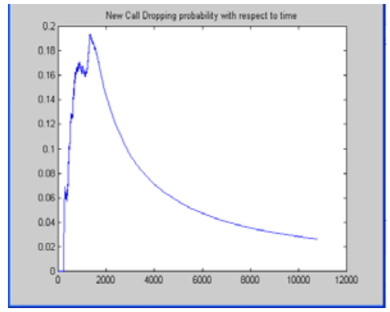

Figure.6: New call dropping probability with respect to time

3.3.4. Average Degradation Period Ratio

Algorithm takes advantage of adaptive nature of multimedia applications in order to maintain low existing and new user dropping probabilities. Because users are degraded to incorporate more incoming new and existing users, users receive degraded service for some portion of its lifetime. It is proved that human users cannot notice degradation in service quality if degradation period ratio is below 10% of user total lifetime. To maintain a low value of DPR, algorithm returns bandwidth to existing degraded users as soon as some user leaves the cell.

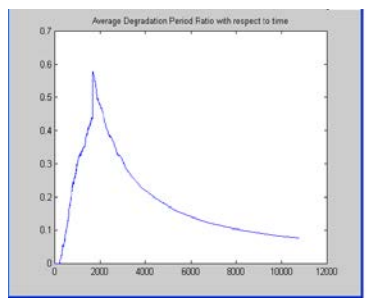

Figure.7: Average Degradation period ratio with respect to time

3.4. Conclusion and future work

The femtocells in the vehicular environment i.e., the mobile femtocells will be the new paradigm of the femtocellular network deployment. However, the deployment of mobile femtocells will create huge handover calls with the macro cellular networks. The group handovers need to be managed carefully. Otherwise huge number of running calls will be dropped. The proposed scheme is able to efficiently manage the bandwidth of the macro cellular networks to handle huge number of handover calls.

In this paper we discuss about the group handover in femtocell network and also discuss about the adaptive resonance theory of class 1 by which we can minimize the loss of handover calls in the femtocell network .By using ART Map class 1 the performance of handover in the class is better .In this paper, we can apply more classes of adaptive resonance theory in group hand over for future direction .

References

[1] Vikram Chandrasekhar, Jeffrey G. Andrews, and Alan Gatherer, "Femtocell networks: a survey," *IEEE Communication Magazine,* pp. 59 – 67, September 2008.

[2]Chandrasekhar and J. Andrews, "Uplink Capacity and Interference Avoidance in Two-Tier Femtocell Networks," to appear, *IEEE Trans. Wireless Commun.*,june-2009.

[3] Ping Xia ,V. Chandrasekhar and Jeffrey G. Andrews ,"CDMA uplink capacity in both open and closed access Two tier femtocell network", To appear ,IEEE Globecom workshop on femtocell network.october-2010.

[4]Shin – Ming Cheng ,Weng Chon Ao, and Kwang Cheng Chen ,"Download capacity two –tier cognitive femto network " To appear ,IEEE 21st international symposium on personal indoor and mobile radio communication .june-2010.

[5]Chiao Lee ,Jane Hwa Huang and Li Chun Wang ,"Distributed channel selection principle for femtocells with two tier interference" ,IEEE trans ,August-2010

[6]Mostafa Zaman Chowdhury, Seung Que Lee, Byung Han Ru, Namhoon Park, and Yeong Min Jang, "Service Quality Improvement of Mobile Users in Vehicular Environment by Mobile Femtocell Network Deployment," *IEEE International Conference on ICT Convergence (ICTC),* September 2011.

[7]Weiqiang Liu ,Xiaohui Chen and Weidong Wang ,"Price-Based uplink resource allocation for hybrid spectrum femtocell network " IEEE Trans,May- 2012.

[8] Siew Eng Nai and Tony Q.S. Quek ,"Coexistence in two tier femtocell network :Cognition and optimization" IEEE Trans , April 2012.

[9] Chuan Ma ,Guanding Yu, Jietao Zhang ,Inte –tier handover in Macrocell / Relay/femtocell heterogeneous networks, IEEE ,May-2012.

[10] Ibraheem Shayea ,Mahamod Ismail and Rosdiadee Nordin ,"Advance handover technique in LTE-Anvanced system" International conference ICCCE 2012,3-5 July 2012.

[11]Mostafa Zaman Chowdhury ,Sung Hung Chae and Yeong Min Jang ,"Group Handover management in mobile femtocell network deployment", IEEE ,2012.

[12]A study of access method effect on the performance of TWO TIER LTE femtocell network Mofreh EI- Gendy, Essam Sourour.(2011)

[13]Utilizing Weighted Rating of Multiple Attributes Scheme to Enhance Handoff Efficiency in Heterogeneous Wireless Networks by Shin-Jer Yang, Wen-Chieh Tseng.(2011)

[14]A Fully Distributed Method for Dynamic Spectrum Sharing in Femtocells Gustavo W. O. Costa_, Andrea F. Cattoni , Istvan Z. Kovacsy and Preben E. Mogensen y Aalborg University, Aalborg, Denmark y Nokia Siemens Networks, Aalborg, Denmark.

[15]Clustering Based Resource Allocation for Inter-femtocell Interference Management Wei LI_, Tao SU, Wei ZHENG, Xiangming WEN Beijing University of Posts and Telecommunications, Beijing, China.

[16] Incentive mechanism for uplink interference avoidance sin two-tier macro-femto Networks.(2012)

[17] HarriHolma, AnttiToskala,LTE-The UMTS long Term Evolution: From The-ory to Practice. John Wiley & Sons Ltd, 2009.