A Handoff Technique to Reduce False-Handoff Probability in Next Generation Wireless Networks

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Abstract—Next Generation Wireless Systems (NGWS) include co-existence of current wireless technologies such as WLANs, WiMAX, General Packet Radio Service (GPRS) and Universal Mobile Telecommunications System (UMTS). The most important and challenging issue is seamless handoff management in NGWS to ensure the Quality of Service (QoS). In this article, we propose a GPS based handoff technique to improve handoff probability in NGWS. Using GPS we determine the direction of velocity of the MT (Mobile Terminal). In earlier works handoff based on Relative Signal Strength (RSS) of BS (base station) was proposed. But in the case when a MT is moving towards an NBS whose RSS is less than that of its adjacent NBS, to take the decision of handover is quite decisive. But using GPS we can ensure efficient hand-off. The result shows that the proposed approach can solve the problem and helps to take the right decision decreasing false hand-off initiation probability.

***Index Terms*-Next Generation Wireless Systems (NGWS), Handoff, GPS (Global Positioning System), Direction of velocity of MT (Mobile Terminal), Pre-registration.**

I. Introduction

High capacity wireless access for mobile users is increasing rapidly. In tomorrow's always-on wireless connectivity, users will come to expect a certain level of Quality of Service (QoS) from their network providers. Integration of wireless networking and communication systems such as GSM(Global System for Communication),GPS(Global Positioning System GPRS(General Packet Radio Services), UMTS(Universal Mobile Telecommunication Services) and Wireless LAN (WLAN), Bluetooth for personal area and Satellite networks for Global networking can assure a certain level of Quality of Service (QoS). Two types of handoff can be occurred in NGWS shown in fig 1.

→ Horizontal handoff: handoff between two BSs of the same system. It can be further classified into

- 1) Link-layer handoff: Horizontal handoff between two BSs, under same foreign agent (FA), *e.g.*, the handoff of a MT from BS10 to BS11 in Fig. 1.
- 2) Intra-system handoff: Horizontal handoff between two BSs that belong to two different FAs and both FAs belongs to the same system and hence to same gateway foreign agent (GFA), *e.g.*, handoff of MT from BS11 to BS12 in Fig. 1.

→ Vertical handoff (Inter-System Handoff): Handoff between two BSs, belong to two different systems and two different GFAS, *e.g.*, the handoff of the MT from BS12 to BS20 in Fig. 1.

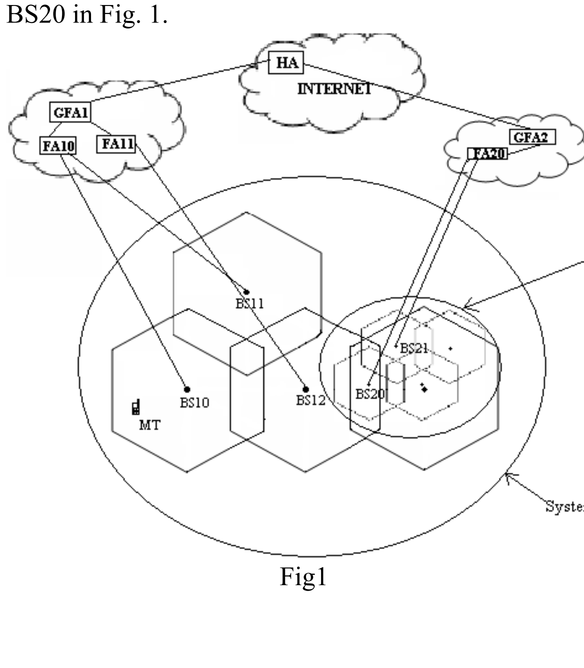

Fig1

II. RELATED WORKS

Recently different cross layer approaches has been proposed to enhance the performance of handover in next generation heterogeneous wireless networks. Some proposed new algorithms or new protocols. For QoS demanding applications like VoIP and multimedia seamless handoff in mobility support has become a great issue in NGWS.

Due to mobility the mobile terminal MT(P) moves into the coverage area of the NBS. The MT can learn about the possibility of moving into another NBS by comparing the RSS of OBS and NBS. Sth is the threshold value of the RSS to initiate HMIP handover process. This implies when the RSS of OBS is below Sth ,the HMIP registration procedures are started [1]. But the direction of mobile terminal can be changed. Our proposed approach takes care this change of direction of the MT.

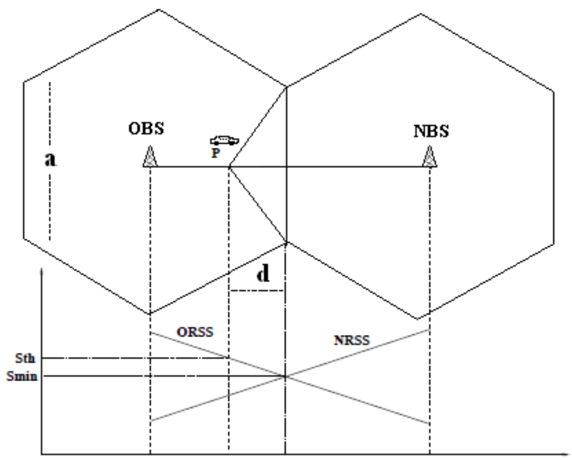

Fig 2

A novel mobility management system is proposed in [2] for vertical handoff between WWAN and WLAN. The system integrates a connection manager (CM) that intelligently detects the changes in wireless network and a virtual connectivity manager (VCM) mantains connectivity using end-to-end priciple.

In [5] signal to interference ratio between old base-station and neighboring base-stations are calculated to make the handoff initiation decision for next generation wireless system or 4G networks.

In [7], the authors proposed a handoff algorithm in which the received pilot signal strength is typically averaged to diminish the undesirable effect of the fast fading component. Unfortunately, the averaging process can substantially alter the characteristics of path loss and shadowing components, causing increased handoff delay.

In [10], a handoff algorithm using multi-level thresholds is proposed. The performance results obtained, shows that an 8-level threshold algorithm operates better than a single threshold algorithm in terms of forced termination and call blocking probabilities.

III. A PROPOSED APPROACH

An OBS is surrounded by six NBSs. An MT can go any of the two adjacent NBSs. As shown in Fig 2 though the RSS of NBS2 is greater than that of NBS1 but the MT goes to NBS1 finally. The proposed approach is composed of two subsequent steps:

(a) Whether the MT is in the region where handoff can be initiated.

(b) Determine the direction of the velocity of the MT.

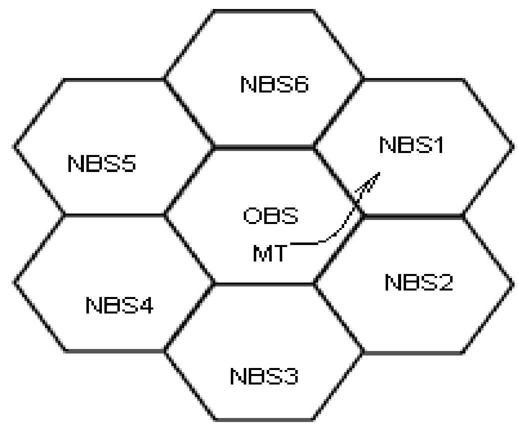

Fig 3

The paper is organized as follows. Section-2 describes our proposed algorithm and its implementation. In Section-3 the performance of the proposed mechanism is analyzed and the simulation results are shown. In Section-4.We conclude the paper.

III. B PROPOSED WORK

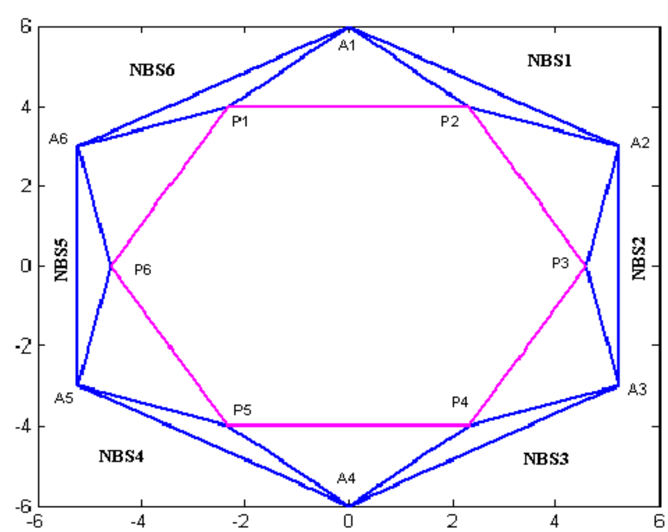

Fig 4

We define (i) $P_1P_2P_3P_4P_5P_6P_1$ as core area where no hand off occurs ; (ii) $\Delta A_iP_{i+1}A_{i+1}$ (i =1 to 5) and $\Delta A_1P_1A_6$ (which will be called Δ_1 region) and (iii) $\Delta P_iA_iP_{i+1}$ (i =1 to 5) and $\Delta P_6A_6P_1$ (which will be called Δ_2 region). If a MT is in one of the Δ_2 regions then there is a possibility of handoff of that MT. In those regions handoff may be occurred between OBS and any one of the adjacent NBS. In the above fig. handoff may be occurred between OBS and NBS1 or between OBS and NBS2.

So we have to decide one of the two NBSs for handoff initiation. To decide this we will not depend on RSS rather we depend on the direction of velocity of the MT.

The decision making procedure will be as follows (we now consider $\Delta P_2A_2P_3$ region):

(i) First it is to be determined whether the MT is in the region $\Delta P_2A_2P_3$ or not. The coordinates of P_2 and P_3 are [(√3a/2-d)/2, (√3a/2-d)√3/2] and [(√3a/2-d),0] respectively. So the equation of the straight line P_2P_3 is:

$$a1\,x + b1\,y + c1 = 0.$$
$$[\ a1=\sqrt{3}\ ;\ b1=1\ ;\ c1 = \sqrt{3}(d - \sqrt{3}a/2\ )]$$

By GPS system, we get the location of MT. So we can determine whether the MT is out of that region or in that region.

(ii) As we find the location of MT (and we assume that it is in that region), we now decide the direction of the velocity of that MT.

Let, at some instant the location of the MT is (xi , yi) then the angle (with A_2P_3) is

$$mi = \arctan\,[(A2B1-A1B2)/(A1A2+B1B2)] \text{ -----(1).}$$

where , A1=(a/2-yi)
B1=(xi-√3a/2)
A2=yi
B2=(√3a/2-d-xi)

So the angle mi can be determined.

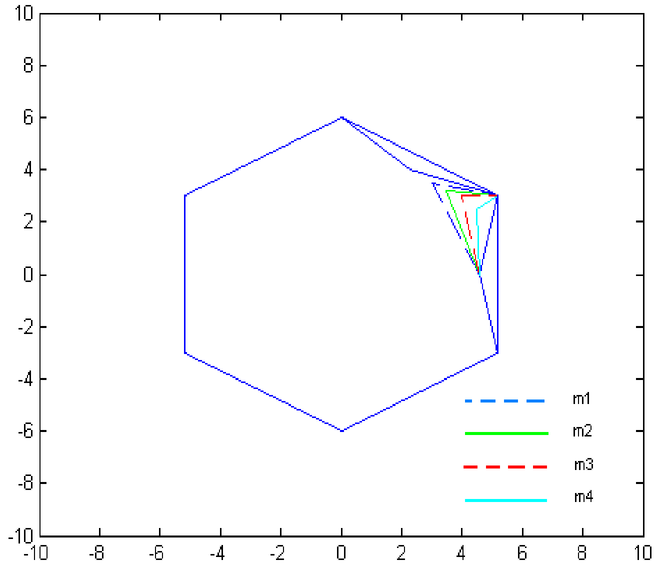

Fig 5

So for i = 1, 2, 3…… we get corresponding angles. If m3>m2>m1.. we can conclude that the MT is going towards NBS2. If m1>m2>m3>…we can conclude that the MN is going towards NBS1. Thus though at first the Relative Signal Strength (RSS) of NBS1 is greater than NBS2 it will wait and take the proper decision for hand off initiation. Thus we can reduce the probability of false handoff initiation of MT.

IV SIMULATION

We assume for macro cellular system a=1 km and cell reference distance, d=100 meter.

Let us consider a MT is going towards NBS2 as shown in Fig6. The location of the MT at t1, t2, t3 and t4 are (3,3.5) , (3.5,3.2), (4,3) and (4.5,2.5) respectively. From equation (1) we get angles (in degree) 53.3037, 65.0633, 79.5926 and 121.1407 respectively. As [53.3037< 65.0633< 79.5926< 121.1407 (fig7)] we conclude the direction of velocity of MT is towards NBS2. Though at the beginning RSS of NBS1 is greater than that of NBS2 the MT will do the pre-registration with NBS2.

Fig 7 shows the adjacency towards NBS2 with different time interval.

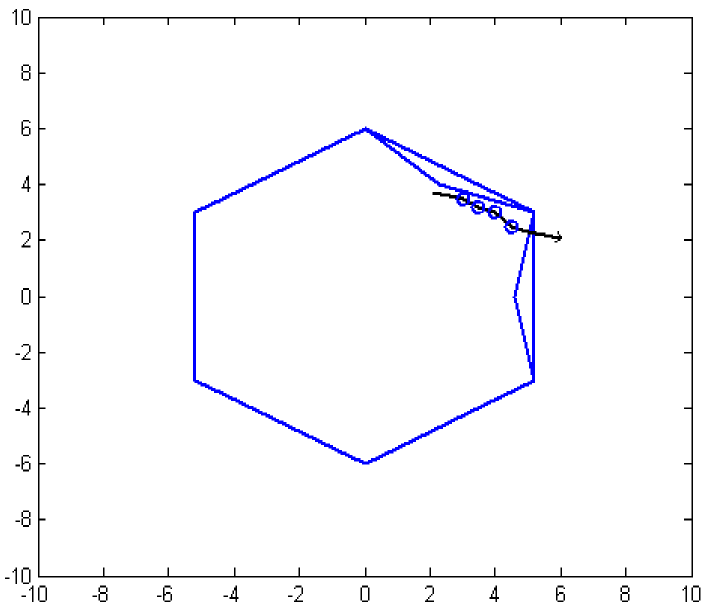

Fig 6

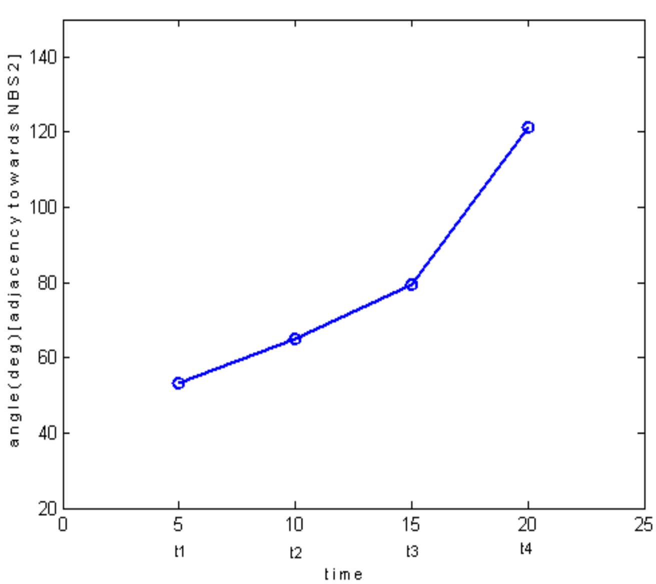

Fig 7

Let us consider a MT is going towards NBS1 as shown in Fig8. The location of the MT at t1, t2, t3 and t4 are (4.5,1), (4.5,2), (4.3,2.5) and (4.2,3) respectively. From equation (1) we get 149.300, 138.3594, 110.7532, 83.6886 respectively. As [149.300 > 138.3594 > 110.7532 > 83.6886 (fig 9)] we conclude the direction of velocity of MT is towards NBS1. Though at the beginning RSS of NBS2 is greater than NBS1 the MT will do the pre-registration with NBS1.

Fig 9 shows the adjacency towards NBS1 with different time interval.

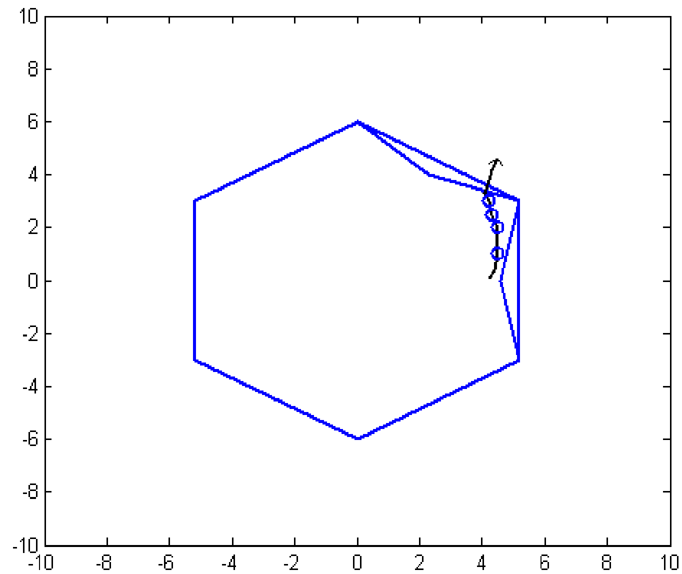

Fig 8

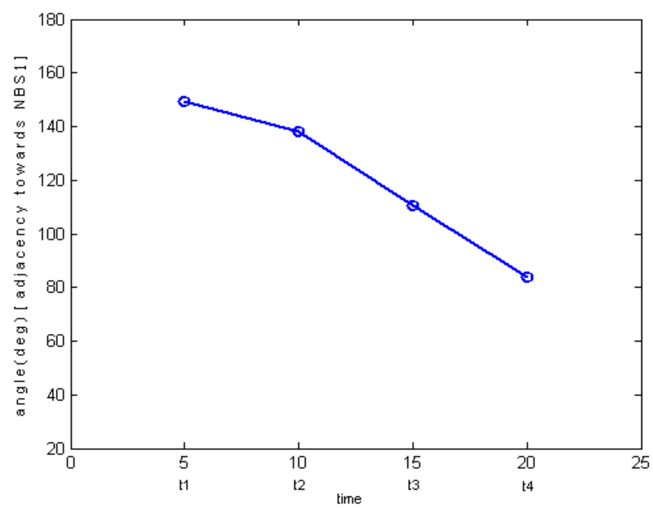

Fig 9

V. Conclusion

In this paper, first we described different handoff method in next generation wireless system. Then we proposed a mobility management algorithm to determine the direction of velocity of MT. The simulation results show that the proposed method is efficient if at different time interval the angles (which may be called adjacency of an MT towards a certain BS) are stored in memory and compared for a specific time interval. This helps to detect the trajectory of the MT through which it moves to the new BS. Hence we can take the right decision, with which BS handoff registration is needed depending on it. This process considerably reduces the false handoff initiation probability effectively.

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He is an author/co-author of the several published/accepted articles in WDM optical networking field that include "Adaptive Dynamic Wavelength Routing for WDM Optical Networks" [WOCN,2006], "A Heuristic Solution to SADM minimization for Static Traffic Grooming in WDM unidirectional Ring Networks" [Photonic Network Communication, 2006],"Genetic Evolutionary Approach for Static Traffic Grooming to SONET over WDM Optical Networks" [Computer Communication, Elsevier, 2007], and "Genetic Evolutionary Algorithm for Optimal Allocation of Wavelength Converters in WDM Optical Networks" [Photonic Network Communications,2008].