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Revamp energy efficiency in Homogeneous Wireless Sensor Networks using Optimized Radio Energy Algorithm (OREA) and Power-Aware Distance Source Routing protocol

J.T. Thirukrishna *, S. Karthik, V.P. Arunachalam

Department of Computer Science and Engineering, SNS College of Technology, India

HIGHLIGHTS

- Sensor network deployment is well organized in the proposed system in order to increase the lifetime of the sensor network.
- Optimized Radio Energy clustering algorithm is used to minimize the energy level (i.e. save energy) through homogenous WSN.
- The PADSR routing protocol used in the sensor networks to identify the route path and to establish the communication between nodes in an efficient manner.
- PADSR is used in the election of cluster head and also used to identify the dead nodes. This routing protocol decides the performance evaluation of QoS.
- The data quality is balanced by measuring the quality metrics such as packet delivery ratio, loads etc.

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ABSTRACT

Wireless Sensor Networks (WSNs) are often used to monitor the physical world. By using sensor nodes, various types of environmental conditions can be sensed and also it can communicate with the sensed data via wireless communication. The sensor nodes are provided with a battery, and the reduction of the power consumption may lead to the prolonged anticipation of a lifetime of sensor nodes. Researchers worked on sensor nodes to gain energy efficiency and increase its lifetime. Reliable and effective communication among nodes routing algorithms is often used for WSNs. The important objective of routing algorithms is energy saving. Clustering algorithm improves energy efficiency in Homogeneous WSNs. The clustering technique identifies the shortest path, and it is used for cluster head selection. To dissipate energy efficiently, Optimized Radio Energy Algorithm (OREA) is used. Power-Aware Distance Source Routing (PADSR) clustering algorithm has been proposed for increasing Network lifetime of WSNs. Energy consumption and data quality are balanced by Quality of Service based routing protocols. Power-Aware Distance Source Routing (PADSR) decides performance evaluation of Quality of Service.

1. Introduction

Technological advancement enables the development of low-cost, low-power sensor nodes in wireless technologies and Micro Electro Mechanical System (MEMS). The process of sensing and communication among components are made by sensor nodes [1,2].

The Wireless Sensor Networks which introduced recently perform many applications based on sensing and actuating. The WSNs are comprised of thousands of sensors. The applications include wildlife habitat monitoring, underwater monitoring, pollution monitoring and so on. The small, low-cost sensor nodes perform processing, communication and gathering information [3,4].

The sensors are made up of the processor, storage memory and communication channels. For communication, these sensors use communication channel and frequency channel.

The efficient routing algorithms maximize the lifetime of the network in WSN. The network life is increased by matching the routes to the energy constraints. A routing protocol tells how routers communicate and the implementation of a routing algorithm in software or hardware. WSN consists of autonomous sensors to monitor temperature, sound, vibration, pressure and so on. WSNs do not use a fixed networked infrastructure. The challenges of WSNs are inherent features. The energy efficient protocol eliminates the candidate nodes to improve the performance of network [5].

* Corresponding author.
E-mail addresses: maill2thiru@gmail.com (J.T. Thirukrishna), profskarthik@gmail.com (S. Karthik), vp_arun@yahoo.com (V.P. Arunachalam).

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There are various protocols for increasing the WSNs life and routing correct data. These protocols have their Pros and Cons [6].

6LoWPAN, a simple, low-cost wireless network has limited power and relaxed throughput. Its usage includes networking transducers, networking simple controls and networking complex controls. It supports topologies such as star topology, mesh topology, ring topology, etc. Each node carries an IPv6 address. Nodes need less memory, power and implemented by wireless microcontroller [7,8].

2. Related work

Radio transmission and reception involve a radio wave which is acting as a carrier of information-bearing signals. The information can be encoded directly on the wave by interrupting its transmission periodically or impressed on it by a process known as modulation. Radio transmission and reception process consume a lot of energy in a wireless sensor network (WSN). These are made up of low-cost, low-power, small size and multifunctional sensor nodes. Thus, one of the important issues in wireless sensor network is the inherently limited battery power within the sensor nodes. Therefore, battery power is a crucial parameter in the algorithm design in maximizing the lifespan of sensor nodes. This maximization process uses routing protocols for Mobile *Ad hoc* Networks (MANET's). MANET is also known as wireless *Ad hoc* network, and it is considered as a self-configuring network without infrastructure. The routing protocols involve DSR, ABR and AODV [9,10].

ABR is a mobile routing protocol and in this, the concept of associates such as link stability among nodes over time and space are included. In homogeneous sensor networks, all the sensor nodes and base stations are identical regarding hardware capability and initial battery power. In this method, the static clustering elects Cluster Heads (CH) only once for the entire lifetime of the network. The responsibility of the cluster head is to collect the data from cluster's nodes and forward the aggregated data to base station. Election of the CH once results in overload on cluster heads. Some clustering protocols have been explored to obtain the effective energy usage in WSNs. As proposed in Low-Energy Adaptive Clustering Hierarchy (LEACH) [11,12], the role of cluster heads is randomly and periodically rotated over all the nodes to ensure the same rate of dissipation of battery power for all the sensor nodes [13].

The mesh topology contains nodes which can communicate with any other nodes [14]. If these nodes do not communicate directly within range, they can communicate indirectly by relaying the transmission through multiple additional nodes (Fig. 1). In the mesh topologies, messages can take any of the several nodes from a source to destination, and they travel through gateways [15]. The gateways and nodes work together to form a mesh network. The gateway maintains a list of nodes that have been authorized for network access [16].

Fig. 1 depicts Mesh Topology Transmission through additional nodes. Each device in MANET is free to move independently in any direction and will change its links to other devices frequently. It supports hierarchical routing protocol. With this type of protocol, the choice of proactive and reactive routing depends on the hierarchical level in which a node resides. With some proactive prospect routes, the routing is primarily established and assists the request from additional active nodes. This is achieved through reactive flooding on the lower levels. The Distance Source Routing (DSR) protocol is managing the routing through cluster head selection [17,18]. The choice for one or the other method requires proper attribution for respective levels. Power management is a technique to reduce the energy consumed in the wireless interface of mobile devices. And these mobile devices are known to be battery powered. The design of optimal power management

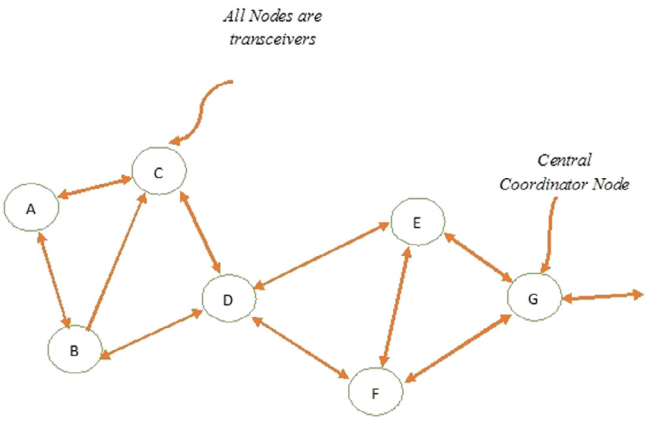

Fig. 1. Mesh topology node coordination.

policies needs to explicitly account for the diverse performance requirements. These needs are posed by different application scenarios such as latency, throughput and other performance metrics [19,20].

Power management policy in wireless networks is invoked to answer the following questions: (i) which set of nodes should perform power management (ii) when a power-managed node switches to the low power state and (iii) when power-managed node switches from the low-power state to the active state. The following cases are the overhead increases for sending multiple paths through replies, increasing the multiple numbers of paths, increasing the path length, increasing of distance between the source and the destination, all above [17,21]. *Ad hoc* On-Demand Distance Vector AODV is a routing protocol for mobile and *Ad hoc* networks(MANETs) and other wireless *Ad hoc* networks. It is a variation of Destination Sequenced Distance Vector (DSDV) routing protocol which is collectively based on DSDV and DSR.DSDV means Destination-Sequenced Distance-Vector Routing which is a table-driven routing scheme for *Ad hoc* mobile networks based on the Bellman–Ford algorithm. AODV aims to minimize the requirement of system-wide broadcasts to the greater extent. It does not maintain routes from every node to every other node in the network. They are discovered as and when needed and are maintained only as long as they are required. The key steps used by AODV for the establishment of Unicast routes are Route discovery and Route maintenance [22,23]. AODV is a routing protocol, and it deals with route table management. Route table information must be kept even for short-lived routes and they are created to temporarily store reverse paths towards nodes originating Route Requests (RREQ). This RREQ is a route request packet. It is broadcasted from a source node to other nodes in the network [24].

Power Efficient Gathering in Sensor Information Systems (PEGASIS) is a near optimal chain-based routing protocol, this achieves optimization in a large manner and also realizes a balance of energy consumption between nodes. In PEGASIS each node communicates only with a close neighbour and takes turns transmitting to the base station while communicating with their nearest neighbours and alternate. These are the leaders in transmission to the BS. BS refers to the external base stations. The protocol uses the thought of neural network to select the chain head, and it uses ant colony algorithm to find the best path to send data to the BS. Then the whole area is divided into multiple equal parts. In PEGASIS, all the sensor node locations are random, and each node has the power of data detection, data fusion, wireless communication and positioning. Energy load is distributed equally among all sensor nodes in the network. In this, the chain is shaped by the nodes themselves [25,26]. They can first acquire location on data of all

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