LIFETIME MAXIMIZATION IN WIRELESS SENSOR NETWORK USING CROSS LAYER DESIGN: A DESIGN REVIEW

Manisha S. Masurkar¹, G.M. Asutkar², Dr. K.D. Kulat³

¹ Research Scholar, G. H. Raisoni college of Engg., Nagpur
ISTE member, m_zade@rediffmail.com
² Assistant Professor, G. H. Raisoni college of Engg., Nagpur
IEEE member, g_asutkar@yahoo.com
³ Professor, VNIT, Nagpur, IEEE member, kishorekulat@yahoo.com

Abstract

In our paper we consider the comparison performance of wireless sensor network to optimize the event detection and TDMA schemes using cross layer interaction. we consider the accuracy and lifetime of WSN because accuracy and lifetime are the important parameters of wireless sensor network because working of system depends upon it.

Lifetime maximization relates with various factors such as throughput, end to end delay, lifetime parameter such as time, output, packet delivery rates, no. of nodes, nodes efficiency, operating frequency to operate and relate each parameter. It is very difficult to study and compare all the above parameters simultaneously in the Wireless Sensor Network.

So throughput is end to end delay or packet delivery of nodes can be verified any improvement in one of the parameter so that it can optimized the operation capability of the whole wireless network.

Depending upon the no. of nodes corresponding hoping is developed. Routing through no. of hopes can disturbed the lifetime of WSN.

Keywords: Wireless sensor network, routing, mac layer.

1. Introduction

With consideration of accuracy and lifetime, comparison between cross layer, physical layer, MAC and routing is to be considered. It is assumed that each node can vary its transmission power, modulation scheme and duty cycle. The term transmission scheme, strategy refers to data rates, transmission power and link schedule for a network. Wireless Sensor Network (WSN) has come into existence with a development of low cost and small size sensors that can interact using in expensive and low power radio interface. While designing WSN, following requirements are taken into consideration; the system should work very well for few predefined objectives, the designed system should be sufficiently scalable so that number of nodes can be increased or decreased in future, the system should have capability of self organization to take care of changing topology because some nodes may die or some new nodes may be deployed in between the lifetime and finally network should be power aware so that it has larger overall lifetime. For energy-constrained wireless networks, we can increase the network lifetime by using transmission schemes that have the following characteristics.

(1) Multihop routing: In wireless environments the received power typically falls off as the mth power of distance, with $2 \leq m \leq 6$. Hence, we can conserve transmission energy by using Multihop routing.

(2) Load Balancing: If a node is on the routes of many source destination pairs, it will run out of energy very quickly. Hence, load balancing is necessary to avoid the creation of hot spots where nodes die out quickly and cause the network to fail.

(3) Interference mitigation: Links that strongly interface with each other should be scheduled at different times to decrease the energy consumption on these links.
(4) **Frequency reuse**: Weakly interfering links should be scheduled simultaneously so that each link can transmit at a lower rate when active. This reduces the average transmission power on each link.

### 2 Prior Work

The protocol stack for WSN includes physical layer, data link layer, network layer, transport layer and application layer. But as sensor network are supposed to do well for limited number of objectives, it is not really required to have strict, discrete and isolated layers when better can be done if layers communicate with each other without increasing the overall complexity. This idea gives birth to cross layer optimization which can be formally defined as making information to flow between the layers, thus increasing the interaction between the layers in layered architecture for achieving some desired advantages such as increasing lifetime, and improving the functional capability of the sensor network.

### 3 Algorithm

The iterative approach used to compute an approximate optimal strategy is summarized in the flowchart in Fig. 1. The various steps are as follows.

1) Find an initial suboptimal, feasible schedule to begin with. A good candidate would be a schedule in which most of the links are activated at least once in each frame of $N_\psi$ slots, and also links that are activated in the same slot only interfere weakly.

2) Solve problem $P_2$ to find an optimal routing flow and transmission powers during each slot under the high SINR approximation. If the problem is infeasible, quit.

3) Turn off links during slots in which they have an SINR close to 1. Since we approximated the rate as $r_\psi = \log(\text{SINR})$, links carry very little traffic over the slots in which they have an SINR of about 1.

4) Find a link that consumes the maximum average power over the entire frame. Schedule this link to be on during an additional time slot. The selected slot should be the one in which there is minimum interference to this link. We the resulting schedule is one that was used in a previous iteration, quit.

5) Check if $\text{SINR} \geq 1$ is feasible over all slots. If yes, go to else quit.

![Flowchart](image)

**FIG.**-Iterative approach to compute powers, rates and link schedule

A) **String Topology**

A string topology consists of one source and one sink, connected by intermediate nodes that are arranged linearly. Each pair of intermediate nodes is separated the same distance $d$, and connected by a directed link. The network carries information generated by the source to the sink. An example of a string topology of four nodes and three links is shown in Fig. 3. Here each link
needs to support the same amount of average rate, which is the rate at which the source generates information. For this topology there is only one routing path from the source to the sink. Hence, we only need to compute the link schedule and transmission powers.

B) Linear Topology

![Linear Topology Diagram]

FIG 2: Linear Topology

The linear topology is a simple generalization of the string topology. The nodes are again arranged linearly, but now each node is a source generating data at a possibly different rate. I can computed the network lifetime using our algorithm for a linear topology of 10 nodes and 9 links with \( d = 1m \). This topology is shown in Fig. 3. The source rates were taken to be \( s_1, s_2, \ldots, s_9 = 0.1 \text{nats/Hz/s} \), while the frame length was \( N = 18 \) slots.

C) Rhombus Topology

![Rhombus Topology Diagram]

FIG 3: Rhombus Topology

The rhombus topology is shown in above Fig. use this topology to illustrate the routing behavior of our algorithm. There are four source nodes - nodes 1, 2, 3, 4 with source rates \( s_1; s_2; s_3; s_4 \), respectively. Node 5 is the sink consider node. the nodes are to be considered are(1,3,5),(2,3,5),(3,5)and (4,3,5) for sources 1,2,3 and 4, respectively.

3 Conclusion

On comparison of different topologies of MAC routing, we consider the computation of transmission powers, rates and link schedule for an energy-constrained wireless network to jointly maximize the network lifetime. TDMA schemes, obtained the exact optimal transmission scheme as the solution of a mixed integer-convex optimization problem, computationally the importance of cross layer design for energy-constrained networks, and illustrated the advantages of multihop routing, load balancing, interference mitigation, and frequency reuse in increasing the network lifetime. Traditional TDMA scheme for routing were found to perform poorly for certain topologies. On Evaluation of working of different topologies, The lifetime of the wireless sensor network should be maximized. we will use the same algorithm to all topologies. Hence by using same algorithm we will increase the lifetime of WSN. This is the brief idea.

5 References


