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Selection of Hysteresis Margin for Optimum Handover Triggering in Next Generation Cellular Systems

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Abstract—*Handover, a process of transferring connection of a mobile unit from an access point to another access point, is a challenging aspect in next generation cellular systems. The major difficulties experienced during handover between various technologies include high handover delay, large number of handovers and poor quality of service experienced by mobile users. This paper attempts to find an appropriate handover point in order to deal with handover related problems and to provide a promising quality to mobile users. The handover decision is taken on the basis of received signal strength and hysteresis margin. The variation of the received signal strength of current access point and the target access point with distance is followed to choose a suitable point for triggering handover. It is observed from the results obtained through Matlab simulation that the handover trigger point gets affected by variation in the hysteresis margin. In addition, the velocity of mobile users also has great impact on handover parameters such as handover trigger point, hysteresis delay and total handover delay.*

INDEX TERM*: Handover, Received signal strength, hysteresis margin, hysteresis delay, handover trigger point*

1. INTRODUCTION

A wireless local area network (WLAN) is a protocol that uses high frequency radio waves to connect with two or more devices at the same time to share some data. An access point is involved in a WLAN in order to connect it to internet. While using the WLAN users can move

in the coverage area to get the benefits of it. 2.4 GHz and 5 GHz are the commonly used frequency in the wireless local area network. In Wi-Fi unlicensed spectrum is used mainly referred as ISM bands. It enables users to use the radio spectrum without any restriction.

Handoff management is a process of maintaining a connection when the mobile unit moves across the two access point. It involves three stages in first stage the mobile unit gets out of reach from one access point and enters in the second access point then in the second stage it connect with the second access point but during that time there will be a handover delay which is affected by various factors like velocity of the mobile unit etc. and in the final stage the connection is set up with the second access point [1].

Handover delay occurs because of the time taken by Received signal strength algorithm.MAC layer and higher layers are mainly focused when handover delay is analyzed .Hysteresis margin is used to provide a buffer for the initiation of the handover process. It is the difference between the signal strength from the target access point and the current access. Whenever the difference between the target and current access point becomes more than hysteresis margin, handover is triggered. For different values of hysteresis margin different handoff performance will be obtained. An optimum value of hysteresis margin is to be selected in order to have minimum delay [2].

Hysteresis delay is the time difference between the moment at which handover is triggered at a particular value of hysteresis margin and the triggering point when hysteresis margin is 0 [7]. For a particular hysteresis margin the hysteresis delay is different for different velocities. Handover delay is the summation of hysteresis delay and the time taken in the processing of handover procedures.

This research paper consists of five sections:

In section II, the related work regarding this research paper is explained.

In section III, the proposed work which include the system model and the analytical methods is discussed.

In section IV, the simulations results are shown. In section V, the conclusion of the research paper is explained.

2. RELATED WORK

Few authors have elaborated the impact of hysteresis margin used in handoff that if the value of hysteresis margin is too high then the handoff delay may result in terminated connection or low QoS (quality of service) and if the value is too low, unnecessary number of handoff may occur. Handoff algorithm should be designed properly so that the value of hysteresis margin provides minimum delay. The commonly used approach to avoid the handling of the connection back and forth in between two access point is the hysteresis margin. Whenever the signal strength between two access points in the coverage area differ by the specified hysteresis margin (h) the triggering of handover process occurs. [3]. The handover delay can be minimized by numerous methods which has been proposed in the literature. . This is done in [4] by Predictive Address Registration to reduce the handover delay. [5] Describes a soft and over solution where packets are duplicated, while [6] describes a hard-handover where packets are buffered to avoid packet loss during handover. In [5] and [6], the use of back-to-back user agent (B2BUA) is recognized as an effective way to provide better and faster handoff, and both solutions require deployment of entities in each domain or subnet that interact to support the handover.

3. PROPOSED RESEARCH WORK

A) SYSTEM MODEL

In this research paper, the relation between received signal strength and the distance between the two access points is determined. This relation is examined by the log based path loss model. There will be a point between those access points at which the handover should be triggered but due to various factors like velocity, shadow fading and overlapping coverage area, the handover is triggered after the optimal point. To reduce the large delay time, hysteresis margin should be chosen appropriately. So to find that value of the hysteresis margin we study the graph between the hysteresis margin and the handover trigger point. And also to see the effect of velocity on the hysteresis delay the relation between then is simulated in the matlab and the graph is obtained and the conclusion is determined.

B) ANALYTICAL METHODS

In this section the equations that are used are explained in details.

Variation of received signal strength with the distance is measured by using log based path loss model. The log-distance path loss model is a radio propagation model that predicts the path loss a signal encounters inside a building or densely populated areas over distance [1]. The mathematical formula of path loss for log distance path loss model is

$$PL = PL_o + 10\,\gamma\,\log_{10}(d/d_o) + X_g$$

Where PL_o is the path loss at the reference distance d_0. Unit: Decibel (dB), d is the length of the path, d_o is the reference distance, usually 1 m. γ is the path loss exponent. X_g is a normal (or Gaussian) random variable with zero mean, reflecting the attenuation (in decibel) caused by flat fading.

$$X_g = r_o X(g\text{-}1) + S_0[1-r_o]^{1/2}$$

X_g is a normal (or Gaussian) random variable with zero mean, reflecting the attenuation (in decibel) caused by flat fading. Auto correlation coefficient of shadow fading is represented by the parameter r_o. X(g-1) is the previous value of normal random variable. X_0 is equal to standard deviation S_0.

Hysteresis margin is commonly used so that there will be no ping pong effect. Due to ping pong effect there will be connections back and

forward with the both the routers when the mobile unit at the end point of the coverage area of the router. Hysteresis margin is denoted by

(h) and given by: $h = \mu 1(d) - \mu 0(d)$

where μ1(d) is the received signal strength of the targeted access point and the μ0(d) is the received signal strength of the current access point.

Handover trigger point is the point where actual handover takes place. It is calculated using the formula:

d = D*{(10^(h/K2))/ (1 +10^(h/K2))}

where D is the distance between the two access point , h is the hysteresis margin and K2 is the path loss parameter which depends on path loss exponent.

Hysteresis delay is the delay caused due the triggering of handover procedure after the hysteresis margin [3].

The formula used for finding hysteresis delay is given by:

Hd=[D/(2*v)]*[[[10^(h(j)/K2)]-1]/[1+10^(h(j)/K2)]]

Where D is the distance between the two access points, v is the velocity of the mobile unit, h is hysteresis margin ,K2 is path loss parameter.

4. SIMULATION RESULTS

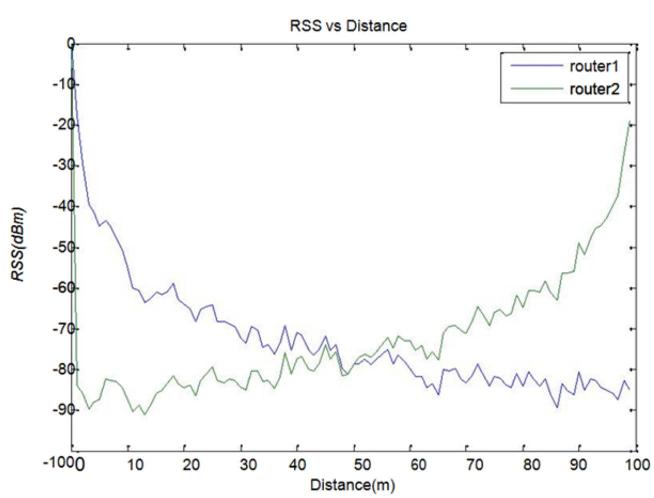

FIG 1

As the mobile set moves from first access point to second access point the signal strength from first access point decreases exponentially and the signal strength from second access point increases increases exponentially.

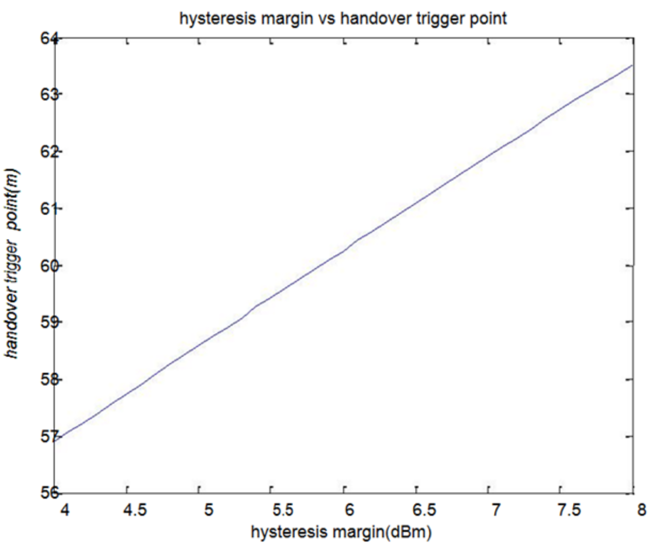

Fig. 2

Handover trigger point vs hysteresis margin graph follows almost a linear curve if taken

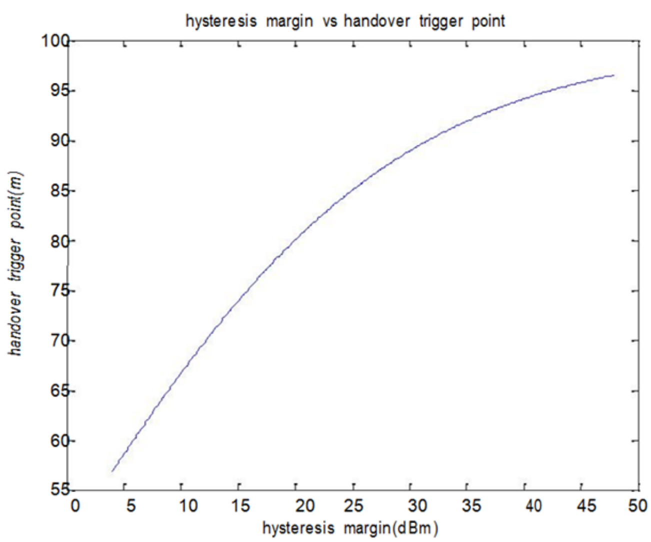

FIG 3

within the range 4 dBm to 8 dBm. If the values are taken on the larger dynamic range then the curve starts to bend. Therefore the hysteresis value is mostly selected within the 4 to 8 dBm range. Higher values of hysteresis margin shift the handover trigger point away from the optimal handover point.

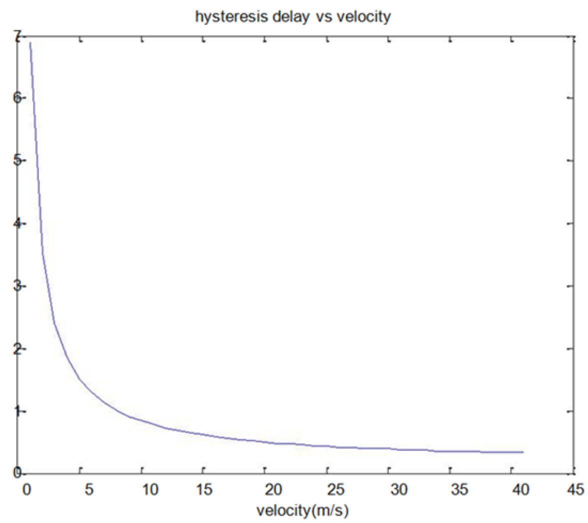

FIG 4

Initially with the slight increase in velocity the hysteresis delay decreases drastically, with further increase in velocity the slope of reduction of hysteresis delay less. After 20m/s the slope tends to a constant value and hysteresis delay is not much affected by the increase in velocity.

5. CONCLUSION

In this research paper we conclude that as the mobile station moves towards the another router then at the end of the coverage area of the router the handover took place and the graph of hysteresis margin vs. handover trigger point concluded that if the value of hysteresis margin is kept low then handover trigger point varies linearly with the hysteresis margin but as we keep increasing the value of hysteresis margin it vary exponentially. The velocity also plays a very crucial role in the handover delay as we keep on increasing the velocity of the mobile unit with that the value of handover delay decreases which means that the handover is triggered very fast so the velocity is inversely proportional to handover delay

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