

COMPARATIVE STUDY OF ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORK

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ABSTRACT

Wireless Sensor Networks consist of small nodes with sensing and computation, communication capabilities. Wireless networks are highly dependent on specific application and are constrained by energy, storage capacity and power. In WSN, the sensor nodes have a limited transmission range, and their processing and storage capabilities as well as their energy resources are also limited. Routing protocols for wireless sensor networks are responsible for maintaining the routes in the network and have to ensure reliable multi-hop communication under these conditions. In this paper, we give a survey of routing protocols for Wireless Sensor Network and compare their strengths and limitations. This comparison reveals the important features that need to be taken into consideration while designing and evaluating new routing protocols for sensor networks.

Keywords- Wireless Sensor Networks, Routing Protocols, Applications

I INTRODUCTION

Sensor networks have emerged as a promising tool for monitoring the physical world, networks of battery powered wireless sensor network that can sense, process and communicate. A WSN consists of a large number of low cost, low power and multifunctional wireless sensor network have been widely used in the industry, traffic, environmental protection, military and many other fields. A sensor network is a network of many tiny disposable low power devices, called nodes. The tiny sensor nodes, which consist of sensing, data processing and communicating components. Each node consists of four components: power unit and central processing unit (CPU), sensor unit and communication unit. They are assigned with different tasks. The important requirements of WSN are: Use large number of sensors, Low energy consumption, Self organization capability. In this paper, first we discuss the network architecture and design, secondly we discuss the routing protocols for wireless sensor network and at last we compare the routing protocols of wireless sensor network.

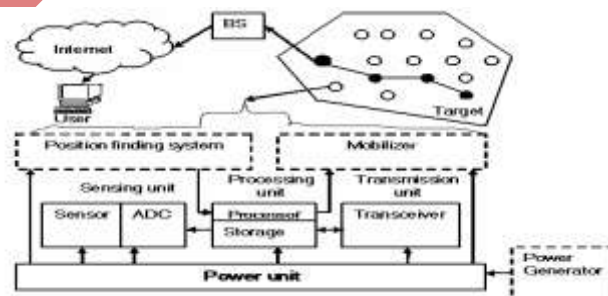


Fig 1: Structural View of Sensor Network

II NETWORK ARCHITECTURE AND DESIGN OBJECTIVES

Different architectures and design constraints have been considered for sensor networks. The performance of a routing protocol is related to the architectural model.

Network Architecture

Sensor network consists of three main components .these are the sink, monitored events and sensor nodes. Routing messages from moving node more challenging since route stability is more important factor, in addition to energy, bandwidth etc.

Node Deployment

Another consideration is the topological arrangement of nodes. The arrangement of sensors is either deterministic or self organizing. In self organized systems, the sensor nodes are scattered randomly creating a path in an ad hoc manner. However in deterministic system, the sensors are manually placed and data routed through predetermined paths. The position of the sink or cluster head is also crucial in terms of energy and performance

Energy Deliberation

The process of setting up the routes is greatly influenced by energy considerations. Most of time sensors are scattered randomly over an area of interest.

Node Capabilities

All sensor nodes are assumed to be homogenous, having equal capacity in terms of computation, communication and power. Set of sensors raises multiple technical issues related to data routing.

III ROUTING PROTOCOLS

Routing in WSN differs from conventional routing .There is no infrastructure, wireless links are unreliable, sensor nodes may fail ,and routing protocols have to meet strict energy saving requirements. Many routing algorithms were developed for wireless networks. When sensor nodes are static, it is preferable to have table driven routing protocols rather than using reactive protocols. a significant amount of energy is used in route discovery and setup of reactive protocols. All major routing protocols classified into seven main categories shown below:

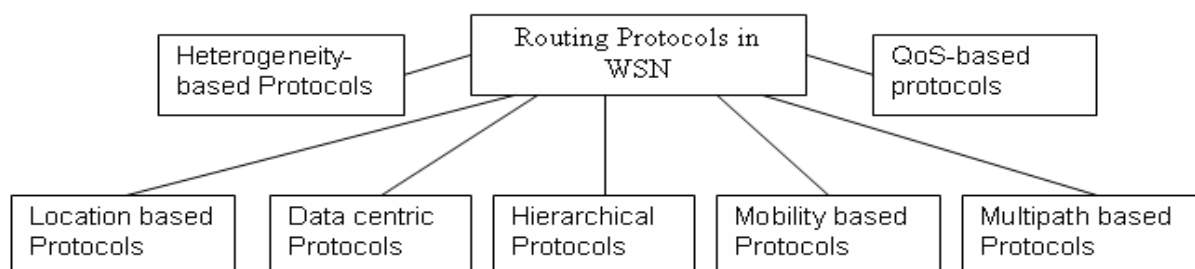


Fig 2: Classification of Wireless Sensor Network

III LOCATION BASED PROTOCOLS

The location information based routing protocol uses location information to guide routing discovery and maintenance as well as data forwarding, enabling directional transmission of the information and avoiding information flooding in the entire network. Location information is needed in order to calculate the distance between two particular nodes so that energy consumption can be estimated.

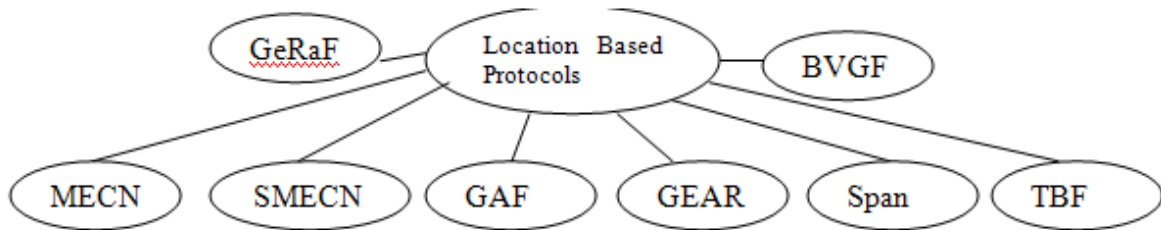
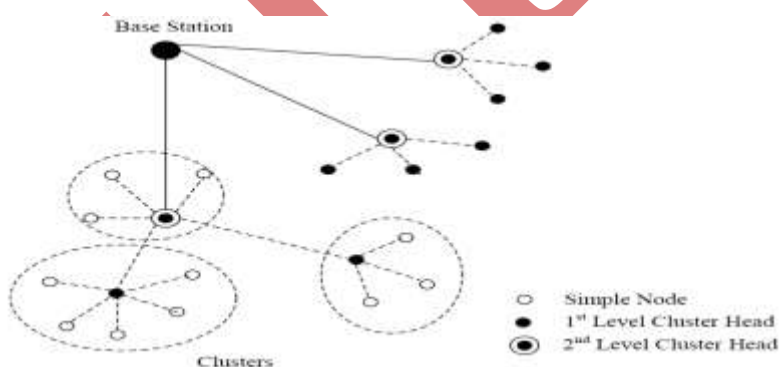


Fig 3: Classification of Location Based Protocols

IV HIERARCHICAL PROTOCOLS

Clustering is an energy efficient communication protocol that can be used by the sensors to report their sensed data to the sink. Hierarchical routing is to efficiently maintain the energy consumption of network. This provides inherent optimization capabilities at the cluster heads. A network is composed of several clusters. Each cluster is managed by a special node, called cluster head, which is responsible for coordinating the data transmission activities of all sensors in its cluster. Representative Protocols of hierarchical routing are as follows:

- (a) PEGASIS (b) HEED (c) TEEN (d) APTEEN (e) LEACH



Cluster-based Hierarchical Model

4.1 Data –Centric Protocols

Data centric protocol different from traditional address centric protocols in the data they carry. While in ad hoc networks individual data items are important, in sensor networks it is the aggregate data carried in the data rather than the actual data. In data centric routing, the end nodes, the sensors themselves, are less important than data itself. The sink sends queries to certain regions and waits for data from the sensors located in a selected

region. Data centric protocols are classified in to nine categories of routing protocols are as follows: SPIN, DD, RR, MCFA, GBR, IDSQ, CADR, COUGAR, ACQUIRE, EAR .

4.2 Heterogeneity-Based Protocols

In heterogeneity sensor network architecture, there are two types of sensors namely line-powered sensors which have no energy constraint, and the battery-powered sensors having limited lifetime, and hence should use their available energy efficiently by minimizing their potential of data communication and computation. Representative protocols of heterogeneity-based protocols are as CADR, CHR.

V COMPARISON OF ROUTING PROTOCOLS

In this paper we compared the following routing protocols according to their design characteristics.

Classification and Comparison of Routing Protocols In WSN

Routing Protocols	Data Aggregation	Power Usage	Scalability	Over head	Query Based	QoS	Data delivery model
GAF	No	Ltd	Good	Mod	No	No	Virtual grid
GEAR	No	Ltd	Ltd	Mod	No	No	Demand driven
SPEED	No	Low	Ltd	Less	Yes	Yes	Geographic
SPAN	Yes	Ltd	Ltd	High	No	No	Continuously
SAR	Yes	High	Ltd	High	Yes	Yes	Continuously
ACQUIRE	Yes	Low	Ltd	Ltd	Yes	No	Complex Query
SPIN	Yes	Ltd	Ltd	Low	Yes	No	Event driven
DD	Yes	Ltd	Ltd	Low	Yes	No	Demand driven
SOP	No	Low	Good	High	No	No	Continuously
VGA	Yes	Low	Good	High	No	No	Good
PEGASIS	No	Max	Good	Low	No	No	Chains based
TEEN&AP TEEN	Yes	High	Good	High	No	No	Active Threshold
LEACH	Yes	High	Good	High	No	No	Cluster head
COUGAR	Yes	Ltd	Ltd	High	Yes	No	Query driven
CADR	Ltd	Ltd	Low	Yes		No	Continuously

VI CONCLUSION AND OPEN ISSUES

In recent years, the routing protocols in WSN has become one of the most important research areas and introduced unique challenges compared to traditional data routing in wired networks. The main aim behind the routing protocol design is to keep the sensors operating for a long time, thus extending the network life time. In this paper, we compare and classify the routing protocols into three main categories: Data Centric Routing (Flooding), Hierarchical based routing (clustering) and Location –based routing (Geographic) on the basis of network structure. An important issue for routing protocols is the consideration of node mobility. Most of the current protocols assumes the sensor nodes and sink are stationary. Although many routing protocols have been proposed in WSN, many issues still exist and there are still many challenges that need to be solved in the sensor networks.