Conclusion and Future Work

The goal of the present work has been to reduce energy consumption in an ad hoc network and maximize the network throughput. In this thesis, we have focused on energy efficient MAC protocol design in an ad hoc network. The design of the new proposed protocols presented in the current work is completely different from the previous existing schemes. The IEEE 802.11 MAC protocol and the existing power control (BASIC and PCM) schemes form the basis of our work. The first step in the thesis has been to study the relation between the IEEE 802.11, power control schemes and the interference. Next we have investigated the effect of carrier sensing range on the energy consumption and throughput of the network. Based on these studies, we proposed new MAC protocols and simulated them using Glomosim network simulator to evaluate their performance. Simulation results are compared with IEEE 802.11, BASIC and PCM schemes. The results show that our proposed protocols perform better than the existing schemes in terms of throughput and data delivered per joule. Finally, we took this work further, and used rate adaptation in conjunction with power control to develop protocols that can conserve more energy and maintains the same throughput that adaptive rate protocols achieve.

Contributions

The contributions of this thesis are a set of studies, modifications to the existing protocols and proposing new power saving schemes with the goal to conserve more energy without trading-off the throughput. The major contributions of the work are listed below:

- Explored the effects of the interference and carrier sensing range on the performance of IEEE 802.11, BASIC and PCM schemes in terms of throughput and energy consumption.
The benefits of the optimum carrier sensing range on the performance of mobile ad hoc networks have been investigated.

Design of IPCM protocol – an improved version of existing PCM protocol.

Design of PCM/COMPOW and IPCM/COMPOW power saving schemes by integrating PCM and IPCM with the existing COMPOW protocol for multi-hop ad hoc networks.

Design of MIPCM protocol – a modified version of IPCM.

Performance comparison of proposed power saving schemes with the IEEE 802.11, BASIC and PCM schemes.

Performance comparison of proposed power saving schemes.

Studied the relationships between the BER, SNR, communicating distance, transmission power, data rate and their influences on the energy consumption and throughput using mathematical concepts.

Designed TSRP control protocol – an energy efficient MAC for DCF IEEE 802.11b based ad hoc networks.

Findings

Results were obtained through a series of experiments conducted on simulated network. After examining the results of the study the following observations are made:

- The interference has a huge effect on the performance of mobile ad hoc networks.

- An optimum carrier sensing range can greatly enhance the performance of mobile ad hoc networks in terms of the data delivered per joule and throughput.

- Our proposed power saving protocols – PCM/COMPOW, IPCM/COMPOW and MIPCM have performed better than IEEE 802.11, BASIC and PCM schemes.

- MIPCM scheme gives better results than PCM/COMPOW and IPCM/COMPOW power saving schemes.
• The energy efficiency can be maximized with the large packet size.
• Network throughput can also be maximized together with energy efficiency by carefully designing the energy efficient protocols. As in the literature, most energy efficient protocols have trade-off between the throughput and the energy efficiency.
• Rate adaptation in conjunction with the power control only makes sense in energy conservation if the distance to the intended receiver is smaller and the traffic load is light.
• Energy efficient MAC protocol design based on traffic sensing to determine the data rate can provide better performance than other rate adaptation and power control protocols.

**Future Work**

No research work can be completed within a specified time specially, within given course duration. We made our modest efforts to accomplish the goals set in the initial proposal. However, some of the objectives remained untouched due to the limited availability of time. Like any other research works, the outcome of the current research has exhibited the possibilities of further extensions. List of the work that can be carried out in future as an extension of current work is given below:

• We focused on energy efficient MAC protocol design and used them with already existing power ware and conventional routings protocols. Designing a network layer protocol compatible with energy efficient MAC layer protocols is our main future direction. Therefore, a protocol design considering issues from both the layers together is an interesting challenge.
• As design of energy efficient protocol is a cross layer issue, therefore, possibilities of investigating challenge from other layer than network affecting the design is another direction of future study.
• All these power saving schemes can be further evaluated for others metrics, such as delay and remaining node energy.
• The impact of the fading and different mobility models on these schemes needs to be investigated.
• The scalability of the proposed schemes needs to be tested.
• We aim at extending TSRP protocol further taking into account the packet size and load-balancing techniques.