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Analysis on Energy Efficiency Flat Routing Protocols for Wireless Sensor Communication Network

Lt. D.Antony Arul Raj[1] Dr. P.Sumathi[2]
[1]*Assistant Professor, Department of IT & CT VLB Janakiammal College of Arts and Science, Coimbatore*
[2]*Assistant Professor PG and Research Department of Computer Science Government Arts College - Coimbatore*

Abstract*: *Wireless Sensor Communication Networks (WSCNs) are designed, which requires that energy be taken as the most crucial element if WSCNs are to be used in the most effective way to serve the purpose for which they have been deployed in the target region. Routing protocols are the main support that can help in dropping the energy consumption required by the transmission of data throughout the sensor networks. In this paper we have discussed about Flat Routing protocol for wireless sensor networks. Flat routing protocols are simplest protocols routes from the source to the destination are determined by use of only the hop count and remaining energy of the neighbor nodes for each node.
Keywords: Flat routing protocols,WSCNs, TORA, E-TORA, COUGAR.

I. INTRODUCTION

Wireless Sensor Networks (WSCN's) is the most admired existing wireless network all over the globe. Comparing to other wireless networks such as ad-hoc network or mesh network etc., sensor network has its own constraints in exchanging data from a source to the destination. In WSCN, sensor units are installed at various locations in the network, and they always measures such as temperature, humidity, pressure etc. Naturally, a sensor node is a tiny device that includes four main components specifically a sensing unit, microcontroller, communication unit and a battery fig.1. The main advantage of such network is the installation of nodes at any spot and exchange of data via supportive near by nodes which act as routers to transfer data from one to other node[1]. WSCN is less cost effective, very easy to install and also maintenance is also minimum. In the lack of energy efficient techniques, a node would exhaust its battery within few days. To minimize energy utilization and improving the network life time researchers had developed various protocols for routing. These protocols are generally classified into three groups i.e. based on Network Structure, Function Protocol, Transmission Mode Fig.2. This paper provides a complete survey on the flat routing protocols for WSCNs based on Network structure. The focus is on the techniques these protocols use in order to route messages, based on the energy they consume so that the lifetime of the network is extended.

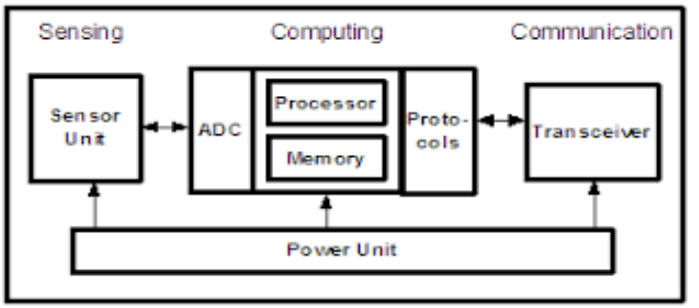

Fig.1

A. *Applications*

1) Area monitoring
2) Health care monitoring
3) Environmental/Earth sensing
4) Air pollution monitoring
5) Water quality monitoring
6) Natural disaster prevention

7) Wine production

Types of Routing Wireless Sensor networks have been divided into four categories, and each category has its own sub categories. Fig.2.

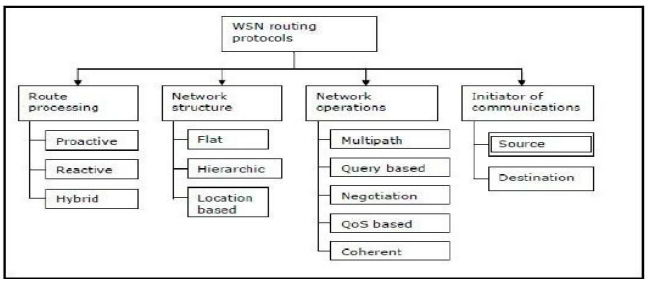

Fig.2

Flat Protocols All the nodes in the network take part in the same role. Flat network architecture presents several advantages, includes minimal slide to maintain the transportation between communicating nodes. Hierarchical Protocols: To achieve energy efficiency, stability, and scalability, the routing protocols in this scheme are based on the hierarchical structure in the network. In these types of protocols, network nodes are organized in the form of clusters. The node with higher residual energy, assumes the role of a cluster head. The cluster head takes the responsibility for coordinating activities within the cluster and forwarding data between clusters. Use of the clustering reduces energy consumption and extends the lifetime of the network. Clustering have high delivery ratio and scalability and can balance the energy consumption. The nodes around the base station or cluster head will deplete their energy sources faster than the other nodes.

II. FLAT ROUTING PROTOCOL A REVIEW

A. Flat Routing Protocol

Network communication protocol is a flat routing protocol execute by routers in which all routers are each other's peers. Flat routing protocol distributes routing in order to routers that are related to each other without any association or segmentation structure among them. Flat Networks Routing Protocols for WSCNs can be classified according to the routing plan, into three main categories: Pro-active protocols, Re-active protocols and Hybrid protocols [2]. Even though they have been calculated for the same network, all these protocols change in various ways and do not present the same characteristics; the following sections talk about particularly about the Flat routing protocols.

1) *Pro-active or Table-Driven Routing Protocols***:** Pro-active (or table-driven routing protocols) work in a way linked to wired networks: based on the seldom exchanging of routing information among the different nodes, each node builds its own routing table which can be used to find a path to a destination. Each node is necessary to maintain one or may be extra tables by storing routing information. They also react to any changes in network topology by transfer updates through the wireless network and thus sustain a constant network view. As the route is previously known so, there does not exist, more delay when a path to some destination is required to forward the packets. Lot of bandwidth and more battery power is required to keep the information up-to-date. Some of the accessible table-driven routing protocols are Wireless Routing Protocol. (WRP), the Topology spreading Based on Reverse-Path Forwarding Protocol (TBRPF) discussed in [3], [4]. usually, battery power is limited in WSCNs so these protocols are not energy efficient.
2) *Re-active or Source-Initiated On-Demand Routing Protocols***:** A unusual move toward from table-driven routing is the source-initiated on-demand routing. different pro-active (table-driven) routing protocols, re-active protocols (on-demand protocols) only create a route discovery process when needed [5]. When a route from a source to a destination is needed, a kind of global search procedure is started. This task does not request the constant updates to be sent through the network, as in pro-active protocols, but this process does cause delays, because the requested routes are not available and have to be found. In some cases, the preferred routes are still in the route cache maintained by the sensor nodes, which reduces the additional delay because routes do not have to be discovered. The whole process is done as soon as a route is found or all possible route combinations have been examined
3) *Flooding:* Flooding is an aged and but very simple technique, which is used for routing in WSCNs [6]. In flooding, copies of received packets are sent by every link except the one by which the packets arrived. This process generates an huge amount of extra traffic. Flooding is an extremely forceful technique but as long as there is a route from source to

destination, the delivery of the packet is assured. Flooding is a immediate technique, and does not need costly topology protection and complex route invention algorithms. As the additional packets are sent this technique is not energy efficient. There have been some protocols developed that use flooding as a part of their routing [7].

B. Drawbacks

1) Implosion
2) Overlap
3) Resource blindness
4) *Gossiping:* When the individuals are linked by means of the communication network, gossiping and distribution are two main problems of information dissemination [8]. In gossiping, every person in the network knows a single item of information. This information is necessary to be communicated to everyone else in the network. In broadcasting, one character has an item of information, which needs to be communicated to everyone else in the network. in fact, gossiping is a derived of flooding in which nodes do not broadcast the information but send the incoming packets to a randomly preferred neighbor. even though this approach avoids the implosion difficulty by just having one duplicate of a message at any node, it takes lengthy to spread the message to all sensor nodes in the network.

C. Advantages

1) Avoid the implosion.

divided into zones and the zones proactively sustain the topology of the zone, still, there is no periodic exchange of the topology change all over the network. The neighboring nodes are informed only at periodic intervals. If there is need for ZRP to look for a exacting node, then it initiates the route query and broadcasts it to the nearby sensor nodes.

D. Cougar

COUGAR is data-centric routing protocol planned by Y. Yao and J.Gehr in 2002, taking into consideration the sensor networks as a huge circulated database system. The main plan is to establish a new query layer among the applications and the sensor network. This layer uses declarative queries in organize to abstract query processing from the network layer functions such as selection of related sensors and consume in-network data aggregation to save energy. In COUGAR, sensor nodes pick a leader node to execute aggregation and throw the data to the sink (destination).

The sink generates a query plan which specifies the necessary information about the data stream and in-network calculation for the incoming query and transmits it to the related nodes. The query plan also describes how to choose a leader for the query.

Query plan at a leader node: The leader node gets all the readings, calculates the average if it is greater than a threshold sends it to the gateway (sink) .

E. Advantages

1) COUGAR provides energy savings especially when the generated data is enormous
2) COUGAR provides network-layer independent methods for data query.

F. Drawbacks

1) Extra overhead of energy consumption and memory storage by introducing additional query layer on each sensor node Dynamic maintenance of a leader node to avoid failure
2) For successful in-network data computation, it requires synchronization the active query is fully determined, a completed response is sent directly back to the querying node.
3) *Temporarily Ordered Routing Algorithm (TORA):* This is an adaptive loop-free distributed routing algorithm based on the concept of link reversal. Each node i know its own height and the height of each directly connected neighbor j in this algorithm [11,12]. TORA was designed to minimize the communication overhead associated with adapting to network topological changes and thus, to minimize the energy consumption. In addition, it supports multiple routes and multicast. However, TORA does not incorporate multicast into its basic operation.
4) *Energy-aware Temporarily Ordered Routing Algorithm (E-TORA):* The E-TORA is an alteration of TORA and its focus is to minimize the energy consumption of the nodes . The classic TORA chooses the routes with the least hops as long as the network topology does not change. This may cause to the nodes that are on the main route heavy load. In addition, if some routes repeatedly include the same node, the node will run out of its energy much earlier than the other nodes. Thus, the use of nodes in the shorter path without considering their power leads to the decrease of the network lifetime. Thus, E-TORA was

proposed in [13] to solve this problem. E-TORA takes into consideration the level of power of each node and avoids using nodes with low energy. In addition, the energy consumption of nodes is balanced in order to avoid that some nodes exhaust their energy earlier if they are used too frequently.

III. COMPARISON OF FLAT ROUTING PROTOCOLS AND DISCUSSION

The flat routing protocols compared in this study has certain limitations in terms of scalability, mobility, data aggregation, multipath, overhead (in terms of route discovery),energy efficiency, data delivery model and do not support quality of service of the sensor network. Flooding and gossiping performs very limited in scalability because the nodes send the received data through every outgoing link, use a large amount of power and they suffer from reliability as well as information delay issues.

sensor node does not have global identification number .All these protocols do not present the same characteristics and differ in many ways. Although they have been designed for the same underlying network. We can't say any particular protocol is better than the other since each protocol in this category has a specific application. For all applications, an important issues

and challenges for routing protocols in WSCN are : The density of sensors with large number for to prolong the lifetime of the network. Make secure routing protocols to ensure the transmission of messages between the nodes.

IV. ANALYSIS ON FLAT ROUTING PROTOCOLS

Routing protocols	Classification	Scalability	Negotiation-based
Flooding	Flat	NO	NO
Gossiping	Flat	LTD	NO
DD	Flat	LTD	YES
RR	Flat	GOOD	NO
COUGAR	Flat	LTD	NO
ACQUIRE	Flat	LTD	NO
TORA	Flat	LTD	NO
E-TORA	Flat	LTD	YES

TABLE.1

Routing protocols	Data Aggregation	Multipath	Qos	Power usage
Flooding	NO	SIMPLEST	NO	LARGE
Gossiping	NO	_	NO	LARGE
DD	YES	YES	NO	LTD
RR	YES	NO	NO	LOW
COUGAR	YES	NO	NO	LTD
ACQUIRE	YES	NO	NO	LOW
TORA	YES	NO	NO	LTD
E-TORA	YES	YES	YES	LOW

TABLE.2

Routing protocols	Query based	Over head	Data delivery model
Flooding	NO	HIGH	NO
Gossiping	NO	MOD	NO
DD	YES	LOW	DEMAND DRIVEN
RR	YES	LOW	DEMAND DRIVEN
COUGAR	YES	HIGH	QUERY DRIVEN
ACQUIRE	YES	LOW(LTD)	COMPLEX QUERY
TORA	YES	LTD	QUERY DRIVEN
E-TORA	YES	LOW	QUERY DRIVEN

TABLE.3

V. CONCLUSION

Routing in sensor networks is a new area of research. As sensor nodes are constrained by limited battery, backup, memory, computation capacity, scalability, data aggregation, etc. Many routing protocols have been proposed by many researchers to take into account these sensors nodes constraints. So, the routing protocols design for this type of networks is a crucial challenge to improve the usage of limited network resources. It can be divided into flat, hierarchical and location routing protocol. This paper gives in detail general overview about flat routing protocols based on network structure in wireless sensor networks with their comparisons and specifies the associated problems and applications designated for each protocol. It highlights the challenges in WSCN and helps the researchers to understand the work done in this domain. For future perspective, we aim to improve the contribution of one of the protocols in order to solve the challenges identified in the discussion by evaluating their performances based on metrics : packet delivery ratio (PDR), end-to-end delay, energy consumption, throughput and confirm the improvements in the simulator NS2 network.

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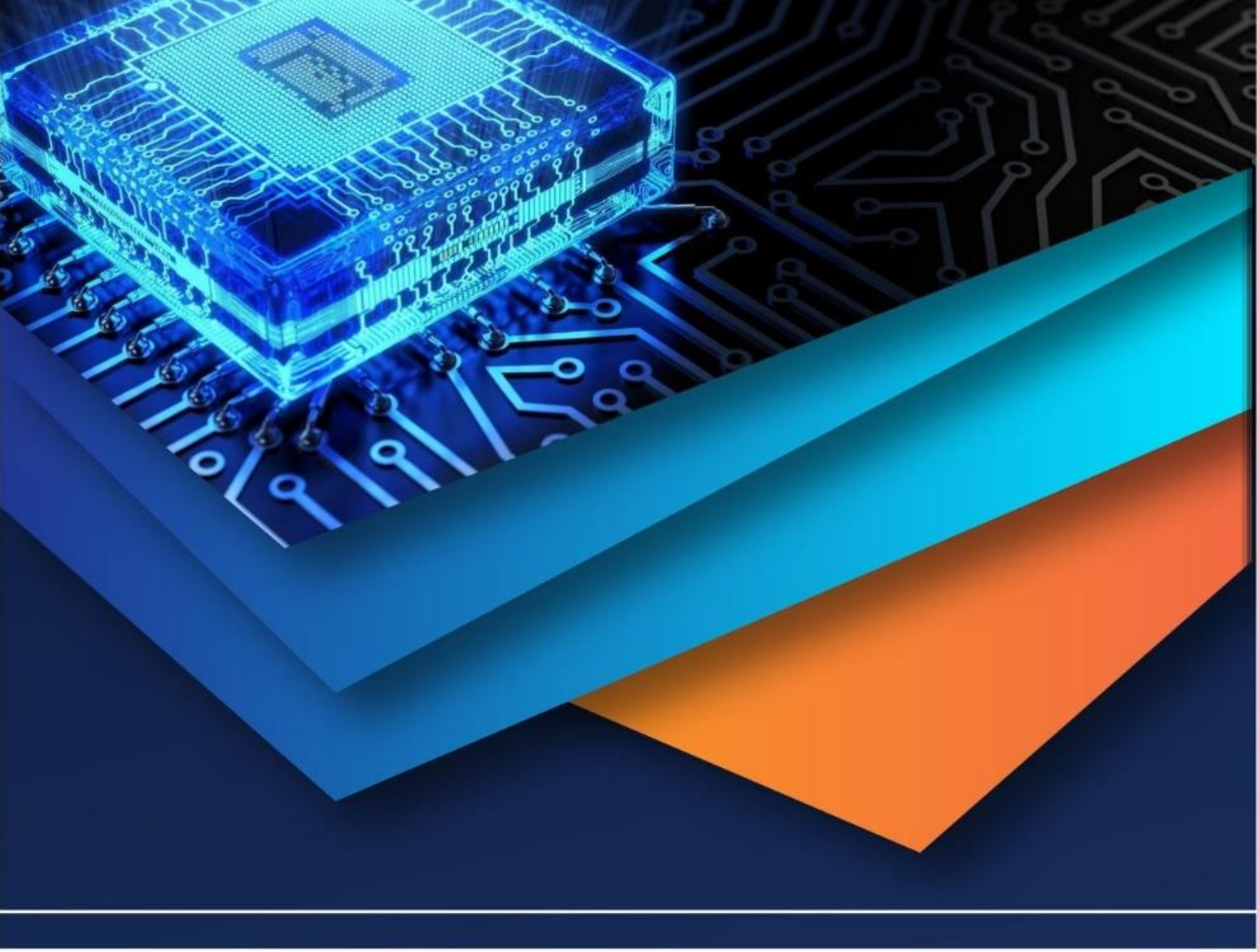

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