CHAPTER

7

CONCLUSIONS

In paper 'A', we first discuss the different types of handoff in the next generation wireless systems. Then we analyze the performance of handoff management protocols that use a fixed value of RSS threshold (Sth) to initiate the handoff process. Through our analysis, we observe that when a fixed value of Sth is used, handoff failure probability increases when either speed or handoff signaling delay increases. Based on this analysis, we suggest a method by which handoff failure probability can be kept constant and within limit.

Thus by our proposed method in paper' B', we can reduce handoff failure as well as handoff latency quite a remarkable amount as we can reduce the traffic in the cellular network by introducing a WLAN AP. The various advantages of incorporating the WLAN AP in the CN thus can be enlisted as follows.

- This facility will relieve congestion on the GSM or UMTS spectrum by removing common types of calls and routing them to the operator via the relatively low cost Internet.
- This scheme allows carriers to add coverage using low cost 802.11 access points. Subscribers enjoy seamless coverage.
- This handoff procedure cuts out the scanning delay from the handoff latency components by scanning the channels while in the WLAN coverage. The handoff failure probability tends to zero.

In our proposed method in paper 'C', we are considering a Mother Cell with a seven cell cluster. Thus the total number of cells in a communication region should be an integral multiple of seven. But these criteria may not be fulfilled all the time. Thus it will increase the complexity. Here we can see that the Mother Cell AP cannot cover up the whole seven cell cluster which may cause an error during handoff initiation. It is worth mentioning here that although the proposed work has been presented considering honeycomb structures yet our algorithm would work in a similar manner for other cell structures and neighbor AP locations. Minor changes would be introduced depending on the network topology.

In paper 'D', our discussion is based on IEEE 802.11wireless networks have gained ever greater popularity nowadays. Handoff is a critical issue in IEEE 802.11 based wireless networks and latency in the handoff process is a major concern.

In this paper, we propose to reduce handoff latency for IEEE 802.11 wireless networks with Neighbor Graphs (NG) pre-scanning mechanisms. IEEE 802.11 uses 11 channels of which channels 1, 6 and 11 do not mutually overlap. So these channels are expected to have a lower carrier-to-interference ratio (CI) compared to the other channels present under the same base station, which increases the channel's availability during handoff. Based on the NG prescaning mechanism, when handoff criterions have been met, we design an algorithm to first scan the channels 1, 6 and 11, if present under the next Access Point

(AP), to reduce the scanning delay. We also introduce pre-authentication mechanism, which will effectively reduce the message processing delay.

In paper ‘E’, it is shown that the threshold value of SIR depends on the velocity of the MT and the latency of handoff. It is shown that how size of the present and neighboring cells determine the threshold of SIR in any handoff process. Through our analysis we see that adaptive value of SIR_{th} depending on the cell size behaves better than using a fixed value of SIR_{th} for different sizes of cell. Our proposed handoff management estimates mobile‘s speed and predicts the handoff signaling delay of possible handoffs and also the size of the present and the neighboring cell. Our protocol uses this information to calculate a dynamic value of SIR threshold (SIR_{th}) for handoff initiation. Using different values of SIR_{th} for handoff between different sizes of cell reduces the false handoff initiation probability considerably and hence unnecessary traffic load which could lead to unnecessary call blocking.

In paper ‘F’, we explore the different handoff scenarios that can take place in NGWS. We have also proposed a scheme in which the handoff decision will depend on the type of network the MT is presently in and also the type of network it is attempting handoff to ensure least amount of handoff failure probability, thus providing sufficient QoS for delay sensitive and real time services. Effective handoff schemes also ensure minimal false handoff initiation probability, which leads to congestion and hence dropping of calls.

In paper ‘G’, we explain co-ordinate evaluation method, we can reduce the handoff latency to a great deal as we can get a clear idea as to which channel to scan for a particular MN. The selection of the most potential AP by the MN effectively reduces the scanning delay, as the number of channels scanned will be lower. As our simulation has shown, in 99.25% of the cases, this algorithm chooses the correct AP. This is a vast improvement over other GPS-assisted handover schemes suggested so far. Since it uses GPS, it is also power-saving. In 22.5% of the cases, we have had to scan two APs. This results some time delay, but is essential to make the process fool-proof.

In paper ‘H’, we described IEEE 802.11 based WLAN standard, handoff at link layer (L2) consists of three distinct phases scanning, authentication and reassociation. Scanning process takes 90% of the total handoff execution time [7] which is known as handoff delay or handoff latency. So in this paper our main goal is to reduce scanning delay, as a small handoff delay results a seamless and successful handoff. And a successful handoff ensures an uninterrupted flawless connectivity when the mobile station (STA) moves out of its old base station‘s (BS) coverage area. In this paper we proposed selective scanning based on position, speed and direction of motion of the Mobile station using the neighbor graph to reduce the scanning delay.

In paper ‘I’, we have seen that model simulations givefavorable results for our new approach. Also the simplicity and flexibility of the proposed method point to diverse fieldsof implementation with the help of appropriate improvements and modifications.For example, though we have been able to reduce handoff latencies we do not consider whether the handoff was at all necessary in the first place, i.e. ping-pong effects can significantly increase the number of false handoffs taking place. Also, our approach may result in handoff failure in a very small number of cases when more than two distances from APs are involved, i.e. towards the vertices of the hexagonal cells. Such limitations can be effectively eliminated using mobility measurements of the STA involved in handoff. Indeed this would not require significant changes to the actual scheme as we are already using GPS to get positional data. We intend to take up this matter in future studies. The real challenge as of now is to interpret the coverage areas of APs geometrically and incorporate that knowledge locally to optimize handoff performances.

In paper ‘J’, our proposed method aims at reducing handoff time by reducing the number of APs to be scanned which is accomplished by cell sectoring and distance measurement with help of GPS. This in turn reduces the number of APs to be scanned which brilliantly reduces the handoff delay as is clear from the simulation presented in the above section. To further hasten the process we can look to pre-authenticate with the two best options so that we now effectively reduce the handoff time. However, our proposed method leaves some drawbacks which we can leave for the future works. For example, though we have been able to reduce handoff latencies we do not consider whether the handoff was at all necessary, i.e.

ping-pong effects can significantly increase the number of false handoffs taking place. The ping pong condition arises when a MS moves back and forth between two BSs very frequently. Handoff cannot take place in this condition due to this frequent movement of MS. To avoid such problem, one traditional way is that the MS is allowed to continue maintaining a radio link with the old AP until the signal strength from new AP exceeds that of the old AP. But in our proposed method MS is bound to perform handoff in handoff region i.e. it has to reject its radio link with the old AP and has to connect with the new AP within that old cell. Thus MS cannot continue its radio link with the old AP any more. So in our proposed mechanism no such cure is possible for ping pong effect. Also, our approach may result in handoff failure in a very small number of cases when the MS moves along the borders of the sectors i.e. GPS cannot decide in which sector the MS is. The use of GPS is not an economy friendly approach. It is worth mentioning here that although the proposed work has been presented considering honeycomb structures yet our algorithm would work in a similar manner for other cell structures and neighbor AP locations. Minor changes would be introduced depending on the network topology.

In paper 'K', it is worth mentioning here that although the proposed work has been presented considering honeycomb structures yet our algorithm would work in a similar manner for other cell structures and neighbor AP locations. Minor changes would be introduced depending on the network topology.However, our proposed method leaves some drawbacks which we can leave for the future works.For example, when a MS moves back and forth between two spot-beams very frequently, a significant the number of false handoffs takes place. Handoff cannot take place in this condition due to this frequent movement of MS. Also, our approach may result in handoff failure in a very small number of cases when the MS moves along the borders of the spot-beams or the footprints. In that case, the satellite cannot decide the nearest spot-beam or the nearest footprint of the MS. The use of GPS is not an economy friendly approach. We intend to take up these matters in future studies. The real challenge as of now is to interpret the coverage areas of spot-beams geometrically and incorporate that knowledge locally to optimize handoff performances.

Future Scope:

- Future works can be done on improving the traffic distribution between the CN and WLAN, so that handoff failure can be eliminated completely.
- The limitation stated in above discussion can be effectively eliminated by using following discussions.
- When the total number of cells in a communication region will not be the integral multiple of seven, we will consider the Mother Cell by minimum factor of the total cell numbers. E.g. if the total cell number is 25 we can consider the Mother Cell consists a five cell cluster instead of the seven cell cluster. If the total cell number is 27 we will consider the Mother Cell as three cell cluster. In that case we have to make some changes in our proposed algorithm.
- We intend to take up these matters in future studies. The real challenge as of now is to decrease the handoff failure probability by means of different channel allocation technique.
- By this co-ordinate evaluation method, we can reduce the handoff latency to a great deal as we can get a clear idea as to which channel to scan for a particular MN. The selection of the most potential AP by the MN effectively reduces the scanning delay, as the number of channels scanned will be lower.
- Future work regarding this topic may include researches aiming to minimize the error approximation to a greater extent. We have tried for accurate approximation as far as possible, but there is always scope for improvement. Besides, time required for this tracking scheme can also be minimized by more efficient algorithms.
- The mobility measurement of the STA that is involved in handoff is the most useful one. Indeed this would not require significant changes to the actual scheme as we are already using GPS to get positional data.

- The ping pong effect may be minimized by using received signal strength method along with our proposed algorithm.
- We can avoid the use of GPS by using neighbor graph or some other coordinate evaluation technique to make our proposed method more economy friendly.
- We intend to take up these matters in future studies. The real challenge as of now is to interpret the coverage areas of APs geometrically and incorporate that knowledge locally to optimize handoff performances.