CHAPTER VII

CONCLUSION AND FUTURE WORK

In this chapter, the summary of overall research work is provided. It also discusses potential directions for future research related to cross layer based handover.

1.1 SUMMARY

In upcoming wireless networks, it is vital to keep user’s overall satisfaction at a very high level by providing them high QoS at affordable cost. In the proposed research work, cross layer trigger is used for implementing efficient and flexible handover schemes. It would enable users to roam across different kinds of networks seamlessly. The existing research related to cross layer based handover algorithms has been studied. Despite of their significant contribution in the field of wireless networks, some research gaps have been observed. To ensure reliable communication with best service connectivity, it becomes essential to overcome these limitations. The information about the location and velocity of the mobile user is used to compute the time required to reach the boundary of the current cell. The proposed handover initiation algorithm is based on signal strength, hysteresis margin and time to reach the boundary of the cell. The inclusion of these factors makes the handover possible near the boundary of the cell. The hysteresis margin and threshold value of time to reach boundary are estimated for different values of velocity corresponding to minimum handover rate and appropriate position of first handover. The performance of this algorithm is evaluated in terms of handover rate and probability of call interruption. The handover rate and probability of call interruption, are reduced by 30% and 80% respectively, relative to conventional signal strength based handover algorithm. Thus, it may be concluded from the results obtained through computer simulation that the proposed scheme is able to achieve minimum service interruption with reduced signaling overhead.

Three methods for handover trigger generation are introduced to initiate handover procedure at the appropriate time so that it may be accomplished before the link down. These
methods, referred to as Biased handover trigger generation, Neutral handover trigger generation and Prediction based handover trigger generation, are described in detail. Two metrics, termed as handover failure probability and false handover initiation probability, are considered to evaluate performance of these methods. The late handover may result into interrupted calls due to insufficient signal strength from the serving network while an early handover may lead to under utilization of network resources. The biased trigger generation method allows one of the metric to attain the desired value at the cost of another. With the help of cross layer information (velocity and handover signaling delay required to accomplish the handover procedure), the appropriate threshold for signal strength is calculated for the desired value of the performance metric. The handover trigger is generated when received signal strength drops to a level below certain threshold value.

The neutral handover trigger generation method maintains balance between the two metrics by selecting the handover execution point where both the metrics have equal value. In this case, a tradeoff is achieved between the two metrics thus handover can neither be generated too early nor too late. The handover initiation trigger is generated prior to the execution point for successful completion of the handover procedure before link down event. The trigger time is also made adaptive with respect to the velocity of the mobile user.

The prediction method provides the approximated value of future signal strength that would be received by the MN. It is determined with the help of past samples of signal strength received by MN. The prediction technique determines LU time and LD time associated with the target and serving networks respectively. It enables MN to take advance decision regarding handover trigger generation time and ultimately reduces the probability of wrong decision and unnecessary handovers to significant extent. The simulation results proved that the performance has been enhanced for varying velocity and overlapping region by 55%, 70% and 25% in terms of probability of unnecessary handovers, handover failure probability, and probability of false handover initiation respectively as compared to traditional methods.

A dynamic handover mechanism for handover requirement estimation and target network selection with the help of cross layer information is proposed. The handover requirement factor is determined with the help of fuzzy controller in which signal to interference ratio, QoS and time to reach boundary act as inputs. The fuzzy rules are designed to have output corresponding to all possible combinations of input parameters. When handover requirement factor attains a
crisp value greater than the predefined threshold, the most suitable target network is selected using TOPSIS method. The weight is assigned to cross layer parameters of the networks assumed to be responsible for the target selection using FAHP to design a robust algorithm. In contrary to the existing fixed weight methods, the variable weight assignment technique is proposed, taking end user information into account. To maintain QoS in diverse conditions, the weight to power consumption, movement direction and traffic load is made dependent upon remaining battery level, velocity of mobile user and time of call respectively. The weight assigned to delay, data rate, bandwidth and jitter varies according to the type of application such as streaming, conversational, background and interactive. The computer simulation results demonstrate that the target network is selected in accordance with the situation context of user and type of application. Consequently, the performance is improved in terms of data rate, security and delay by 43%, 17% and 35% respectively relative to single criteria algorithms.

In the last phase, the cross layer triggers are employed to reduce the handover delay in mobile WiMAX networks and overlapping of L2 and L3 functions is allowed. These triggers enable link layer and network layer executing their process simultaneously. The handover latency and handover delay are analyzed quantitatively for both non-cross layer and proposed cross layer approach. The L3 delay is reduced by 37% and latency by 54% approximately as compared to non-cross layer applications which reduces signaling overhead and service disruption significantly.

7.2 FUTURE RESEARCH DIRECTIONS

In this section, the scope for further improvement in different aspects of the proposed scheme is discussed. Some of the major issues that can be of interest for further research related to the cross layer based handover are as follows:

- The cross layer approach followed in this research makes use of MIH functionality. The interfacing among different layers needs more exploration for implementing more efficient trigger methods.
The selection of the target network is one aspect of the handover decision to provide ubiquitous access to mobile users. The proposed scheme for network selection can be combined with efficient channel assignment strategies to provide continued service.

The history of user profile can be a useful measure of expected service requirements. The past samples about user information can be utilized to take a handover decision in advance.

In this research, fuzzy logic has been employed to devise a robust algorithm. Furthermore, more artificial intelligent techniques such as neural networks can be integrated with it to achieve better performance.

The complexity of the proposed handover schemes need to be analyzed to determine feasibility of the algorithm in real time scenario.

The proposed algorithm investigates the handover execution for mobile WiMAX. The research can be extended to 4G and beyond 4G technologies.

The proposed schemes are tested using MATLAB that can provide results based on analytical methods. Better visualization may be achieved using network simulators and test–based measurements utilizing real wireless network conditions.

The cross layer concept needs to be investigated further for advanced mobility protocols of MIPv6 to reduce handover latency and packet loss.