# OPEN ISSUES IN ROUTING TECHNIQUES FOR AD HOC WIRELESS SENSOR NETWORKS

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*Abstract :* Ad hoc sensor networks are impromptu networks that are outlined by distributed network and ad hoc deployment. Sensor networks have all the key characteristics of ad hoc networks but to different extent– for example, much lower mobility and much more compelling energy requirements. We determine the ongoing state of research and figure out open issues in development of routing techniques in wireless sensor networks.

***Index Terms* - Sensor Network, MANETs, PODS,LEACH,GEAR**

## I. INTRODUCTION

### Introduction

Consider a wireless network made up of units that perform both measurements and communications. These units are totally self-reliant and are efficient of recording data from sensors. The flexibility of these units is very low but the data promoting strategy is robust enough to be fault tolerant and to allow infrequent mobility among units.

For example, we deal with the sensor network being developed for the PODS project at UH Manoa. One of the major objectives of the project is to implement a sensor network to study imperiled plants such as “SileneHawaiiensis”, in order to conclude what is crucial for the plant’s survival in its endemic habitat. The challenge is to implement an ad hoc network constitutes of hundreds of small sensors or pods, which monitor wind, rain, temperature, light and moisture, and which are used for determining spatial or temporal figures in the environment of the plant being designed.

Such a real life sensor network consists of hundreds of sensors. The nodes are battery powered, so the first networking protest getting data back with nominal energyexpenditure, by choosing energy-efficient paths and by minimizing the routing overhead. The second objection is to maintain connectivity in case some pods are moved to a different location or fail to participate due to lack of power, though overall mobility is likely to be more limited than in a network of laptops. The third objection is that sensor networks can be anticipated to grow to many thousands of nodes, so any algorithms used in these networks must be scalable. Finally, these networks should use multiple paths whenever possible, both for redundancy and to distribute the energy expenditure of forwarding packets. These requirements distinguish ad-hoc wireless sensor networks from mobile ad-hoc networks (MANETs). Table 2 compares MANETs with ad hoc sensor networks.

A sensor network by its nature the PODS network also conflicts from many of the wireless sensor networks studied in the literature. Though some data can be combined and summarized, other data, for example camera images, must be delivered unchanged to a base station. The PODS network is designed to have multiple base stations if possible. In addition, communication is not limited to sending data to base stations: interaction between individual sensor nodes may be needed to allow distributed computation among nodes in close geographic proximity, to support occasional communication from the base stations to the individual nodes, and for a variety of reasons including fault-tolerance. These requirements mean that a PODS-style network needs to be able to support any-to-any communication, though the common mode of communication is from nodes to one or more base stations.
There has been a lot of analysis in wireless routing protocols. Present protocols support distinct tradeoffs among the following desirable aspects: fault tolerance, distributed computation, robustness, scalability, and reliability. Wireless protocols nominated so far for wireless sensor networks are very limited, generally aiming on communication to a specific base station or on fusing sensor data. While these protocols are appropriate for their predetermined intentions, in this paper we probe the use of protocols developed for MANETs to provide more general communication among nodes in a sensor network.

## II. OPEN ISSUES

### Low Energy Consumption

Procedure for MANETs are planned for connection among laptops. Though laptops are battery-powered, their power cost far surpasses that of a node in a wireless sensor network. Such nodes are often disposed in remote areas. Whether powered by batteries, solar energy, or some other method, reducing energy consumption lessens the weight or extends the lifetime of the package and makes the sensor easier to conceal. Every node in a wireless sensor network only needs to note, carry, and lead data, unlike a laptop which might have to perform much more complicated tasks. As a result, the computational engine in a sensor node consumes significantly less energy than a laptop, and communications must likewise use less energy.

Profuse networking protocols have been forth put for both MANETs and wireless sensor networks containing protocols that target on "minimal energy" routing. For example, shows that a route with more, shorter hops often requires less total energy than a route using fewer, but longer, hops. Other papers focus on developing generalized power aware/energy aware routing schemes,designing power aware cost metrics ,using transmit power adjustment to control the network topology, or using the location information to minimize the power relay route, thus minimizing the total energy consumption. However, none of these studies focus on practical issues such as the overhead of computing such minimum-energy routes. Doshi et al., account the following reasons why minimal energy routing is hard to implement in practice. Minimum energy routing forthputs an overhead cost, the extra routing data is not free, existing protocols fail to provide sufficient information for making power level decisions, lower power routes leave less margin for channel fluctuations or measurement errors, minimum energy routes are difficult to discover, and minimum energy routes are difficult to maintain. Because of these complications, it is not now clear that such "minimal energy" routing is in practice any excelling than other techniques which have reduced theoretical efficiency but provide other practical advantages. Because of these limitations, we consider a variety of protocols, not only those which claim to use "minimal" energy.

The SensIT event at DARPA records that various MANET protocols target on fast topology switches, and that a focus on power-aware metrics, location report, and the energy consumption of each node can head to more power-aware routing. Location information is used by some MANET protocols both to improve scalability and, in some cases, also to minimize energy consumption .Some authors mention that an optimal geographic route may afford power savings and network lifetime expansion compared to a akin route that does not use location information. However, at least for the GEAR protocol this has only been tested under a very limited number of relatively favorable network configurations.

LEACH forth puts a clustering stationed protocol that uses randomized rotation oflocal cluster leads to uniformly distribute energy haul among the sensors in the network. In LEACH each local cluster head carries "local data fusion" to compact the data. It is a lone path routing technique whose scalability is provided by its stratified nature. Nevertheless, some of their assumptions may not be true when compared to general sensor networks like PODS. LEACH requires a fixed base station to which data needs to be routed. Leach only supports sensors which do not move and send data at fixed rate, with symmetric radio channels, and adjustable transmit power. Leach also assumes that the cluster heads can talk directly to the gateway node. LEACH may be a fine solution for a smaller subset of the problem but for a general sensor network like PODS, it does not address the situation when more than one fixed base station is present, where sensors are not static, and where a node can communicate to another node in an arbitrary fashion.

GEAR [29] presented an alternative to this by incorporating the technique of data diffusion and using geographic computations to find low energy paths. They propose that if the destination is quite far from the packet then the path found by geographic routing may be nearly as energy efficient as an optimal route. Some of their techniques that are not useful for the more general sensor networks we are interested in, include the use of data diffusion, which is only useful to deliver the data to a single or a few base stations, and does not support communication between arbitrary nodes. The paper by Doshi et al. showed that a path which is primarily discovered using location information may not be the most energy efficient path.

## Low mobility

Sensor networks differ from MANETs in a very important way and that is in mobility. A MANET is a more general case where the participating laptops can either be stationary or move randomly with a random speed. Asnodes within a MANET move, they progress out of scope of their neighbors and hence are no longer able to communicate with the old neighboring nodes and come within range of new nodes. Hence the mobility introduces the problem of fault tolerance. The optimal routing protocol for MANET should be able to deliver data packets from source to destination even when some of the intermediate nodes move away from their neighbors range. This complicates the design of the routing protocol as this introduces additional routing overhead. In previous work , one of the authors related the speed of the movement of the nodes to the packet delivery ratio and routing overhead. The packet delivery ratio worsens as speed is increased for DSR , whereas AODV does not degrade as rapidly when mobility increases. Nodes in a sensor network most of the time are static and with an unusual breaking of a link as the node runs out of its energy or is relocated. Sensor networks need the capability to re-configure automatically in case links vanish or new nodes appear. Protocols such as GEAR and LEACH think that the nodes in a sensor network are static where as in PODS at least some of the nodes (e.g. a hand-held base station) may be mobile.

## Self-configuring nature

Ad hoc wireless sensor networks are self-configuring in nature. This can be considered an added feature to the existing ad hoc nature of the network. The network is adaptable to the changing requirements and is able to diagnose when a link / sensor node goes down and when it comes up. There are two main schemes to design a wireless sensor network, the address centric scheme and the data centric scheme. The address centric scheme has been used by various routing protocols such as LAR, GSPR, and DREAM etc. In this scheme we assign IP addresses to each sensor node, simplifying the process of routing. This concept is similar to that of normal wired networks. A unique IP addresswill help the source sensor node to know the sensor node to which data must be routed. However a new concept of data centric model is presented which is not address oriented. The mechanism and goal of self-configuration in these networks is different from those of the address centric scheme.

## Multipath desirable

Macker and Corson listed qualitative and quantitative self-reliant metrics for judging the accomplishment of mobile ad hoc network routing protocols. One of these qualitative metrics was path strategy. There are a number of different path strategies. One that is very common is shortest path where one copy of the message is in the network at any time. At the other extreme is the flooding based approach where the message is flooded through the whole network area. A good example of this path is the Multi-path On-demand Routing (MOR) Protocol which is a on-demand, load balancing routing protocol outlined for the PODS project at the University of Hawaii at Manoa. MOR may require as little as one network flood to organize necessary routes and its energy efficient and hefty in low mobility and low energy networks such as PODS. Broadcasting generally resolves the routing in highly mobile conditions but considering our requirement for a general sensor network for PODS this is offensive. The compromise between these two approaches is a multipath strategy, where data packets are routed through a few distinct paths and successive packets follow different paths whenever possible. This not only provides robustness to the network using multiple paths but also helps in distribution of the energy requirement of the network evenly across the network. In A.Nasipuri et al., prove that the use of multiple paths in DSR can keep correct end to end connections, but they did not study the performance improvement on network load balancing. M.R Perlman et al., demonstrate that multipath routing can balance loads.

They propose a diversity injection method to find more node-disjoint paths compared to DSR. However, their work is based on multiple channel networks, which are contention free but may not be available in some applications. Researchers applies the multipath procedure to DSR's source routing technique and obtains some scalability under mobile environment. Nevertheless the energy distribution constituent of the multipath strategy has not been adequately explored in the paper.

## Scalability

An ideal routing protocol for a MANET should be scalable. This means that as the size of the network increases or the number of nodes increases the routing protocol should be able to adapt to the changes and provide consistent performance based on the parameters that we have discussed earlier. describes three methods, which have been used by researchers to provide scalability to a routing protocol for MANETs. The first method uses hierarchy to provide scalability. The second way to provide scalability is caching. The third way to provide scalability is using geographic information. Using hierarchy to provide scalability is the most widely deployed approach to scale routing as the number of destinations increases. Two main strategies used to integrate nodes location and hierarchical network structures are the Zone Based Routing and the Dominating Set Routing. Online power-aware routing schemes are illustration of Zone Based Routing and GRID is an example of dominating set routing.

Caching is becoming a generally deployed method for scaling ad hoc routing protocols in MANET . Caching decreases the routing protocols message heft in two forms: It prevents driving topological data where the forwarding load does not want it (like optimal routers) and it usually impairs the number of hops between the router that has topological information and the router thatdesires it. After all, Doshi et al., showed with their implementation of energy aware DSR protocol using old routes from the cache does not inevitably mean that a low energy route is selected every time. The last and most often used technique to furnish scalability to ad hoc routing protocols is to use the geographic location information. This technique thinks that all wireless nodes know their steads and links are bi-directional. This approach has been adapted in GPSR, GEAR and gradient routing.

For a common sensor network a combination of the above-specified strategies would be adequate to provide scalability, as mobility is limited in these networks.

**Table 1: Comparison of three different energy efficient routing protocols for ad hoc sensor networks**

| Method | Distributed | Metrics | Scalability | Comm. Without merging | Multiple base stations | Mobility | Fault Tolerance | Robustness |
|---|---|---|---|---|---|---|---|---|
| New DSR | No | Shortest path | Caching | Yes | Yes | Sufficient | Single path | Yes: Limited |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LEACH | Yes : Location aware: clustering | Location, | Hierarchical | No | No | No | Single path | No |
| GEAR | Yes: Location aware | Shortest Path, Location | Geographic | No | Yes | Not tested | Single path | No |

**Table 2: Comparison of features of MANETs and Ad Hoc Sensor Networks.**

| Features | MANET | Ad Hoc Sensor Networks |
|---|---|---|
| Decentralized control | Yes | Yes |
| Bandwidth deficient | Yes | Sometimes |
| Energy deficient | Yes. But this is of secondary importance as battery packs can be replaced | Yes, it is of primary importance |
| Mobility | Varies (slow to fast) | Limited |
| Traffic | Multimedia rich | Statistical and Multimedia |
| Data rate | High | Low [1-1000 Kbps] |
| Flow of data | Bi-directional | Mostly unidirectional [sensor to sink] |
| Redundancy in data | No | Sometimes |
| Main Goal | To optimize QoS and high bandwidth efficiency | Prolonging the life of the network through aggressive energy management, to prevent connectivity degradation. |
| Fault tolerance | Needed as mobility increases | Needed only if nodes exhaust available energy or are moved |
| Basic features of routing protocol | Loop free, energy and bandwidth efficient, secure, provides QoS, fault tolerant and reactive instead of proactive, and distributed in nature | Most of the same features as for MANETs, but with less emphasis on mobility and more emphasis on energy efficiency, scalability, and multipath connectivity. |

## III. Conclusion

In this paper we have evaluated the essential features of the routing protocols for general wireless sensor network like PODS . Presently the investigation into routing protocols for MANETs and ad hoc sensor networks contribute to make many tradeoffs in various features and are generally tested in a much controlled environment. As seen from the paper that the needs and requirements of routing protocols for general ad hoc sensor networks is very unique correlated to routing protocols for MANETs and other sensor networks. Hence, there is a need for further research into this new field as it poses some of its unique challenges and we would be continuing our research in this area in future.

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