CHAPTER 6

CONCLUSION AND FUTURE WORK

This chapter outlines the summary of the research work, the contribution of the thesis work, applications and the future research scope in wireless sensor networks.

6.1 CONCLUSION

The summary of the research under three dimension, including, QoS analysis, QoS trade-off and user-specified QoS guaranty. A prediction model under multivariate regression statistical technique assesses the Quality of Service by considering the parameters across WSN (Wireless Sensor Network) layers. Two efficient routing protocols that guarantee QoS trade-off and dynamic user bounded QoS. In the first one, a tree-based approach to minimize delay, a better next hop selection which could reduce path cost and ensure guaranteed delivery under an efficient receiver-based collaborative scheduling scheme is presented. In the second method, a universal opportunistic cross-layered routing protocol to guarantee the dynamic multi-constrained QoS by jointly considering the power control with low complexity overhead was discussed.

The various parameters belonging to Application, MAC and Physical layer (AMP) of WSN are collected. The strength of the relationship between these network parameters and QoS performance metrics are analyzed and quantized to discrete values, categorizing them to different levels, such as no correlation, moderate correlation and strong correlation through correlation.
analysis model. The strong association of ET, TP, PS, MAXBE to energy, RSSI, ET, TP to throughput, the values of SO, BO to delay and TP, PS to high SNR are the results of this analysis.

It is also important to know the positive and negative impact of improving one of the QoS performance metrics against another. The correlation matrix formed by such analysis shows that improvement in energy consumption improves SNR by 37.7% while having a high negative impact on delay by 56.4 % and on throughput by 12.6%. The performance of throughput has a negligible improvement in delay by 3.7%, however, causing SNR to degrade by 24.9%. Similar results show that the SNR degrades by 5.5 % on improving the average delay. This study clearly shows that there is more than one dependent variable. Hence the regression equation for every QoS constraint is formed using multivariate regression analysis based on samples of network simulation. To minimize the regression equation for energy, delay and to maximize the regression equation for throughput and SNR, AMP parameters is sampled and hence find their influence on QoS. The same process repeats by sampling different combinations of strongly related AMP parameters obtained during correlation analysis. Furthermore, these equations are validated for proper fitting of the curve made of the samples of actual network performance to minimize the error in prediction.

The equations involving AMP parameters obtained from the above process are brought into the real protocol using a cross-layer approach which forms the basis for the two algorithms EDURo+ and MOR-PT for attaining trade-off among various QoS constraints such as energy, delay and delivery ratio. The algorithm EDURo+ attains general efficiency required for WSN critical applications. Certain applications have stringent QoS constraints which require the exclusive design of algorithms specific to that application. MOR-PT, a universal communication protocol aims at eliminating the
exclusive design and provides universality in accordance with user specified QoS demands.

The EDURo⁺ approach alleviates performance deficiencies in the WSN such as energy and delay by employing prim’s dual routing algorithm and Low-High power MAC scheduling. Prim’s dual algorithm constructs spanning tree by selecting potential child based on metrics formed by the parameters exchanged using cross-layer interaction. Low-High power scheduling improves data transfer process using receiver-initiated transmission method. The EDURo⁺ compares other similar existing algorithms regarding some packets received, energy consumption and delay. EDURo⁺ and LHS scheme is a better MAC-routing combination with less average energy drawn.

MOR-PT, a new routing protocol that guarantees a trade-off between energy costs, delivery delay and the delivery ratio by satisfying the user set constraints and ensures universality. The MOR-PT metric achieves efficiency by three steps, such as initialization, opportunistic routing, and optimal TP selection. The initialization step performs the formation of the MMAP on MOR-PT metrics. The routing step optimizes forwarding set, based on the calculated local MMAP table of the sender node to transmit the data to the sink. The trade-off between energy, delay and delivery ratio in a wireless sensor is achieved, by employing dynamic optimal power selection in routing phase. The simulation results show the superiority of the proposed scheme in maximizing the multi-constraint QoS performance with less overhead by comparing it with the existing schemes.

The WSN applications have taken a new shape in the form of smart computing where all the elements in the environment are interconnected to form interactive sensor networks. The growing environmental awareness requires these interactive sensor systems to be green and mitigates the
environmental impact caused by them in addition to the guaranteed service. The QoS constraints measure the guaranteed service of a sensor network depending on the applications. The parameters present in different layers of WSN determine these QoS constraints. WSN literature suffers a huge setback in understanding the individual and combined effect of the behavior parameters of the WSN protocol stacks. The understanding of the patterns of these parameters and their blends is important to use them together in obtaining required quality of service. This study will also help in providing future directions of development of adaptive communication protocols.

6.2 FUTURE WORK

The concept of smart dust (wireless sensors) would entail a true era of pervasive computing. Such emerging trend in WSN demands many research activities to improve the network complexity. Despite huge research activities that deal with the cross-layer approach, opportunistic and anycast routing schemes, though exist, many issues still need to be considered. Many existing and the proposed algorithm may lead to low performances if the proper bit rate is not chosen appropriately. Furthermore, network coding to enhance the wireless network throughput should be jointly addressed. Thus the future research direction should aim at optimal power control, bit rate selection and network coding jointly with opportunistic routing. To improve efficiency further over fading channel, the design of an algorithm that allows switching between opportunistic routing and deterministic tree based routing appropriately is necessary. The deployment of the node highly influences the reliability of the data transfer. Hence, protocols should be designed for the dynamic self-arrangement of the nodes based on the traffic pattern to maintain network connectivity. The future routing protocol should also consider privacy and security issue as they make the broadcast nature of the medium.
The recent trends in MAC protocol show a gradual shift of responsibility for establishing communication from the sender side to the receiver side. These leads to a challenge of minimizing the idle listening of the sender, however, guarantee that the sender does not miss the beacon of the receiver. The dynamic challenge allocation algorithm should be designed to minimize interference and maximize the bandwidth usage. The receiver’s circuit design can introduce mid-power listening that can harvest energy from the received control messages and process it using high-power only if those control messages are intended to them.