International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 3, March - 2014

Minimization of Handover Latency by Horizontal Distance Measurement using GPS

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***Abstract* - Mobile communication towers are used in many personal and industrial purposes it provides a continuous connectivity to Mobile Nodes (MNs) and permit them to change their connection point from old Access Point (AP) to new AP while needed. Handover has become an essential part in mobile communication system, especially in urban areas, because of the limited coverage area of AP. Handover of calls between two Base stations (BS) is encountered frequently and it is required to minimize the delay of the process. There are number of solutions attempts to improve this process and many methods have been proposed but only a few use geo-location systems in the management of the handover. Here we propose to minimize the handover latency by minimizing the number of APs scanned by the MN during each handover procedure.**

Keywords - Access Point, Base station, GPS, Mobile Node.

I. INTRODUCTION

In recent years, Wireless Local Area Network (WLAN) with wide bandwidth and low cost has been changed as a competitive technology to settle in the user with strong desire for mobile computing. The major problem on mobile computing is handoff management between APs [1]. For real-time multimedia service like VoIP, the problem of handoff delay has to be resolved. To solve this problem, many techniques are proposed by developing new algorithms. Their approaches are broken into three different categories including network layer (L3), data link layer (L2), and physical layer (PHY).

A. Handoff

When a MS moves away from its current AP, it must be reconnected to a new one to continue its operation. The search for a new AP or base station and following registration without any loss known as handover and the time required to complete a handover process is known as handoff latency. Handover can be occurred as shown in Figure 1.

1. *Horizontal* handover*:* handover between two BSs of the same system network. Example is Wifi to Wifi.

2. Vertical handover*:* handover between two different networks. Example is Wifi to Cellular network and viceversa.

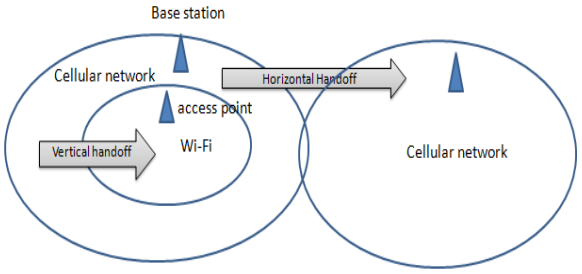

Figure 1: Horizontal and Vertical handoff

The handoff procedure consists of three logical phases where all communication between the mobile station undergoing handoff and the APs concerned is controlled by the use of IEEE802.11 management frames as shown below in figure2.[2]

Scanning: When a mobile station is moving away from its current AP, it initiates the handoff process when the received signal strength and the signal-to-noise-ratio have decreased significantly. The STA now begins scanning to find new APs. It can either use passive scan (where it listens for beacon frames periodically sent out by APs) or chose a faster active scanning mechanism wherein it regularly sends out probe request frames and waits for responses for T_{MIN} (min Channel Time) and T_{MAX} (max Channel Time) . Thus, $n*T_{MIN} \leq$ time to scan n channels $\leq n*T_{MAX}$. The information gathered is then processed so that the STA can decide which AP to join next. The total time required until this point constitutes 90% of the handoff delay[6].

Authentication: Authentication is necessary to associate the link with the new AP. Authentication must either immediately proceed to association or must immediately follow a channel scan cycle. IEEE 802.11 defines two subtypes of authentication service: 'Open System' which is a null authentication algorithm and 'Shared Key' which is a four-way authentication mechanism. If Inter Access Point Protocol (IAPP) is used, only null authentication frames need to be exchanged in the re-authentication phase. Exchanging null authentication frames takes about 1-2 ms[2].

Re-Association: Re-association is a process for transferring associations from old AP to new one. Once the STA has

been authenticated with the new AP, re-association can be started.

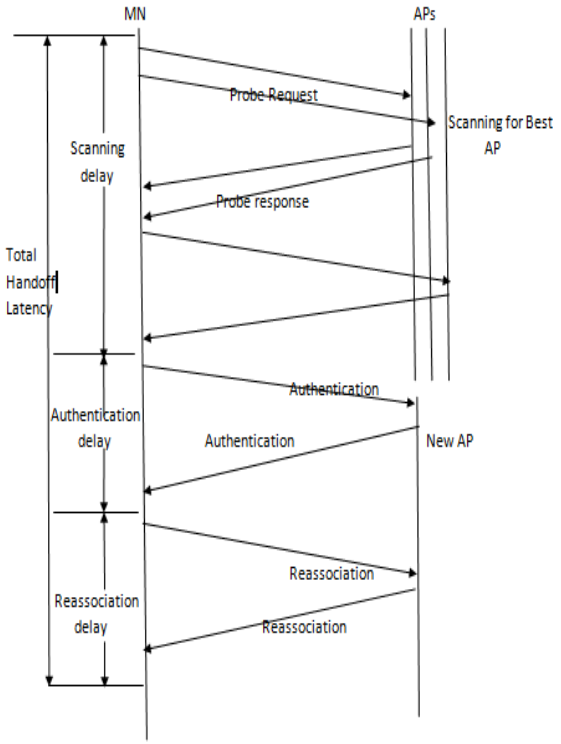

Figure 2: Total handoff Process

B. *WiMAX handover*

In the *WiMAX* network, for handover process, the Serving BS broadcasts information message, typically using MOB NBR-ADV which contains information of neighbor BSs. The MS scans the neighbor BSs periodically and selects the target BS candidates, on the basis of quality of signals or other parameters and sends a handover request message to the serving BS. The Serving BS then exchanges the handover messages with the target BSs candidates and finally selects a target BS. It sends the handover response message to the MS. The MS, on the reception of message, breaks the connection with the serving BS and makes the connection with target BS and performs network re-entry process. The Target BS gets the security information of the MS from the serving BS. MS can receive or send traffic after network re-entry process. The network re-entry process consists of synchronization with new downlink, ranging and synchronization with uplink, reauthorization and re registration procedures. After breaking the connection with Serving BS, the MS synchronizes with new downlink of Target BS to obtain DL and UL transmission parameters.

C. *GPS system*

The Global Positioning System (GPS) is a satellite based system that is used to establish positions anywhere on earth. GPS is a collection of satellites that are continuously orbiting the earth. These satellites, which are combined with atomic clocks, transmit radio signals that include their exact location, time, and other information. The signals of radio from the satellites, which are observed, monitored and corrected by control stations, and are picked by the GPS receiver. A GPS receiver needs only three satellites to plot a rough, 2D position. Four or more satellites are needed to plot a 3D position, which is more accurate.

II. LITERATURE SURVEY

Mobile stations move from one cell to another cell in wireless network. In each cell on AP (base station) handle the communication of the mobile station. When it changes its cell some times are required to transfer information of mobile station to the new cell AP. This information is transferred with the help of number of packets. So, a delay is introduced during the mobile communication. Sometimes connection may be break due to unavailability of the proper information of a station to the cell's AP. Basically this delay is known as handoff delay. There are three types of handoff delay. Different types of scheme are proposed to reduce these three types of delay. In [6] authors proposed a pre-scanning scheme using Neighbor graph cache memory. If MN has T time before handover, and scanning time is Ts. Then total no of times cache is updated with neighbor graph is n=T/Ts. Scanning delay in this mechanism depends upon n. If the probability of n being an integer is greater, that is minimum delay. In [2] When a mobile node or station setup call it scans channel only once and calculate scanning time as Ts. As soon as MN tries to associate new potential AP, it calculates the distances of mobile node from old AP as S by using GPS and velocity V of the MN. Then it calculates the time before handover that is T = S/V and also calculates a factor N = T/Ts. So, when N is equal to or less than 1, the MN starts scanning and gets all the potential APs before the actual handover is triggered. With this scheme, probe delay is reduced in the handover procedure. In [3], Handoff Minimization using cell sectoring method, in which a cell is divided in three sectors and thus reduces the number of APs to be scanned by fixing the neighbour APs with respect to each sector. Thus, here two APs are fixed for each sector. MS will choose the nearest one out of two APs. In [4] distance measurement method they propose a new scanning method where it determine distance of nearest AP from MN to bypass the main process.

III. IMPLEMENTATION DETAILS

A. *Cell Sectoring with quadrant*

The entire hexagonal cell is divided into 4 sectors (Quadrants) with each sector having an angle of 90^{o} as shown in the Figure 3. Now by using GPS find out the position of the MS i.e. in which quadrant it is presently operating.

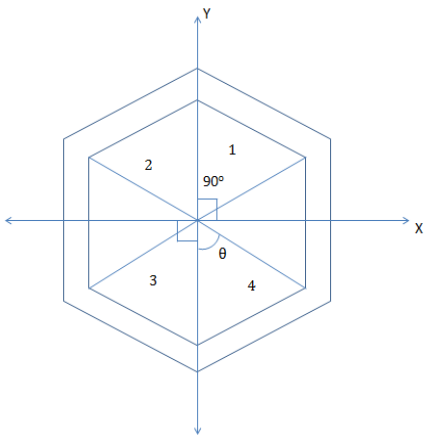

Figure 3: Cell sectoring with quadrant

B. Minimization of number of APs to be scanned

Here we are going to use GPS technology. The instantaneous velocity (v) of the MN is determined by GPS technology. After the call has started, measure the distance travelled (Δx) by the MN in every interval of 5 ms with the help of GPS. The MN's instantaneous velocity is v = Δx / 5. We assume that the approximate maximum handoff delay in the scanning, authentication and re-association phase of a single AP be t_{delay} ms as per the latest proposed algorithm. The potential AP searches can be made up to a certain distance after which the MN performs the handover process. The distance'd' which is required in order to carry out the remaining portion of the handover procedure is given by the equation: $d = v \times t_{delay}$

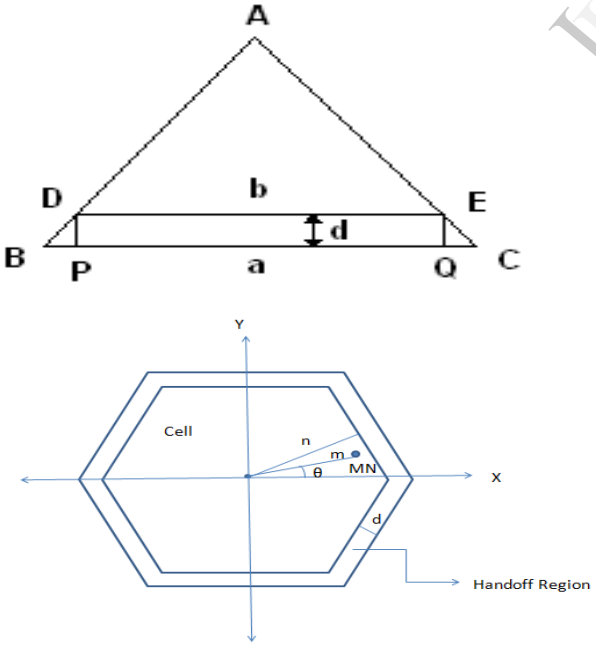

Figure 4: Distance 'd' , 'a' and moving distance 'm' of MN.

The AP has 4 quadrants with X and Y axis as shown in Figure 4. The initial coordinate of the MN be (x, y). The angular displacement of mobile node can be calculated as following,

(1) If x > 0 and y > 0 then Θ = arctan(y/x)
(2) If x < 0 and y > 0 then Θ = 180○ – arctan (|(y/x)|)
(3) If x < 0 and y < 0 then Θ = 180○ + arctan (|(y/x)|)
(4) If x > 0 and y < 0 then Θ = 360○ – arctan (|(y/x)|)

It is from the value of Θ, the sector in which the MN is situated at that instant, can be determined.

C. Selective Channel Scanning

Selective channel scanning method reduces the total handoff delay by a huge percentage when compared with selective scanning or basic active scanning. IEEE 802.11 uses 11 out of 14 possible channels, out of these 1, 6 and 11 these 3 channels are mutually non-overlapping. When the MN responds to handoff, it first looks for the potential AP, when the threshold distance from its current AP has been exceeded then it first scans the channels 1, 6 and 11. So scanning delay for selective scanning is calculated as t = N'× r + α where 't' is the scanning delay, N' is the number of channels scanned, 'r' is the round trip time and 'α' is the message processing time. 'r' is the summation of the time taken for the Probe Request is to be sent to the selected AP's and for the Probe Response to be received.

D. Proposed Algorithm:

1. After call setup of mobile node, GPS find co-ordinates of MN
2. Decide the quadrant according to position of MN
3. Calculate moving distance of MS (m) from centre of old AP
 3.1 Calculate n = a - d for each and every movement of MS(n - point at which handoff is to be initiate, a- hexagonal side, d- handoff region.)
 3.2 If m ≤ n MS starts scanning selectively and jump to step 4
 3.3 Else jump to 3.1
4. Authenticate with new AP
5. Re-associate with new AP

/*Handoff complete*/

E. Platform:

Network simulator-3 used for checking delays occurred in handoff procedure. The ns-3 uses the C++ and python for front end. The environment required for WLAN, WIMAX are given by ns-3. It also supports the GPS for location finding purpose.

IV. CONCLUSION AND FUTURE SCOPE

Our proposed method aims at reducing handover time by reducing the number of APs to be scanned which is accomplished by cell dividing in 4 quadrant and horizontal distance measurement with help of GPS. The angle θ made with X axis gives direction of potential AP where MS has to move in new AP. In this method, moving distance of MS using GPS is calculated to check whether it is present in

handover region or not to initiate handoff .This new proposed algorithm reduces the number of APs to be scanned which reduces the handoff delay.

There is always scope with new refined algorithm to reduce handoff delay. The ping pong effect of MS may reduce effectively using new technique.

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