CHAPTER

3

INTERFERENCE RATIO AND RECEIVE SIGNAL STRENGTH

3.1. Concept of Carrier to Interference Ratio

We propose a selective scanning mechanism using Neighbor Graph (NG) to solve the problem of handoff latency. Career to Interference (CI) ratio forms an essential part in channel selection process during handoff, though traffic plays a more dominant role. IEEE 802.11b uses 11 channels out of 14 possible channels, of which only channels 1,6,11 do not mutually overlap. So these channels will have a very low interference with other frequency. It may have a noticeable interference only if the same channel is used by any other APs within its frequency re-use range. Thus it is quite evident that these channels will have a high probability of having a greater CI ratio as compared to the other channels within the same AP. So based on this fact, when the MS responds to handoff, according to the pre-scanning mechanism of Neighbor Graph (NG), it first looks for the potential AP and then first scans the channels 1, 6 and 11, if present. If this fails, it will start scanning the other channels. In addition, we propose to reduce the authentication delay by pre-authentication method, where the authentication process is performed during the scan phase. More over we consider a hexagonal packed cluster formed by coverage area of 7 APs to find out the most potential AP, towards which the MS heads when it tries to handover its call with the aid of GPS server. Reduction of scanning of the channels of the APs reduces the handover delay to a greater extend. We have formulated three mathematical methods based co-ordinate geometry in two dimensions by virtue of which we can find out the most potential AP towards whose coverage area the MS may enter after handover. The methods are explained in detail in the section to follow.

The maximum range up to which the signal can be transmitted is determined by the height of the antenna and the power of the signal is inversely proportional to the square of the distance from the AP. But due to fading, the signal strength is never equally spread in all direction even for an Omni-directional antenna. There are mainly two types of fading responsible for the uneven distribution of the signal strength from the AP. They are namely fast fading (fading due to scattering of the signal by object near transmitter) and slow fading (fading due to long term spatial and temporal variations). Ideally without fading, the cell‘s coverage area would be circular, but due to fading it becomes an undefined contour. Here we define the coverage area of each AP to be concentrated within a hexagon of certain edge length, which is the best approximation so far considering uneven distribution of signal. Second generation wireless systems and most of the research works follow Frequency Division Multiple Access (FDMA) or Time Division Multiple Access (TDMA) for multiple access of a single channel frequency band. In TDMA, one channel is used by several users, with AP assigning time slots for different users, and each user is served in a round-robin method. In FDMA, the allocated frequency band for one channel is subdivided into many sub-bands

and each sub-band is allocated by the AP to each user. Thus, in FDMA, it may be seen that a particular sub-band is allocated to an user which falls between the interference zones of channels within the same AP. Thus, protocols using FDMA techniques have a certain probability that during handoff, even when the channel is free, the user is allocated such a sub-band within the above mentioned region. Thus, it will encounter a very low CI ratio and the MN ceases to operate on that channel and scans for the next channel. During scanning of the non over-lapping channels, this problem will not be faced. So our method works even better in cases where FDMA is used for multiple access of a single channel.

With these assumptions, we propose (i) a selective channel scan, as in [21], and (ii) pre-authentication scheme with the help of neighbor graph for reducing the total handoff delay. In paper 'D', we discuss about reduce of handoff delay using the concept of Carrier to Interference Ratio.

3.2. Concept of Signal to Interference Ratio

We attempt to develop a handoff algorithm that reduces false handoff initiation which creates unnecessary traffic load, by considering different value of signal to interference ratio (SIR) threshold of different sized cells and different velocity of MT.

In this section we assume that two base stations, the primary BS and the secondary BS antennas are transmitting a signal and both of the signals are received by a MT currently under BS1.

SIR_{th} is the threshold value of Signal to Interference Ratio (SIR) to initiate Hierarchical Mobile IP (HMIP) handover process. Therefore, when the SIR of the BS1 drops below SIR_{th}, the HMIP registration is initiated for MT's handover to the new BS (BS2). We are considering the scenario where the mobile terminal (MT) is moving with a velocity v away from BS1 towards BS2.

During its motion the MT anticipates a handoff with a neighboring BS when it finds the SIR decreasing in a constant manner. Then it needs to perform HMIP registration with the corresponding BS or the FA (Foreign agent) serving the BS. The existing HMIP protocols propose to initiate the handoff process when the SIR from the serving BS drops below SIR_{th}.

It is not efficient at all to use same value of SIR_{th} for inter and intra system handoff because the latencies of inter and intra system handoff is different. In intersystem handoff the MT takes much greater time than intra-system handoff.

It is also inefficient to use same SIR_{th} value if the cell size differs from one another because handoff initiation takes place a lot earlier than needed in smaller cell. In this case false handoff initiation probability may be increased causing greater traffic load.

In our approach we want to use five parameters: speed of the MT, SIR, latency of handoff, size of the cell the MT is served at present and size of the cell with which the MT is attempting to initiate handoff. We define threshold of SIR, based on latency, speed, size of the cells, hence the threshold will be dynamic depending on the situations.

We assume that at the position the SIR drops below SIR_{th} value and the MT will start HMIP registration with the BS of the neighboring cell.

Here we consider cells to be hexagonal. The signal from the secondary station BS2 causes interference with the signal from the primary base station BS1. We take SIR as the ratio of signal strength of the primary BS to that of the secondary BS. So as the MT moves towards the cell boundary it decreases and it increases if the MT moves closer to the primary BS. We want to use this ratio to define a threshold, so that when the SIR drops below this threshold value handoff is initiated.

We consider that the receiver and transmitter antennas have the same gain and the system loss factor is the same for all the BSs. In paper 'E' we reduced handoff delay using the concept of Signal to Interference Ratio.

3.3. Concept of RSS Based Handoff in Heterogeneous Networks

We want to find the different received signal strength threshold value for handoff and also a proper scheme of handoff between neighboring cells in the Cellular Network (CN), between cellular Wireless Local Area Network (WLAN) and cellular network and vice-versa , between High Performance Radio LAN

(HIPERLAN) and cellular network and vice-versa. Received signal strength is a measure of the power present in a received radio signal. It determines the connectivity between a Mobile Terminal (MT) and Base Station (BS) or Access Point(AP).The Received Signal Strength (RSS) should be strong enough between BS/ AP and MT to maintain proper signal quality at the receiver. RSS gets weaker as a MT moves away from a BS/AP and the opposite happens when the MT moves closer to the BS/AP. Whenever MT goes away from the current BS/AP, handoff becomes necessary with its neighboring BS/AP of WLAN. The RSS threshold value for handoff between different networks will be calculated in this section using formula of RSS for different networks. The threshold value of RSS depends on a few factors:

1. The velocity of the MT.
2. The latency of the handoff process.
3. The type of network the MT is presently in and the type of network with which the MT is trying to initiate handoff.
4. The size of the CN/WLAN/HIPERLAN cell the MT is presently residing.

If the same threshold value of RSS is used irrespective of the handoff scenario then that will increase the probability of false handoff initiation which increases unwanted traffic resulting in the blocking of other calls. Also it will increase the probability of handoff failure resulting in dropping of ongoing calls. So a different threshold value of RSS is used depending on the scenario of handoff. In paper 'F' we described the concept of decreasing handoff delay in Heterogeneous Networks.