# A Review of Location-Based Geographic Routing Protocols for Wireless Sensor Networks

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***Abstract—*** *Wireless Sensor Networks (WSNs), which is a system of nodes connected by wireless links, is a very popular area for exploration. The nodes are free to move around and organize themselves into a network. The design of an efficient routing protocol is one of the most important considerations in design of WSNs. The routing protocols can be of flat topology or hierarchical topology. The routing protocols can also be data-centric, whose main aim is the reduction of the redundant data. These may be location-dependent also, as in the Geographic routing protocols. In this paper, some of the major geographic routing protocols for WSNs are presented.*

*Index Terms — Geographic Routing, Wireless Sensor Networks.*



## 1. INTRODUCTION

Compared to adhoc networks the number of nodes in a Wireless Sensor Network is several orders of magnitude higher. And these nodes are densely deployed. They are prone to failure. The sensor network topology changes frequently. Adhoc networks are based on point to point communication whereas sensor nodes mainly use a broadcast communication. Sensor network is an infrastructure consisting of sensing, computing and communication components that gives an administrator the power to observe and respond to events and in a given environment [1].

### 1.1 ARCHITECTURE OF WIRELESS SENSOR NETWORKS

The scattered sensor nodes have the capacity of collecting data and route data back to the sink. The sink can communicate with task manager node via internet or satellite as explained in the fig. 1.2. [2].

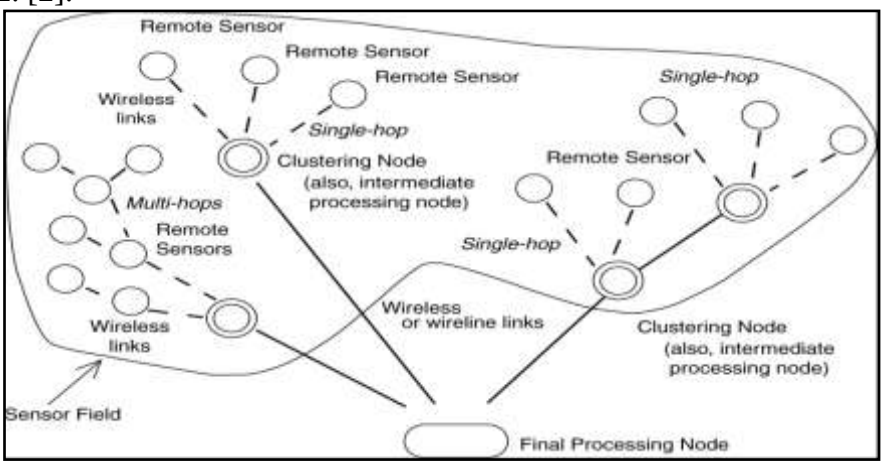


Fig. 1.2. Typical Sensor Network arrangement [2]

### 1.2 DESIGN FACTORS OF SENSOR NETWORKS

- Fault tolerance: It is the power to maintain WSN functionalities without any sensor node failures.
- Scalability: The sensor nodes can range from a few hundreds to thousands inside a sensor field.
- Production costs: Since large number of sensor nodes constitutes the sensor network the cost of each node decides the overall cost of the network.
- Operating environment: Sensor nodes are usually deployed unattended.
- Sensor network topology: The nodes can be mobile or stationary.
- Hardware constraints: The processors, size of memories, etc., are limited.
- Transmission media: Wireless medium is used to link the communicating nodes in a multi-hop sensor network. Radio, infrared or optical media is used for these links. The medium should be chosen such that it is available worldwide to enable global operation.
- Power consumption: The WSN node is a microelectronic device and has only limited power.

## 2. NETWORK LAYER PROTOCOLS

Nodes communicate with each other by transmitting messages using *Message Routing Protocol.* Message Routing is the procedure of determining the route that a message will take to travel from the source to its destination. Routing can be categorized as follows:

- *Centralized vs. Distributed:* In centralized routing, the path that a message is supposed to follow is calculated by the source, and is embedded inside the message. Intermediate nodes just forward the message to the next node on the route. On the other hand, in distributed routing, each node calculates the next node on the path, based on the routing procedure.
- *Static vs. Dynamic:* Static Routing provides the way for explicitly determining the next node from any intermediate node, for a given destination. Dynamic Routing chooses the next node on the path from multiple nodes based on various criteria.
- *Flat vs. Hierarchical:* The entire network is considered as a flat topology in case of Flat Routing. In Hierarchical Routing, the network topology is presumed to be hierarchical in nature. Groups of nodes results in a cluster. Clusters are combined to form a higher-level cluster, and so on.



## 3. LOCATION-BASED GEOGRAPHIC ROUTING PROTOCOLS: REVIEW

Authors Patwani et.al [3] discussed the cooperative localization. The measurement-based models like Angle of Arrival (AOA), Time- of- Arrival (TOA), and the received signal strength (RSS) are described in reference to wireless sensor networks. These model are useful to calculate Cramer-Rao bound (CRB) on location estimation precision. It is helpful for researchers to select measurement technologies and evaluate localization algorithms. Sensor location information is extremely useful for geographical routing algorithms. Sometimes the location itself is the data that needs to be sensed. The authors gave an alternative approach of using Global positioning Systems (GPS) which are expensive and energy prohibitive. They proposed selecting of some small number m of sensors, called reference nodes. The coordinates of these reference nodes are taken with the help of GPS devices, and the remaining n unknown location nodes can get their coordinates by themselves. Positioning techniques used for cellular mobile station (MS) and Wireless Local Area Networks (WLAN) could be applied here. The best application they have shown is Animal tracking. Using multihop location data through the sensor network enables low transmit powers from the animal tags. Another motivating application is in Logistics. Deploying sensor nodes in an

office building and making these sensors wireless reduces the high cost. Automatic localization of these sensors further increases automation.

Ennaji [4] discusses about various routing protocols and the different simulation techniques to find the best routing protocol. AODV and DSDV are studied and DSDV is considered as the best one for this particular simulation Network Simulator. The paper says that defining the best simulator completely depends on the goal of the research.

Radek Salon et al [5] present implementation of AODV in wireless sensor networks. The need of simple implementation of routing protocol intended for tiny system is motivation of this work. Small objects, equipped a form of sensor or actuator, a tiny microprocessor, a communication device and a power source are the parts of sensor networks. The main advantages of such system are, there is no need of any operation system.

Li Qiong et.al [6] discuss the optimization problems of AODV Routing Protocol. If the speed of movement of nodes is less than the threshold value, a backup table is built. This method decreases the average delay throughput and routing load. It also improves the capacity of the network. Traditional AODV does not take the consideration of current load of the network. This causes network congestion. AODV is improved, based on the mobility of node. A threshold value V is taken to judge whether to join a backup routing table. It reduces the flooding RREQ to the network.

Julia Rahman et.al [7] compares AODV, DSR and DSDV protocols. Different sensor network scenarios are used. Packet delivery ratio, Throughput, end to end delay and Normalized routing load are used as performance matrix. The results show that DSDV performs better in high density networks or networks with strict requirement on time. DSR is good at smaller networks. In networks with high throughputs and low loss environment AODV is preferable.

Nor Suryati Mohamad Usop et al [8] evaluate the performance of AODV, DSDV & DSR. This work presents the simulation results for choosing the best routing protocol with the highest performance in the target mobile grid applications. The simulations show that the protocols like DSR have a tremendous decrease in performance for high mobility. However the AODV and DSDV protocols perform very well under high mobility conditions.

Sengar Abhishek et.al [9] evaluate performance of AODV and DSDV by using performance matrix such as packet delivery ratio, throughput and Routing overheads. NS2 simulation is used. The results show that AODV is better in throughput and having minimum routing overheads. DSDV has maximum routing overheads.

Yu Kim et al [10] say that for supporting frequent movement, IEEE 802.15.4 is a very important technology of sensor network. The paper proposes improved AODV routing protocol for reset a new routing path during sending a packet. It discusses various routing protocols, specially proactive and reactive protocols. DSDV is proactive protocol, which operates routing path before sending the data. The reactive protocols like AODV and DSR will set the routing table on demand and maintains active routes only. The improved AODV ensures shortest path through fixed expire time.

Abdul Hadi et al [11] suggest the use of a message substitution scheme for its invalid path reconstruction for improvement in the packet delivery ratio of DSDV routing protocol. Here AODV, DSDV and I-DSDV were compared using NS-2 package with respect to packet delivery ratio, routing overhead, and end to end delay in different environments. The number of nodes speeds and pause time area varied. The results show that improved DSDV (I-DSDV) shows reduced number of dropped packets with little increased overheads. But AODV is best in higher node speed and number of nodes.

Kulkarni et al [12] discussed about sensor deployment. A new deployment technique called 'Quasi Random Deployment' (QRD) technique is being introduced by them. This method is to increase the network life time and coverage. The QRD produces highly uniform coordinates and it systematically fills specific area. NS-2 simulator is used. The three routing protocols AODV, DSDV and DSR are evaluated to determine the efficiency of this deployment. At transport layer UDP protocol is used and at application layer CBR traffic is generated. The performance of these routing techniques is compared based on energy consumption, coverage area. The results show that the conventional protocol DSR is good for RD and QRD of sensor nodes, where there is no mobility of sensor nodes. Between AODV and DSDV, AODV performs best.

Varsha Sahni et al [13] considered three scenarios a) Phenom nodes with mobility, sensor nodes with mobility while sink node is stationary. b) Phenom nodes with mobility, sensor nodes are stationary and sink node is stationary. c) Phenom nodes are stationary, sensor nodes are stationary and sink node is stationary. AODV and DSR are taken as protocols for comparison. Qualinet 5.0.2 simulator is used. Packet delivery ratio to sink, end to end delay to sink, overhead, throughput are the matrices used for this simulation. The various problems faced while simulating are discussed.



Fotis Diamantopoulos et al [14] say that power control can be obtained by CLUSTER POW algorithm. In DSDV most part of the traffic is due to overheads to update the tables. The paper says that by carefully adjusting some parameters, the performance improves. Less energy is consumed by reduction in routing overheads.

## 4. CONCLUSION

WSNs have seen tremendous growth in endless applications over the recent years. This speedy progress has resulted in the stress towards solving the hurdles that this area has to face. Routing is a very important issue faced by these WSNs. The routing can be of many types, depending on its applications. The literature review in this paper elaborately discussed the various geographical routing protocols.

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