

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

In this thesis, three common hierarchical routing protocols of wireless sensor networks were analyzed and evaluated. These common routing protocols are LEACH, PEGASIS, and TEEN, where the main reason to propose such protocols is to reduce energy consumption of wireless sensor networks. The performance evaluation criteria are based on: end to end delay, amount of traffic received by the base station, load in the network and the throughput, where these factors have the most effect on the chosen protocols under evaluation. A simulation was conducted to analyze and compare the performance of these protocols using OPNET 14.5 modeler.

As a conclusion, LEACH is not recommended to deploy in large networks, because of the single hop routing technique and the BS with LEACH protocol is get more traffic than the other two protocols , it is get more traffic by about 50% and 75% than the TEEN, and PEGASIS protocols. Also the network using LEACH consumes more power than the network using other protocols. On the other hand, the data in this protocol is transmitted very fast; there is just one hop between the end sensor and the BS. The efficiency of delivering information to BS is very high and the BS can update the information very quickly. So, LEACH is good for small WSNs and when time is critical.

When power is critical, and the life time of the sensor battery is very important issue, it is better to deploy PEGASIS. There is more delay because the data is transmitted node by node (multi hop) choosing optimal path. This protocol is useful in large WSNs, when time is not critical and power is

important, because the PEGASIS protocol has more delay and load in the network than the TEEN and LEACH protocols by about 12% and 22% respectively.

In TEEN networks, the sensor node is more complicated. Nodes communicate in different levels providing good time and efficiency. It is useful when there are sudden changes in environment (it is designed to be responsive to sudden changes in temperature).

5.2. Recommendations and Further Research

This thesis evaluates the performance of hierarchical routing protocols of wireless sensor networks according to several factors: end to end delay, data Load in the network, amount of traffic received by the base station, and throughput. There are other factors to evaluate and compare the performance of hierarchical routing protocols that can be studied further, such as: fault tolerance, topology change, mobility, cost, environment, scalability, and data fusion; although the impacts of these factors are very limited and associated closely to the investigated WSN application.

Moreover, the simulation scenarios were performed using OPNET14.5 modeler, where there are some limitations in this environment when it is used to simulate WSNs. Therefore, it may be more worthy and close to the practical scenarios to use one of the last versions of OPNET, where the WSN is more mature and precise, or using software such as MATLAB, NS2, and Omnet++.