CHAPTER 7

CONCLUSION AND SCOPE FOR FUTURE WORK

7.1 CONCLUSION

Identifying a more suitable and reliable transport protocol for WSNs from available protocols and to tailor the congestion control mechanisms to improve the performance of WSNs is done in this work. The reason behind this is to maximize the utility of the power hungry nodes of WSN in view of the practical difficulties in reaching them, once deployed.

The transport protocols considered for evaluation are TCP, SCTP, UDP and DCCP. For evaluation, a typical WSN scenario was suggested with the sensor field consisting randomly deployed nodes with a sink node. The attributes of the nodes and the sensor field are so chosen to depict a real time network. NS2, a popular discrete event network simulation tool and widely accepted by researches across the world is used to simulate the proposed scenario.

A thorough analysis of the above four transport protocols revealed that DCCP is a more suitable transport protocol for WSN, based on the six standard metrics considered in this work for evaluating the performance during congestion. A brief discussion on DCCP has also been presented in this work. DCCP is supporting only two congestion control mechanisms DCCP-TCP-like and DCCP-TFRC and designated by CCID 2 and CCID 3 respectively. Provisions are available to add new mechanisms in future. The
selection of the appropriate congestion control mechanism is left to the application. Further, it permits the modifications in the available mechanisms to tailor them to the needs of the designer. Hence, it is proposed to exploit both the congestion control mechanisms of DCCP to utilize the available resources effectively and efficiently.

To improve the performance of DCCP protocol based WSNs during congestion, the shortfalls were analyzed and suitable modifications were proposed during Reset action that takes place during congestion. The function reset is invoked during every Reset action. During a typical DCCP communication scenario reset function is invoked several times in each state of DCCP and during every call it resets several parameters to their respective predefined default values in both DCCP-TCP-like and DCCP-TFRC. In the proposed RC-DCCP algorithms instead of resetting certain parameters of the network to their default values on realizing congestion, selected parameters are dynamically updated based on the prevailing congestion level. As the rate at which the parameters are dynamically modified is based on the frequency of the reset call, these methods are called as RC-DCCP.

As a first step DCCP-TCP-like is considered for modification and the parameters considered for modification are ssthresh, cwnd, max_rtx_to and initial_rtx_to are. Over a wide range of data reporting intervals, the scenario was simulated repeatedly and the performance of the networks based on the normal DCCP-TCP-like and proposed RC-DCCP-TCP-like, were analyzed with respect to standard metrics.

When the congestion level is low the parameters ssthresh and cwnd are permitted to grow and hence an appreciable improvement in throughput is observed. Due to the improvement in throughput, packet-drop during transmission is brought down which in turn decreases the associated energy
requirement, routing load and MAC load and improves the overall performance of WSN, barring EED delay. Hence, it may be concluded that the networks based on RC-DCCP-TCP-like protocol result in better performance than its counterpart DCCP-TCP-like as the former, in a predefined way, improves the associated parameters as long as the congestion level over the network is relatively less and utilizes the resources effectively.

Consequently it is proposed to improve DCCP-TFRC congestion control mechanism. Here, the parameters considered for dynamic modification are s_x, s_x_inst, initial_rtx_to and max_rtx_to. These parameters are dynamically modified based on the estimated level of congestion. It is observed that the proposed algorithm results in better performance with respect to the metrics throughput, energy, dropped packets and routing load. In case of the remaining two metrics, MAC load and EED Delay it is observed normal DCCP-TFRC and the proposed RC-DCCP-TFRC closely follow each other. However, it is noticed that when MAC load is considered, normal DCCP-TFRC provides marginally better performance during low data intervals and proposed RC-DCCP-TFRC provides improved performance during mid and high data reporting intervals. As far as EED delay is considered it is difficult to decide the better algorithm as the responses overlap each other with marginal difference over the entire data reporting interval.

From results obtained, it may be concluded that the proposed RC-DCCP algorithms provide overall better performance than their DCCP counterparts in handling the congestion control in WSNs with respect to the six standard metrics considered.
7.2 SCOPE FOR FUTURE WORK

Following are some of the areas where further research work can be taken up to improve the congestion control performance in WSNs.

- With respect to MAC load and EED delay, a suitable modification in addition to the proposed methods may be explored.

- Reset function with more dynamic initial parameters may also be attempted.

- The number of parameters considered for modification in the work is limited. Hence, research may be extended to identify more parameters that influence the congestion, from the list of variables under reset function and to modify them suitably.

- As only two CCIDs have been defined so far in DCCP, novel strategies in a new dimension may also be proposed by the researchers in future using the unused CCIDs, to handle still more complex and complicated congestion environments which the next generation networks may face.