Wireless sensor network sleep-wake cycling in relay selection for geographical forwarding

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Abstract— We seek to develop local forwarding algorithms that can be tuned so as to trade off the end-to-end delay. The proposed work is inspired by geographical forwarding of sporadic alarm packets to a base station in a wireless sensor network (WSN), where the nodes are sleep-wake cycling periodically and asynchronously. The reward metric used for the problem is depending on the end-to-end total cost objective. The forwarding node is uncertain about the reward metric values, number of relays and their wake-up times. When a relay reveals its reward value and the forwarding node's problem is to forward the packet or to wait for further relays to wake-up. In terms of the operations research literature, proposed work can be considered as a variant of the asset selling problem. We design our local forwarding problem as a partially observable Markov decision process (POMDP) and obtain inner and outer bounds for the optimal policy.

Keywords— Wireless sensor network, Markov decision process, local forwarding

I. INTRODUCTION

In geographical forwarding of packets a node that has custody of a packet and has to choose any one from a set of next-hop relay nodes to forward the packet towards the sink. Every relay is linked with a "award" that summarizes the importance of forwarding the packet through that relay.

At this end the relay section of the proposed work a nodes with position and relay nodes,with the relays waking up sequentially at random times. At each end relay node wake up and it will send relay forwarder can choose to probe value of the node with a relay to learn its reward value, based on the forwarding criteria of th nodes relay selection and forward its packet to the chosen relay is having two choice to continue with the forwarding node capability. The forwarder's objective is to select a relay so as to minimize a combination of waiting-delay, reward and probing cost.

Our problem can be considered as a variant of the asset selling problem studied in the operations research literature. We formulate our relay selection problem as a Markov decision process policy as the threshold value loss parameter latency parameter with energy value of ti We also conduct the parameterized value of it with ns2 simulation .

Our approach is to solve, at each forwarding node en route to the sink, the local forwarding problem of minimizing one-hop waiting delay subject to a lower bound constraint on a suitable reward offered by the next hop node and the relay node with capability of it The reward against the topological systems has been materialized with thee following instances of capability of the node (for instance, when the total cost is hop count, we choose to use the progress towards sink made by a relay as the reward). The forwarding node, to begin with, is uncertain about the number of relays, their wake-up times, and the reward values, but knows the probability distributions of these quantities.

This paper is organized as follows. The objective of the proposed system is described in section II. Section III describes the literature survey which helps to get much information to this proposed system. Section IV describes the research methodology. The results describe in section V. Finally conclude the paper in section VI.

II. OBJECTIVES

To conserve energy and also since the events are rare, it is best if the nodes are allowed to sleep wake cycle, waking up only periodically to perform their tasks. In this work we consider asynchronous sleep wake cycling, where the sleep-wake process of each node is statistically independent of the sleep-wake process of any other node in the network.

Due to the asynchronous sleep-wake behavior of the nodes, an alarm packet has to incur a random waiting delay at each hop en route to the sink. The end-to-end performance metrics we are interested in are the average total delay and an average total cost (e.g., hop count, total power etc.,). However such a global solution requires a pre-configuration phase during which a globally optimal forwarding policy is obtained, and involves substantial control packets exchange. The focus of our research is, instead, towards designing simple forwarding rules based only on the local information available at a forwarding node (see Fig. 1).

Towards this end the approach of geographical forwarding turns out to be useful. In geographical forwarding () nodes know their own locations and that of the sink, and forward packets to neighbors that are closer to sink, i.e., to neighbors within the forwarding region (which is the hatched area in Fig. 1).

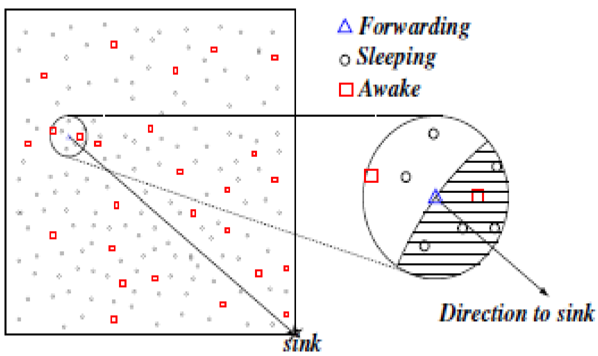


Fig. 1. Illustration of the local forwarding problem.

The local problem setting is the following. Somewhere in the network a node has just received a packet to forward (refer Fig. 1); for the local problem we refer to this forwarding node as the source and think of the time at which it gets the packet as 0. There is an unknown number of relays in the forwarding region of the source. In the geographical forwarding context, this lack of information on the number of relays could model the fact that the neighborhood of a forwarding node could vary over time due, for example, to node failures, variation in channel conditions, or (in a mobile network) the entry or exit of mobile relays.

III .LITERATURE SURVEY

K. P. Naveen, Anurag Kumar was motivated by the problem of geographical forwarding of packets in a wireless sensor networks whose function is to detect certain infrequent events and forward these alarms to a base station, and whose nodes are sleep-wake cycling to conserve energy.This end-to-end problem motivated the local problem faced by a packet forwarding node, i.e., that of choosing one among a set of potential relays, so as to minimize the average delay in selecting a relay subject to a constraint on the average progress (or some reward, in general). Further the source does not know the number of available relays. We formulated the problem as a finite horizon POMDP and characterized the optimal policy in terms of optimum stopping sets. We proved inner and outer bounds for this set (Theorem 1 and Theorem 2,respectively). We also obtained a simple threshold ruleby formulating an alternate simplified model (Section 6).We performed one-hop simulations and observed the good performance of the simple policy.

Silvia Giordano, Ivan Stojmenovic and Ljubica Blazevic describe The successful design of localized single-path loop-free algorithms with guaranteed delivery is encouraging start for future research. The search for localized routing methods that have excellent delivery rates, short hop counts, small flooding ratios and power efficiency is far from over. Since the battery power is not expected to increase significantly in the future and the ad hoc networks, on the other hand, are booming, power aware routing schemes need further investigation. In QoS applications, memorization does not appear to require additional resources and is therefore acceptable. However, the research on QoS position based routing is scarce, in our knowledge, limited to [SRV], and will receive more attention in the future, since surveyed routing schemes which guarantee delivery are all very recent (except, of course, flooding). Further research is needed to identify the best GPS based routing protocols for various network contexts. These contexts include nodes positioned in three-dimensional space and obstacles, nodes with unequal transmission powers, or networks with unidirectional links. One of the future goals in designing routing algorithms is adding a congestion consideration that is replacing hop count performance measure by end-to-end delay. Algorithms need to take into account the congestion in neighboring nodes in routing decisions.

Reuven Cohen and Boris Kapchits exposed a new problem in wireless sensor networks, referred to as ongoing continuous neighbor discovery. We argue that continuous neighbor discovery is crucial even if the sensor nodes are static. If the nodes in a connected segment work together on this task, hidden nodes are guaranteed to be detected within a certain probability P and a certain time period T, with reduced expended on the detection. We showed that our scheme works well if every node connected to a segment estimates the in-segment degree of its possible hidden neighbors. To this end, we proposed three estimation algorithms and analyzed their mean square errors. We then presented a continuous neighbor discovery algorithm that determines the frequency with which every node enters the HELLO period. We simulated a sensor network to analyze our algorithms and showed that when the hidden nodes are uniformly distributed in the area, the simplest estimation algorithm is good enough. When the hidden nodes are concentrated around some dead areas, the third algorithm, which requires every node to take into account not only its own degree, but also the average degree of all the nodes in the segment, was shown to be the best.

Q. Cao, T. Abdelzaher, T. He, and J. Stankovic compare different sleep scheduling policies in terms of average detection delay, and show that ours is closest to the detection delay lower bound for tationary event surveillance. We also explain the inherent relationship between detection delay, which applies to persistent events, and detection probability, which applies to temporary events. Finally, a connectivity maintenance protocol is proposed to minimize the delay of multi-hop delivery to a base-station. The resulting sleep schedule achieves the lowest overall target surveillance delay given constraints on energy consumption.

IV. RESEARCH METHODOLOGY

In this section we will describe the system model in the context of geographical forwarding, also known as location aware routing, [2], . In geographical forwarding it is assumed that each node in the network knows its location (with respect to some reference) as well as the location of the sink.

Consider a forwarding node (henceforth referred to as the source) at a distance v0 from the sink (see Fig. 2). The communication region of the source is the set of all locations where reliable exchange of control messages can take place between the source and a receiver, if any, at these locations. In Fig. 2 we have shown the communication region to be circular, but in practice this region can be arbitrary. The set of nodes within the communication region are referred to as neighbors.

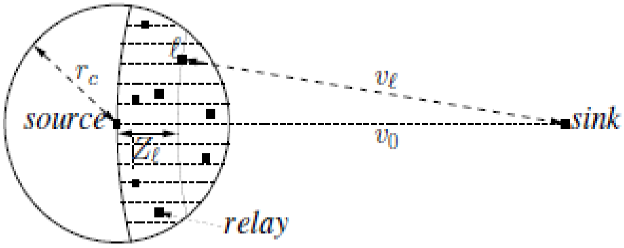
Let v\` represent the distance of a location \` (a location is a point in <2) from the sink. Then define the progress of the location \` as $Z_\ell := v_0 - v_\ell$. The source is interested in forwarding the packet only to a neighbor within the forwarding region

region $\mathcal{L}$ where, $\mathcal{L} = \left\{\ell \in \text{communication region} : Z_\ell \geq 0\right\}$.

The forwarding region is shown hatched in Fig. 1. We will refer to the nodes in the forwarding region as relays. Let H\` represent the random gain of the channel between the source and location

We will assume that the channel gains, , are independent and identically distributed . We will further assume that the channel coherence time is such that during the local decision process the channel gains in the forwarding area remain unchanged.

The rate at which packets arrive to be forwarded through a region is low enough so that the channel gains change in between each forwarding instance. Such low forwarding rates would arise in sensor networks whose main purpose is to detect infrequent events (fires, intrusions, gas leaks, etc.).



Given H`, the minimum power required to achieve an SNR threshold of at location ` is where d` is the distance between the source and the location `, is the path loss attenuation factor, and N0 is the noise variance.

The reward being inversely proportional to P` is clear, because it is advantageous to use less power to get the packet across. RL is made proportional to ZL to promote progress towards the sink while choosing a relay for the next hop. Further motivation for choosing the particular structure for the reward is available in Finally, let F` represent the distribution of RL. Thus, there is a collection of reward distributions F indexed by .

Sleep-Wake Process: Since we focus on local forwarding, we will assume that the source gets a packet to forward (either from an upstream node or by detecting an event) at time 0. There are N relays in the forwarding set L that wake-up sequentially at the points of a renewal process $W_1 \leq W_2 \leq \cdots \leq W_N$. Let $U_k := W_k - W_{k-1}$ $(U_1 := W_1)$ denote the inter-wake-up time (renewal lifetime) between the relay. Then , are independent with their means, equal to .

For example, Uk, $1 \leq k \leq N$, could be exponentially distributed with mean , or could be constant (deterministic) with value . Sequential Decision Problem: Let L1;L2; ;LN, denote the relay locations which are assumed to be i.i.d. uniform over the forwarding set L. Let A() denote the uniform distribution over L so that, for k = 1; 2; ;N, the distribution of Lk is A(). The source (with a packet to forward at time 0) only knows that there are N relays in its forwarding set L, but does not know their locations, Lk, nor their channel gains, HLk . When the k-th relay wakes up, we assume that its location Lk and hence the reward distribution FLk is revealed to the source. This can be accomplished by including the location information Lk within a control packet (sent using low rate robust modulation technique, and hence, assumed to be error free) transmitted by the k-th relay upon wake-up. However, if the source wishes to learn the channel gain HLk (and hence the exact reward value RLk), it has to send additional probe packets (indeed several packets, in order to obtain a reliable estimate of the channel gain) incurring an energy cost of units. Thus, when the k-th relay wakes up (referred to as stage k) the actions available to the source are:

stop and forward the packet to a previously probed relay, thereby accruing the reward of that relay. It is clear that it is optimal to forward, among all the probed relays, to the relay with the maximum reward. Thus, henceforth, the action stop always implies that the best relay (among those that have been probed) is chosen. With the stop action the decision process terminates. continue to wait for the next relay to wake-up (the average waiting time is) and reveal its reward distribution, at which instant the decision process is regarded to have entered stage k + 1.

probe a relay from the set of all unprobed relays (provided there is at least one unprobed relay). The probed relay's reward value is revealed allowing the source to update maximum reward among all the probed relays. After probing, the decision process is still at stage k and again the source has to decide upon an action.

In the model, for the sake of analysis, we neglect the time taken to probe a relay and learn its channel gain. We also neglect the time taken for the exchange of control packets. This is reasonable for very low duty cycling networks where the average inter-wake-up time is much larger than the time taken for probing, or the exchange of control packets.

Algorithm to be implemented is as follows:-

Algo for Relay Selection

Input:- Nodes with initial energy,distance(n=25)

Output:- nodes with sleep-wake cycling in relay selection

Step1 : make scenario of number of nodes in descretehaving one sink .

for (i=0;i<=val(nn);i++)

Set node i[node]

Set x- // set x position of node

Set y- // set y position of node

Set z- // set z position of node

Step2 : At start all nodes are in sleep node

Rx thresh-null

Ry thresh-null

Step3: set 2-3 cbr communication in between nodes and sink[base station]

Step4: when communication start the source node find path with from source to destination with respective distance basis,CTS(cteor to send)value and minimum relay selection mechanism.

*equlidian distance

Set dist[expr $xval(src)-&xval(dest)]

Set dist[expr $dist * &dist]

Set temp[expr $yval(src)-$yval(dest)]

Set dist[expr sqrt[&temp+&dist)]]

If(dist= =min && CTS = =true && node= =awake)

Send data

Else

Find another path

Step 5: On basis of neighbor node knowledge and sleep-wake mechanism minimizes energy.

V. RESULTS

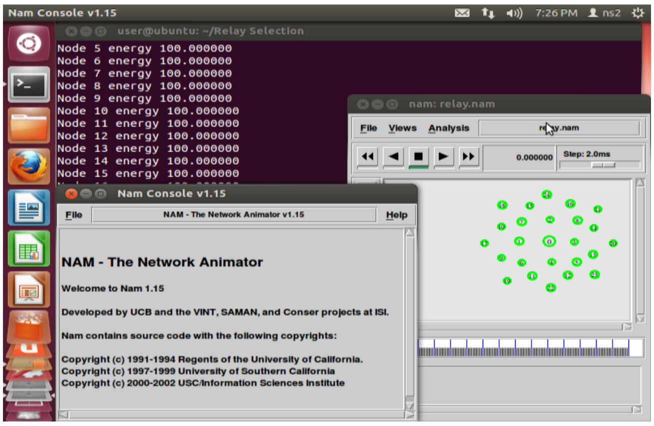
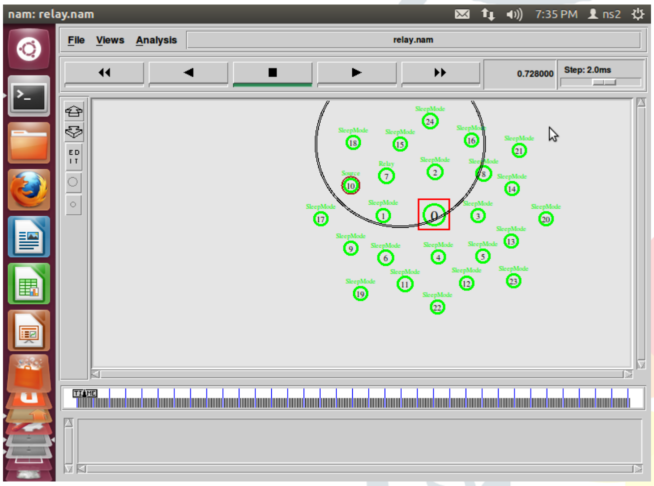
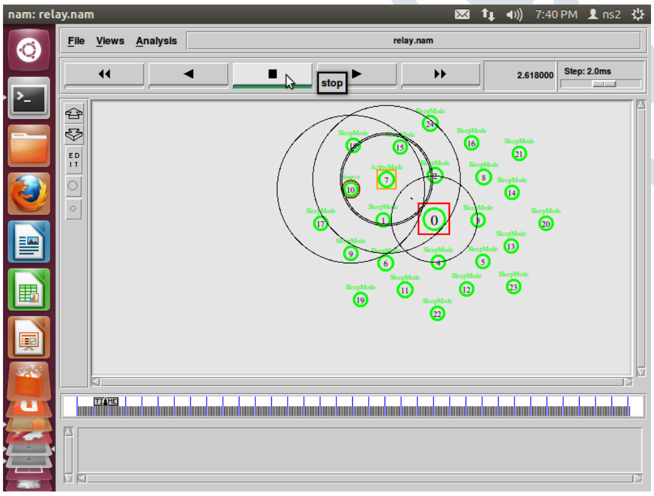


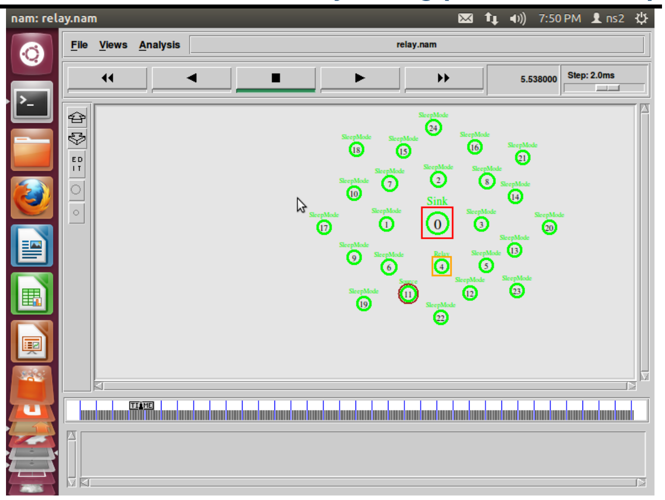
Figure 2. Nam File with node position



Consider node 10 as a active source node ,node 7 is a relay active node



sending of all packet from source node 10 to sink node 0 through relay node,always acknowledgement will send from sink node to source node



Node 11 as a source node sends the packet to the relay active node 4,node 4 sends the packet to the sink .

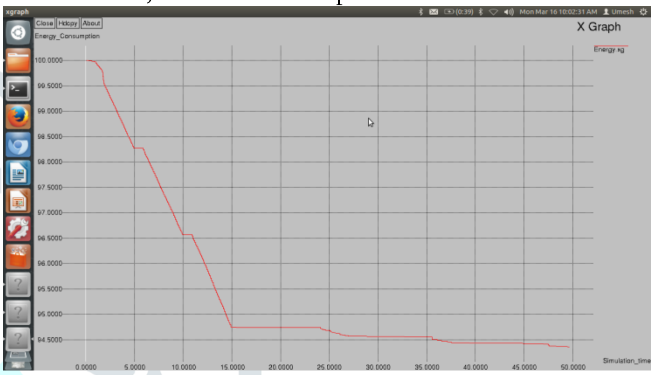


Figure : Energy consumption graph

Figure : Compare Energy consumption graph,on x-axis simulation time and on y-axis energy_consumption

VI. CONCLUSION

In this paper, We have addressed the important problem of minimizing communication latency while providing energy efficient periodic sleep cycles for nodes in wireless sensor networks. The objective is to minimize the latency given the duty cycling requirement that each sensor has to be awake for k fraction of time slots on an average. For the single wake up schedule case, where each sensor can wake up at exactly one of the k slots, we have provided graph-theoretic problem formulations for arbitrary all-to-all (DESS) as well as weighted communication patterns (ADESS).

We can proved that both these problems are NP-hard. We then focused on the DESS problem and derived and proved optimal solutions for two special cases, viz. the tree and ring topologies. For arbitrary topologies, we proposed several heuristics and evaluated them through simulations. These simulations reveal several interesting observations: that purely localized heuristics tend to perform worse than simple randomized slot allocations, that our centralized scheme can provide delay reductions of around 50% over randomized schemes and that specialized heuristics (that exploit the topological structure) like the concentric ring for the grid can provide additional gains.

VII.REFERNCES

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