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A REVIEW OF PRAGMATIC IMPLEMENTATION OF POWER OPTIMIZATION IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Wireless Notes (Motes) are having susceptible and vulnerable issues in terms of energy consumption and power optimization. In most of the applications, the power factor of the notes decay very frequently and these are non-chargeable. A wireless sensor node is a popular solution when it is difficult or impossible to run a mains supply to the sensor node. However, since the wireless sensor node is often placed in a hard-to-reach location, changing the battery regularly can be costly and inconvenient. An important aspect in the development of a wireless sensor node is ensuring that there is always adequate energy available to power the system. This article surveys and classifies the energy aware routing protocols proposed for MANETs. They minimize either the active communication energy required to transmit or receive packets or the inactive energy consumed when a mobile node stays idle but listens to the wireless medium for any possible communication requests from other nodes. Transmission power control approach and load distribution approach belong to the former category, and sleep/power-down mode approach belongs to the latter category. While it is not clear that any particular algorithm or a class of algorithms is the best for all scenarios, each protocol has definite advantages/disadvantages and is well-suited for certain situations. This manuscript highlights various factors and parameters more energy efficient mechanisms.

Keywords - Wireless Sensor Networks, Power Optimization, Energy Optimization, Power Level Optimization Techniques

INTRODUCTION

An ad-hoc network of wireless static nodes is considered as it arises in a rapidly deployed, sensor based, monitoring system. Information is generated in certain nodes and needs to reach a set of designated gateway nodes. Each node may adjust its power within a certain range that determines the set of possible one hop away neighbors. Traffic forwarding through multiple hops is employed when the intended destination is not within immediate reach. The nodes have limited initial amounts of energy that is consumed in different rates depending on the power level and the intended receiver.

We will propose the algorithm to select the routes and the corresponding power levels such that the time until the batteries of the nodes drain-out is maximized. The algorithms are local and amenable to distributed implementation. When there is a single power level, the problem is reduced to a maximum flow problem with node capacities and the algorithms converge to the optimal solution. When there are multiple power levels then the achievable lifetime is close to the optimal (that is computed by linear programming) most of the time. It turns out that in order to maximize the lifetime, the traffic should be routed such that the energy consumption is balanced among the nodes in proportion to their energy reserves, instead of routing to minimize the absolute consumed power.

Consider a group of wireless static nodes randomly distributed in a region, where each node has a limited battery energy supply used mainly for the transmission of data. Assume that at each node some type of information is generated as it monitors the data such as sound or vibration in its vicinity using the sensor, and the information needs to be delivered to a set of gateway nodes. These wireless nodes are assumed to have the capability of packet forwarding, i.e., relaying an incoming packet to one of its neighboring nodes, and the transmitted energy level can be adjusted to a level appropriate for the receiver to be able to receive the data correctly if the receiver is within the transmission range.

Upon or before a new arrival of information either generated at the node itself or forwarded from the other nodes, routing decision has to be made so that the node knows which of its neighboring nodes to forward its data to. Note that the routing decision and the transmission energy level selection are intrinsically connected in this power controlled ad-hoc network since the power level will be adjusted depending on the location of the next hop node. An example scenario for this type of wireless ad-hoc network may include a wireless sensor network where the sensors gather acoustic, magnetic, or seismic information and send the information to its gateway node which has more processing power for further processing of the information or has larger transmission range for the delivery of the information to a possibly larger network for retrieval by a remote user.

Most of the previous works on routing in wireless ad-hoc networks deal with the problem of finding and maintaining correct routes to the destination during mobility and changing topology [1], [6], [11]. In [1], [6], the authors presented a simply implementable algorithm which guarantees strong connectivity and assumes limited node range. Shortest path algorithm is used in this strongly connected backbone network. However, the route may not be the minimum energy solution due to possible omission of the optimal links at the time of the backbone connection network calculation. In [11], the authors developed a dynamic routing algorithm for establishing and maintaining connection oriented sessions which uses the idea of predictive re-routing to cope with the unpredictable topology changes. Some other routing algorithms in mobile wireless networks can be found in [15], [12], [9], [14], which, as the majority of routing protocols in mobile ad-hoc networks do, use shortest-path routing where the number of hops is the path length. The problem of minimum energy routing has been addressed before in [1], [6], [16], [10], [8], [18], [17], and [7].

The approach in those works was to minimize the total consumed en energy to reach the destination, which minimizes the energy consumed per unit flow or packet. If all the traffic is routed though through the minimum energy path to the destination the nodes in that path will be drain-out of batteries quickly while other nodes, which perhaps will be more power hungry if traffic is forwarded through them, will remain intact. Instead of trying to minimize the consumed energy, the performance objective of maximizing the lifetime of the system[3], which is equivalent to maximizing the time to network partition[18] has been considered. In [18], the problem of maximizing the time to network partition was reported as NP-complete. In [3] we identified the maximum lifetime problem as a linear programming problem. Therefore, it is solvable in polynomial time.

The work in [3] considered the single destination version of the problem, while here we extend the problem to the multi commodity case, where each commodity has a its own set of destinations. In our study the topology of the network is static and the routing accounts to finding the traffic splits that balance optimally the energy consumption. Hence the results are applicable to networks which are either static, like the sensor networks we mentioned earlier, or whose topology changes slowly enough such that there is enough time for optimally balancing the traffic in the periods between successive topology changes.

In mobile network, nodes involved in communication initially has 100% battery power once it started performing packet transfer, the battery power decreases tremendously, at one point the network disconnects because of empty battery backup of sender node or any other node in that network.

The major objective of this project is to stabilize the battery backup of all the nodes in a network. So that no node is running below the average battery power, this can be achieved through the energy efficient routing technique for the mobile network.

A wireless sensor network consists of light-weight, low power, small size of sensor nodes. The areas of applications of sensor networks vary from military, civil, healthcare, and environmental to commercial. Examples of application include forest fire detection, inventory control, energy management, surveillance and reconnaissance, and so on. Due to the low-cost of these nodes, the deployment can be in order of magnitude of thousands to million nodes. The nodes can be deployed either in random fashion or a pre-engineered way. The sensor nodes perform desired measurements, process the measured data and transmit it to a base station, commonly referred to as the sink node, over a wireless channel.

The base station collects data from all the nodes, and analyzes this data to draw conclusions about the activity in the area of interest. Sinks can act as gateways to other networks, as a powerful data processor or as access points for human interface. They are often used to disseminate control information or to extract data from the network. Nodes in sensor networks have restricted storage, computational and energy resources; these restrictions place a limit on the types of deployable routing mechanisms. Additionally, ad hoc routing protocols, for conventional wireless networks support IP style addressing of sources and destinations. They also use intermediate nodes to support end-to-end communication between arbitrary nodes in the network.

It is possible for any-to-any communication to be relevant in a sensor network; however this approach may be unsuitable as it could generate unwanted traffic in the network, thus resulting in extra usage of already limited node resources. Many to-one communication paradigms is widely used in regard to sensor networks since sensor nodes send their data to a common sink for processing. This many-to-one paradigm also results in non-uniform energy drainage in the network. Sensor networks can be divided in two classes as event driven and continuous dissemination networks according to the periodicity of communication. Routing protocols are usually implemented to support one class of network, in order to increase energy savings. In continuous dissemination networks, routes will be periodically reconstructed, while in event-driven networks routes will be constructed only when an events occurs, since the cost of constant updates is prohibitive in this scenario. However, sensor nodes are constrained in energy supply and bandwidth. Such constraints combined with a typical deployment of large number of sensor nodes have necessitated energy-awareness at the layers of networking protocol stack including network layer. Routing of sensor data has been one of the challenging areas in wireless sensor network research. Current research on routing in wireless sensor networks mostly focused on protocols that are energy aware to maximize the lifetime of the network, scalable for large number of sensor nodes and tolerant to sensor damage and battery exhaustion. Since the data they deal with is not in large amounts and flow in low rates to the sink, the concepts of latency, throughput and delay were not primary concerns in most of the published work on sensor networks.

However, the introduction of imaging sensors has posed additional challenges for routing in sensor networks. Transmission of imaging data requires careful handling in order to ensure that end-to-end delay is within acceptable range. Such performance metrics are usually referred to as quality of service (QoS) of the communication network. Therefore, collecting sensed imaging data requires both energy and QoS aware routing in order to ensure efficient usage of the sensors and effective access to the gathered measurement. QoS protocols in sensor networks have several applications including real time target tracking in battle environments, emergent event triggering in monitoring applications etc. Their proposed protocol aims to extend the life time of the overall sensor network by avoiding the unbalanced exhaustion of node battery powers as traffic congestion occurs on specific nodes participating in data transfer.

REVIEW OF LITERATURE AND EXISTING THEORY

Energy Conserving Routing in Wireless Ad-hoc Networks, Jae-Hwan Chang and Leandros Tassiulas - An ad-hoc network of wireless static nodes is considered as it arises in a rapidly deployed, sensor based, monitoring system. Information is generated in certain nodes and needs to reach a set of designated gateway nodes. Each node may adjust its power within a certain range that determines the set of possible one hop away neighbors. Traffic forwarding through multiple hops is employed when the intended destination is not within immediate reach. The nodes have limited initial amounts of energy that is consumed in different rates depending on the power level and the intended receiver. We propose algorithms to select the routes and the corresponding power levels such that the time until the batteries of the nodes drain-out is maximized. The algorithms are local and amenable to distributed implementation. When there is a single power level, the problem is reduced to a maximum flow problem with node capacities and the algorithms converge to the optimal solution. When there are multiple power levels then the achievable lifetime is close to the optimal (that is computed by linear programming) most of the time. It turns out that in order to maximize the lifetime, the traffic should be routed such that the energy consumption is balanced among the nodes in proportion to their energy reserves, instead of routing to minimize the absolute consumed power.

Energy Efficient Routing Protocols forMobile Ad Hoc Networks, Chansu Yu Ben Lee Hee Yong Youn - Although establishing correct and efficient routes is an important design issue in mobile ad hoc networks (MANETs), a more challenging goal is to provide energy efficient routes because mobile nodes' operation time is the most critical limiting factor. This article surveys and classifies the energy aware routing protocols proposed for MANETs. They minimize either the active communication energy required to transmit or receive packets or the inactive energy consumed when a mobile node stays idle but listens to the wireless medium for any possible communication requests from other nodes. Transmission power control approach and load distribution approach belong to the former category, and sleep/power-down mode approach belongs to the latter category. While it is not clear that any particular algorithm or a class of algorithms is the best for all scenarios, each protocol has definite advantages/disadvantages and is well-suited for certain situations. The purpose of this paper is to facilitate the research efforts in combining the existing solutions to offer a more energy efficient routing mechanism.

To Improve The Lifetime In Mobile Ad-Hoc Network, R.Indhumathi R.Sureshbabu - Many minimum energy (energy efficient) routing protocols have been proposed. However, few effort has been spent on the routing overhead, route setup time, and route maintenance issues associated with such protocols. This paper first shows that the minimum energy routing schemes in the literature could be fail without considering the routing overhead involved and the node mobility. It then proposes a more accurate analytical model to track the energy consumption and the impact of packets errors, and a simple energy-efficient routing scheme improve the performance in mobility scenarios. The simulation results indicate that the PEERbased energy efficient routing has significantly higher performance than that of a normal energy based routing scheme.

CONCLUSION AND FUTURE WORK

The sensor node consumes power for sensing, communicating and data processing. More energy is required for data communication than any other process. The energy cost of transmitting 1 Kb a distance of 100 metres (330 ft) is approximately the same as that used for the execution of 3 million instructions by a 100 million instructions per second/ processor. Power is stored either in batteries or capacitors. Batteries, both rechargeable and non-rechargeable, are the main source of power supply for sensor nodes. They are also classified according to electrochemical material used for the electrodes such as NiCd (nickel-cadmium), NiZn (nickel-zinc), NiMH (nickel-metal hydride), and lithium-ion. Current sensors are able to renew their energy from solar sources, temperature differences, or vibration. Two power saving policies used are Dynamic Power Management (DPM) and Dynamic Voltage Scaling (DVS). DPM conserves power by shutting down parts of the sensor node which are not currently used or active. A DVS scheme varies the power levels within the sensor node depending on the non-deterministic workload. By varying the voltage along with the frequency, it is possible to obtain quadratic reduction in power consumption. Although establishing correct and efficient routes is an important design issue in mobile ad hoc networks (MANETs), a more challenging goal is to provide energy efficient routes because mobile nodes' operation time is the most critical limiting factor. In this manuscript, we have presented the review of power factors in the wireless sensor networks.

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