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A Robust Vertical Handoff Algorithm with Dynamic New Call Blocking Probability for Heterogeneous Wireless Mobile Networks

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ABSTRACT: *Global information access to the user will be provided by the wireless networking. Now a day's wireless networking is becoming an important and popular way to provide the global information access to the user while roaming among the heterogeneous wireless network. The main aim of seamless mobility is the availability of Simple and robust vertical handoff algorithm. This algorithm allows a mobile node to move across the various heterogeneous wireless networks. Vertical handoff procedure is needed in order to move a mobile node from one heterogeneous wireless network to another heterogeneous wireless network and battery power is considered as crucial parameter for certain mobile nodes. In this paper a simple and robust two-step vertical handoff algorithm is proposed. To the best of our knowledge, this algorithm is the first vertical handoff algorithm that takes the two classifications of mobile nodes into the consideration. One is resource poor mobile nodes and other is resource rich mobile node. In addition to this new call blocking and dynamic new calling probability is introduced in this paper. The experimental results have shown that the proposed algorithm outperforms traditional algorithm in bandwidth utilization, handoff dropping rate and handoff rate.*

KEYWORDS - *Vertical handoff, new call blocking probability, Heterogeneous wireless mobile networks*.

I. INTRODUCTION

The large numbers of heterogeneous mobile networks are integrated in the fourth generation (4G) mobile communication networks, for this integration of heterogeneous mobile networks vertical handoff scheme is needed. The main aim of seamless mobility is to provide the simple and vertical handoff. Vertical handoff is used to allow the mobile nodes to move freely across heterogeneous wireless mobile networks without loss of the quality-of-service (QoS). The vertical hand of scheme is divided into three steps [1]. First, the mobile node should have the knowledge about the wireless networks in order to know which wireless network is reachable this step is called as network discovery. Second step is handoff decision, in this step the mobile has to decide which network is suitable to handoff and this step is evaluated by considering the parameters associated with the other wireless networks. The last step is handoff execution, in this step the mobile node decides to move to other wireless network which is selected in the second step.In this paper we mainly concentrate on the handoff decision. Need of the handoff is decided based on the mobile-controlled handoff (MCHO), network-controlled handoff (NCHO), and mobile-assisted handoff (MAHO) [2].by using MCHO a mobile node continuously monitors the singles of the anchor point and initiates the handoff process. MCHO is suitable for the vertical handoffs. In vertical handoff many parameters as to consider some of them are power consumption, security, cost and network conditions. In vertical handoff scheme many methodologies have been used some of them are policy-enabled schemes, fuzzy logic, neural networks concepts, pattern recognition, etc. In most of the methods handoff decision is made by considering the threshold value of the received signal strength (RSS). But it yield serious ping-pong effect.

Network conditions will be determined based on the available bandwidth. In addition to this the major two QOS parameters are new call blocking probability (NCBP), dynamic new call blocking probability (DNCBP), handoff call dropping rate (HDR). When a user request for new connection then new call is initiated, a handoff call is occurred when a requested user moves from one network to another network. NCBP is the probability of new requested call being rejected. HDR is the probability that the handoff attempt to fail. In mobile communication networks, important QOS issue is limiting HDR with in a pre specified target value. During the handoff process also the mobile node must maintain ongoing session. While performing vertical handoff process on mobile node, the crucial parameter is battery power.In this paper we proposed a simple and robust two-step vertical handoff algorithm. First step describes the quick evaluation method for pre handoff decision. Second step describes handoff decision function for handoff execution. This vertical handoff algorithm considers the mobile nodes into two ways one is resource-poor mobile node and second is resource-rich mobile node. Vertical handoff decision considers only first step for resource-poor mobile nodes. Vertical handoff decision considers both steps for resource-rich mobile nodes. The handoff decision is done based on the comparison of DNCBP of the different networks. DNCBP is used to find the traffic load of the networks. The mobile node should take the handoff to the network, which have the lower DNCBP. DNCBP helps the proposed model to balance the network load among the various networks. The rest of the paper is organized into five sections. In section 2 a brief explanation about traditional approach. In section 3 we explained regarding the background knowledge. In section 4 the proposed algorithm is explained. In section 5 experimental results are shown finally in section 6 we presented our conclusion.

II. TRADITIONAL APPROCH

Traditional algorithm is given in [7]. Vertical handoff decision function is used for all the networks (VHDF). The network with higher VHDF is selected as the best network based on user preferences. The network quality is determined by the following function

$$Q_j = f\left(\frac{1}{CS_i}, S_i, \frac{1}{PC_i}, NC_i, NP_i\right)$$

From above equation CS, S, PC, NC, P denotes the cost of service, security, power consumption, network conditions, network performance. The above equation is simplified as follows. The user preference is to achieve the highest QOS by maximizing the amount of bandwidth.

$$Q_i = f\left(\left(0\ X\ \frac{1}{CS_i}\right), (0\ X\ S_i), \left(0\ X\ \frac{1}{PC_i}\right), (1\ X\ NC_i), (0\ X\ NP_i)\right)$$

III. RELATED WORK

In [3] the targeted network is selected by using the traditional approach, traditional approach select the network based on the received signal strength (RSS). In [4] position aware handoff decision algorithm was proposed, it considers the base station location and coverage area information. By using this algorithm the mobile terminal itself takes the decision about the handoff and it doesn't need any interaction with the base station. In [5] vertical handoff decision algorithm was proposed in that algorithm they used markov decision process (MDP). The main aim of this algorithm is to maximize the total number of connections and a stationary deterministic policy is used to find the disturbed connections. In [6] an optimal vertical handoff decision making algorithm was proposed, in which they used fuzzy member functions to decide which network is suitable for the handoff.

IV. PROPOSED MODEL

Proposed vertical handoff algorithm contains network considerations, new call blocking probability, dynamic new call blocking probability

4.1 Network considerations

Wireless networks are denoted as n_i, where i=1………N. for example consider two networks those are universal mobile telecommunication system (UMTS) and WLAN. N denotes the total number of considered networks. TB_i denotes the total bandwidth of the network n_i and AB_i denotes the current available bandwidth of the network n_i.

4.2 New call blocking probability

The number of request arrival for unit time is denoted as λ_i it is calculated by using poisson distribution. Where i=1……N. the number of requests serviced per unit time is denoted as μ_i it is computed as exponential averaging computations. P_i denotes the new call blocking probability, p_i computed as follows

$$p_i = \frac{\left(\frac{\lambda_i}{\mu_i}\right)^{TB_i}}{TB_i!}\left(\sum_{n=0}^{TB_i}\frac{\left(\frac{\lambda_i}{\mu_i}\right)^{n}}{n!}\right)^{-1} \qquad (1)$$

4.3 Dynamic new Call Blocking Probability

In order to compute the DNCBP of network n_i we just replace TB_i with AB_i in (1). the performance of the DNCBP is much better than the NCBP. Dynamic new call blocking probability is denoted as H_i

$$H_i = \frac{\left(\frac{\lambda_i}{\mu_i}\right)^{AB_i}}{AB_i!}\left(\sum_{n=0}^{AB_i}\frac{\left(\frac{\lambda_i}{\mu_i}\right)^{n}}{n!}\right)^{-1} \qquad (2)$$

4.4 Proposed scheme

Resource limited devices can initiate the vertical handoff. A simple and robust handoff decision, a two-step vertical handoff algorithm is presented to select the optimal target network and low power consumption for vertical handoff decision. The first step in this algorithm describes the quick evaluation method for pre –handoff decision. The second step describes the handoff decision function for handoff execution. Mobile nodes are classified into two types those are resource-poor mobile nodes and resource-rich mobile nodes. Vertical handoff decision considers only first step for the resource-poor mobile nodes. For the resource-rich mobile nodes, vertical handoff decision considers both steps. This approach can reduce the power consumption on resource-poor mobile terminals.

4.4.1 STEP 1: Quick evaluation method for pre-handoff decision

Handoff decision considers different types of user`s traffic classes such as classes of service and service type. These two types of service classes are required to combine different types of vertical handoff parameters. For each of the traffic class we consider four types of QOS classes defined by the UMTS network. They are conversational classes, streaming classes, interactive classes, and background classes. According to the sensitivity delay characteristics the first two types of services are called as real time services and other two services are called as non-real time services. The first step of this algorithm evaluates the minimum guarantee function. This function is used to find whether the mobile node has the minimum guarantee to support for every network.

$$M_i = F(Bi - Btd) * F(RSSi - RSStd) * F(Vi - Vtd) * \mathrm{F(Di - Dtd) * F(PCi - PCtd) * F(MCi - MCtd)} \quad (3)$$

Where
M_i : Means minimum guarantee function.
Bi : Available bandwidth
RSSi : Received Signal Strength
Vi : Velocity
Di : Duration
PC_i : Power consumption

The following parametwrs represents the threshold values of
Btd : Bandwidth
RSStd : Received Signal Strength
Vtd : Velocity
Dtd : Duration
PCtd : Power
MCtd : Monitoring cost

The function F (……) is a unit function. For negative arguments the result of unit step function is zero and for the positive arguments the result is one. If M_i value is one then the netw2ork is added to the candidate set S. After completing the pre-handoff decision step, based on the size of the candidate step the handoff process will be done. If S is empty then MN stays in current network. If S contains only one network and that network is current network then MN stays in the current network. If S contains more than one network, whose minimum guarantee value is one, If MN is resource poor node and the current network is in the set S then MN stays in the current network otherwise MN connected to any one of the network that present in the set S. if MN is resource-rich node then the second step of the algorithm is executed.

4.4.2 STEP 2: vertical handoff decision function for handoff execution

In this step extended vertical handoff decision algorithm function is used (EVHDF). This function is used to measure the improvement of the handing off the particular network. We assume that the size of the candidate set is m. DNCBP is used to find the available bandwidth and traffic load of the network. DNCBP is used in the EVHDF to balance the traffic load across the different networks.

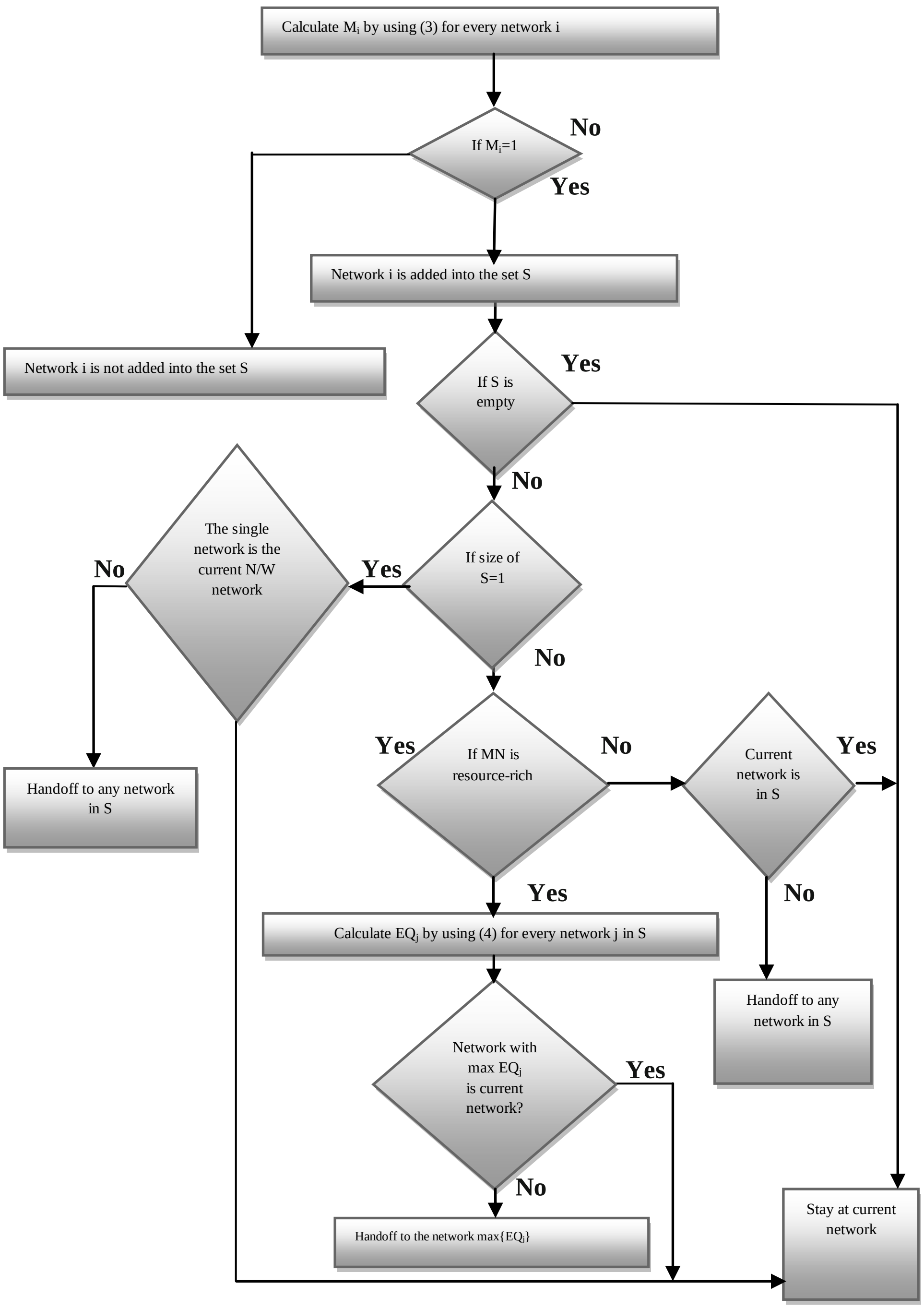
$$EQ_j = \frac{w_{cs}\left(\frac{1}{cs_j}\right)}{max\left(\left(\frac{1}{cs_1}\right)\ldots\ldots\left(\frac{1}{cs_n}\right)\right)} + \frac{w_s S_j}{max(S_1 \ldots\ldots S_n)} + \frac{w_{pc} PC_j}{max(PC_1 \ldots\ldots PC_n)} + \frac{w_{nc} NC_j}{max(NC_1 \ldots\ldots NC_n)} + \frac{w NP_j}{max(NP_1 \ldots\ldots NP_n)} \quad (4)$$

Where
EQ_j : Handoff decision function
w_{cs} : Weight on cost of service

w_S : Weight on security
w_{Pc} : Weight on power consumption
w_{nc} : Weight on network conditions
w_{Np} : Weight on network performance

n represents the size of the candidate set S. The best network for handoff will be selected based on the EQ_j the network which having the height EQ_j value that becomes the preferred network for handoff. If the preferred network is the current network then MN remains in the same network otherwise vertical handoff takes place.

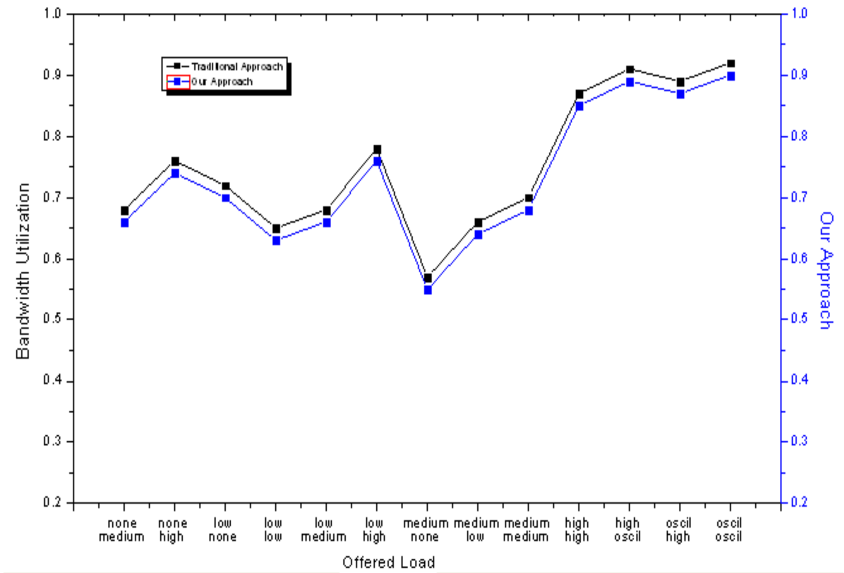
4.3 Proposed handoff decision algorithm*:*



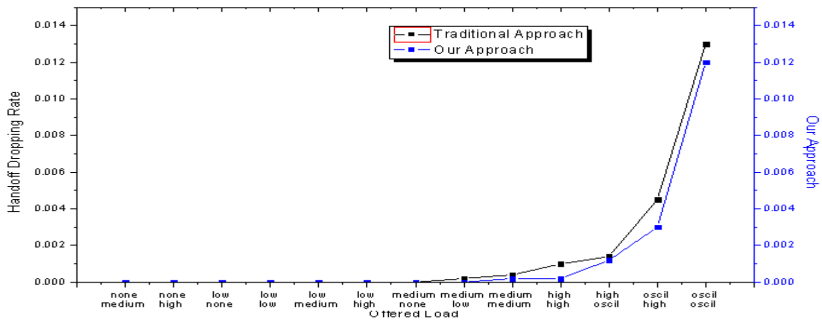
V. SIMULATION AND RESULTS

In this simulation and result we consider two networks those are WWAN with bandwidth 384 kbps and other is WLAN with bandwidth 1MBPS. The offered load is divided into none, low, medium, high, oscillating. We considered the bandwidth requested by each call is constant. So that input traffic is suitable to model the conversation traffic class and streaming traffic class. The numerical result shows the performance comparison with traditional approach.

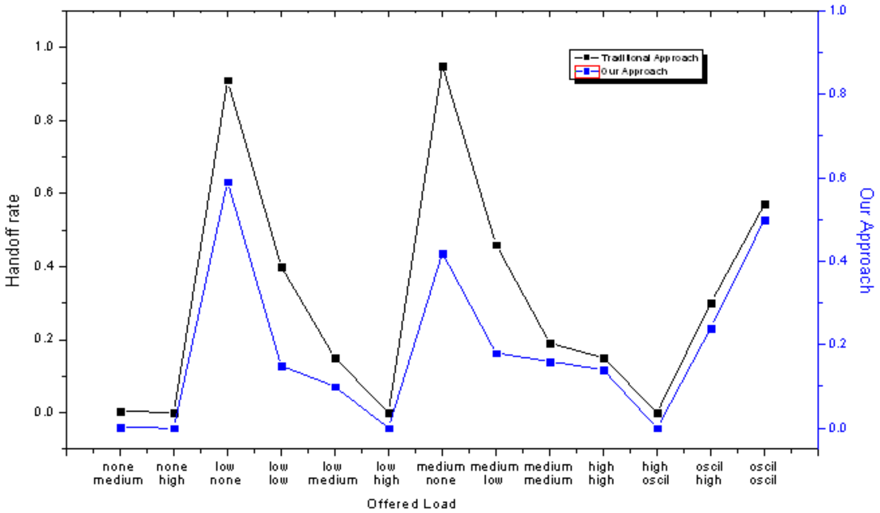
The mobile nodes have two methods to make handoff decision: One is traditional handoff algorithm given in That is, one mobile node prefers to handoff to the network with more available bandwidth. The other is the simple version of our proposed method. More specifically, in the first step, as shown in Eq. (4), we set $Mi = F(Bi - Btd) \cdot F(RSSi - RSStd) \cdot F(Di - Dtd)$. Here the three thresholds B*td*, RSS*td* and, *Dtd* are constant for every mobile user. In the second step, we set $EQj = \frac{NC_j}{\max(NC_1, NC_2, \ldots, NC_n)}$, where $NCj = \frac{b_j}{H_j}$. Here we assume that all mobile nodes have enough resource to make both steps. Note that the values of the above three thresholds are predefined according to the specific application environment. And our experiment did not focus on any specific traffic class. The following graphics are drawn by considering the multiple y axis.



In the above fig, our proposed approach shows better result than the traditional approach on overall bandwidth utilization even if offered load varies. In the above graph we considered bandwidth utilization on y axis and load on x axis. This proposed method increases bandwidth utilization by 2.5% as compared with traditional approach.



The above fig gives the effect of offered load on handoff dropping rate. In the above fig the proposed method gives best result than the traditional approach even offered load varies. Our proposed model reduces the hand off dropping rate by up to 0.480%.



The above fig shows the result over the handoff rate and offered load. The handoff ratio is defined as the ratio of the total number of handoff execution to handoff decision. In the above simulation we considered the number of handoff decision are similar in the both traditional and our approach. In proposed approach the handoff rate is always smaller than traditional approach.

VI. CONCLUSION

In this paper we proposed simple and robust vertical handoff algorithm that uses dynamic new call blocking probability, by using this DNCBP the traffic load of various networks will be managed. In addition to various network parameters traffic load will also be considered in order to decide which network is suitable for handoff. By considering experimental results we can say that the proposed algorithm performance is better than the traditional approach. In results and simulation we plotted graphs among the traditional approach and proposed approach.

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