CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 INTRODUCTION

The growing number of wireless systems and wireless devices present many challenges for industry and academia in the planning and analysis of wireless networks.

Over the past few years, the problem of congestion control has received wide-spread attention in the Internet context, where most of this research has focused on modeling, analysis, algorithm development of end-to-end control schemes (such as TCP). Hence directly using the wired network solutions (TCP based) in MANETs, may not prove good. As a consequence, appropriate congestion control is widely considered to be a key issue for MANETs. Most of the literature conducted in the area of ad hoc networking to date focused on solving the routing problem; however the congestion related problem in ad hoc network has not been addressed much.

This research is focussed on the analysis of network congestion in mobile ad hoc networks. The provision of an efficient congestion control protocol that can cope up with the large number of nodes in a network and limited shared channel bandwidth is one of the most significant challenges for MANETs. The main contribution of this work is identifying an efficient congestion control protocol for ad hoc network. The suggested congestion
control protocols detect network congestion well in advance and choose non-congested path with a cross-layer interaction.

6.2 CONTRIBUTIONS

The main contribution of this work is identifying a simple way for congestion control mechanism in MANETs. A new protocol to handle network congestion effectively with a cross-layer mechanism is developed.

In the first part of the thesis an early detection of congestion and control routing brings forth a new perspective based on predicting congestion at the MAC layer on account of queue overflow and adapting the traffic in the network layer by discovering a non-congested path. A new algorithm is proposed to detect congestion at node level, and two different solutions to detect a non-congested path are proposed, namely (i) Early Detection of Congestion and Self Cure routing protocol (EDCSCAODV) and (ii) Early Detection of Congestion and Control routing protocol (EDAODV). These techniques would be effective to reduce packet loss and delay to improve the overall network performance.

The second part of this research has proposed a new Dynamic Congestion Detection and Control routing in MANET (DCDR). The Dynamic Congestion (DC) estimation technique is a queue management algorithm that makes use of a direct measurement of the congestion status. The DC algorithm uses three parameters, namely Minth, Maxth and $w_q$ to standardize its performance. The CFS (Congestion Free Set) setup is an initialization procedure in which each mobile host calculates its congestion status every second by using the dynamic congestion estimation technique. The significance of dynamic congestion estimation technique is to incorporate traffic fluctuations.
In second phase of this protocol introduces CFS (Congestion Free Set). The CFS (Congestion Free set) setup is an initialization procedure in which each mobile host calculates its congestion status every second by using the dynamic congestion estimation technique. Every mobile host broadcasts its congestion status by using a CSP (Congestion Status Packet) to its one-hop neighbours on the network. After CFS construction, the source node initiates route discovery procedure by using CFS set. Third phase of this protocol introduces alternative path discovery. The alternative path finding algorithm does not incur any significant overhead, because for every CFS, only one extra broadcast message is necessary to inform one of the neighbouring nodes to update its routing table, and also the alternative path discovery process incurs no extra cost.

The third part of the thesis concentrates on Cross-Layer Design approach for Congestion Control protocol (CLCC) to solve congestion and mobility related problems. In this protocol, firstly, the dynamic transmission power control mechanism gathers node’s Receiving Signal Strength(RSS) from MAC layer. This information helps to decide whether a current node is placed either in high or low signal strength area. After computing the RSS, the node broadcasts this information to its one-hop neighbours by hello packets. These hello packers will also help to update all nodes’ RSS in the routing table. Then, each node computes the average RSS values of its neighbours’ and determines three communication regions (Maximum communication region, Minimum communication region, and Average communication region).

Secondly, each node applies dynamic congestion estimation technique that could analyze the traffic fluctuation and categorize the congestion status perfectly. After estimating the congestion status at the node level, each mobile host constructs its CFS (Congestion Free Set). The source
initiates unicast route discovery procedure by using the CFS to find a reliable path to the destination.

The significance of CLCC, is that it has used two mechanisms (i) dynamic congestion estimation technique, which analyzed traffic fluctuation and categorize congestion status perfectly and (ii) dynamic transmission power control algorithm” that predicts a link breakage if likely to happen.

The results show that CLCC is effective in a light traffic environment with moderate mobility. However, the performance of CLCC degrades in higher traffic load and mobility conditions. Even though this small degradation in measured metrics are experienced in the proposed protocol, the results revealed that it performs superior in terms of Packet Delivery Ratio, End to End delay, Total number of Control Packets at all conditions compared to the traditional AODV protocol and CAR. Simulation study also proved that the packet delivery ratio can be significantly improved by employing the CLCC. CLCC can also easily adapt to topological changes by quickly repairing the route with low overhead and delay. The result prove that CLCC is more scalable with heavy traffic loads because of their dynamic transmission power control algorithm, and dynamic congestion estimation technique that control network congestion by reducing heavy packet loss.

6.3 FUTURE WORK

The random waypoint mobility model has been extensively used in this thesis to simulate node mobility. Although this particular mobility model has been widely used in the literature, there are several other models that account for different motion patterns. A possible continuation of this research would be to examine the proposed protocol for other mobility model, like the community based mobility model that models the human movements within
communities and among different communities and the Group mobility model.

The performance analysis of CLCC is done with the assumptions that all the links are symmetric and the nodes are homogeneous. But this would not be the case in realistic scenarios. So the natural extension of the work would be considering asymmetric and heterogeneous nodes in the network.

The proposed protocol could be tested in a very large and high mobility environment like VANET and FANET that are becoming more common. The sensitivity to potentially misleading or obsolete neighbourhood information may be tested in future and a robust scheme to deal with mobility and information status could be developed.

Further studies on the proposed protocol’s physical layer properties, MAC layer properties, and routing layer properties may be investigated and improvise the overall performance of the protocol in highly congested network.