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A Survey on Dynamic Power Management Techniques in Wireless Sensor Network

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ABSTRACT: Mobile Ad-hoc networks (MANETs) are self organized networks whose nodes are free to move randomly while being able to communicate with each other without the help of an existing network infrastructure. In MANET, the routing protocols have to route the packets depending on the MANET constraints such as battery power in addition to the shortest path [1]. The limited battery supply to mobile node in MANET requires that the routing protocols utilize power efficiently and thus maximize the network life time [2]. The energy aware deterioration in ad hoc networks is a very important aspect of the overall management of ad hoc networks. In this paper, the focus is on the reactive power-alert technique for communication between ad hoc network nodes by continuously alerting their energy status to neighbor nodes. Here the concentration is on reducing the energy consumption by proposing optimal path selection method. In this scheme a threshold value is set on the energy consumed by mobile nodes in ad-hoc network. If the energy level of any nodes in the network reaches a threshold level then such nodes are made inactive and inform other nodes not to establish connections with it in this sleep state [4]. In this paper, experimental results and a comparative analysis are presented based on the use of this threshold. The result shows significant improvement in the throughput and routing load which in turn increases the lifetime of the network. In wireless sensor network, nodes are usually powered by batteries with limited amount of energy [7]. This paper uses an Ad Hoc on Demand Multipath Routing Protocol for finding multiple paths to transfer the data from source node to destination node. The proposed work performed the energy efficient routing, when the sink node (base station) is in static state and all other neighbor nodes are in mobile state. Here gateway node acts as a relay for transmitting data from one group of node to another group. The performance of Ad hoc on Demand Multipath Routing Protocol is compared with Ad Hoc on Demand Distance Vector Routing Protocol. The simulation result shows that the proposed energy efficient routing algorithm consumes low energy and gives high throughput.

KEYWORDS: Mobile Ad-hoc networks (MANETs), Dynamic Power management (DPM), Node Alarming Mechanism (NOAL).

I.INTRODUCTION

Wireless Sensor Networks (WSNs) have several applications in different fields as military, surveillance and commercial applications such as environment monitoring, traffic control, remote patient monitoring and disaster relief applications[1-2]. Although WSN is used in many applications, it has many restrictions such as limited computation and limited communication abilities [3]. Hence various routing protocols have been developed for WSNs because the routing in WSNs is distinguished from other networks AODV is one of the reactive routing protocols adapted for WSNs topology [7] this protocol considers hop count to route the data to the required destination from the source. However, this protocol does not consider the energy consumption of the nodes to transfer the message from source to destination node. So the lifetime of the network is reduced by utilizing the same path and nodes. To extend the lifetime of sensor nodes, routing protocol with energy efficient is considered. And also it is desired to maintain the sensor nodes as long as alive as the sensor nodes are irreplaceable. Hence an attempt has been made to implement Energy aware Ad hoc On-demand Distance Vector (EAODV) by appending minimum residual energy along with minimum hop count in the Route Request (RREQ) message of the existing reactive routing protocol named AODV protocol. The throughput performance is evaluated for EAODV protocol and compared with AODV protocol by varying different criteria such as coverage area, packet rate and packet size in CBR traffic which is described in this research work.

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A wide range of wireless sensor network applications are:

- Underwater sensor networks that are used for monitoring of fisheries and coral reefs. The underwater sensor network is composed of mobile and static nodes.
- The installation, deployment and maintenance process is accelerated by using WSN in volcanic monitoring. As these networks use equipments that are lighter, smaller and less power consumption. This application of WSN has many challenges that include data collection, event detection, high data rates and sparse deployment of nodes.

Other applications of WSN include:

(1) Outdoor/indoor monitoring of environment.
(2) Monitoring of health.
(3) Factory and process automation.

II. DYNAMIC POWER MANAGEMENT

A dynamic power management (DPM) strategy ensures that power is consumed economically. The strategy can have a local or global, or both. A local DPM strategy aims to minimize the power consumption of individual nodes by providing each system with amount of power that is sufficient to carry out a task at hand. When there is no task to be processed, the DPM strategy forces some of the systems to operate at the most economical power mode or puts them into a sleeping mode. A global DPM strategy attempts to minimize the power consumption of the overall network by defining a network-wide sleeping state.

III. LITERATURE REVIEW

The problem of energy awareness in MANETs can be addressed at different layers. Many researchers have addressed the problem of optimizing the energy consumption in mobile nodes. Also presented below is a brief review of Work carried out by some authors on energy awareness in MANETs.

1 Node Alarming Mechanism (NOAL):

In this technique the authors suggest that an intermediate node having low energy would alarm its status to the others. By notifying its energy status to others, it can prevent others from sending more data to itself, which stops consuming more energy by forwarding data packets.

2 Low energy routing Protocols:

Here the authors propose a new scheme that uses sub-optimal paths occasionally to provide substantial gains. Multiple paths are found between source and destinations, and each path is assigned a probability of being chosen, depending on the energy metric. Every time data is to be sent, one of the paths is randomly chosen depending on the probabilities; hence none of the paths is used all the time, preventing energy depletion.

3 GPS-based Routing Algorithm method:

It makes use of the location dependent position information to route packets with the minimum required transmit energy. The key requirement of this technique is that the relative positions of nodes are available to all nodes.

4 Minimum Energy Routing:

This method proposes an on-demand routing algorithm which trades off more routing overhead for lower total energy. It is based on minimizing the amount of energy per bit required to get a packet from source to destination.

5 Battery cost-aware routing:

The author proposes power-aware routing that maximizes the lifetime of ad-hoc mobile networks, by evenly distributing power consumption rate of each node and by minimizing overall transmission power for each connection request. He proposes a Minimum battery cost routing algorithm that minimizes the total cost of the route. It minimizes the summation of inverse of remaining battery capacity for all nodes on the routing path. Whereas Min-Max battery cost routing algorithm is a modification of minimum battery cost routing. This metric always tries to

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avoid the route with nodes having the least battery capacity among all nodes in all possible routes. The Conditional Max-Min battery capacity routing algorithm chooses the route with minimal total transmission power if all nodes in the route have remaining battery capacities higher than a threshold; otherwise routes including nodes with the lowest remaining battery capacities are avoided.

6 Lifetime Prediction Routing (LPR):

It is an on demand source routing protocol that maximizes the network lifetime by finding routing solutions that minimize the variance of the remaining energies of the nodes in the network. This uses battery lifetime prediction and favors the path whose lifetime is maximum. In Lifetime Prediction Each node tries to estimate its battery lifetime based on its past activity.

7 Localized Energy-Aware Routing (LEAR):

It achieves a trade-off between balanced energy consumption and shortest routing delay, and at the same time avoids the blocking and route cache problems. This algorithm grants each node in the network, permission to decide whether to participate in route searching, which thus spreads the decision making process among all nodes. When a routing path is searched for, each mobile node relies on local information of remaining battery level to decide whether to participate in the selection process of a routing path or not.

It was observed that the previous work does not particularly address the issue of detecting unfaithful nodes (which run out of battery). Experimental results for a technique of EAODV algorithm with AODV protocol have been put forward. This technique identifies the unfaithful nodes & stops other nodes from establishing connection with them, so that the routing load will be minimized.

Year	Test Method /Technique	Key Findings
2008	PAMAS Protocol	Power aware Multiple Access Protocol was proposed using radio interface of a Node.
2009	Analysis of AODV & DSR protocols	Here selected MANET Reactive Routing protocols, Ad-hoc On-demand Distance-vector (AODV) and Dynamic Source Routing (DSR) Protocol were analyzed in accordance with their finest performance of packets delivery rate, average end-to-end delay, and packet dropping.
2010	Ad-hoc on demand Distance vector routing with path accumulation	This chapter proposes the source route accumulation feature. In Addition a routing Algorithm is proposed which adds a field in request packet which stores trust value indicating node trust on neighbor.

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2011	Energy & mobility aware clustering technique	Passive clustering or GRIDS algorithm (Geographically Repulsive Insomnious Distributed Sensors) was used.
2012	AODV-PA : AODV With Path Accumulation	Modify AODV to improve the source route accumulation feature of DSR.
2013	Energy Aware for low energy Ad-hoc sensor networks.	Proposed a new routing protocol that is suitable for low energy & low bit rate networks. Idea is to use the lowest energy path & utilize resources equitably.
2014	Lifetime Prediction Routing	This uses battery lifetime prediction and favors the path whose lifetime is maximum. In Lifetime Prediction Each node tries to estimate its battery lifetime based on its past activity.
2015	Localized Energy-Aware Routing	It achieves a trade-off between balanced energy consumption and shortest routing delay, and at the same time avoids the blocking and route cache problems.

IV.WIRLESS SENSOR NETWORK

Wireless sensor networks are composed of independent sensor nodes deployed in an area working collectively in order to monitor different environmental and physical conditions such as motion, temperature, pressure, vibration sound or pollutants. The main reason in the advancement of wireless sensor network was military applications in battlefields in the beginning but now the application area is extended to other fields including industrial monitoring, controlling of traffic and health monitoring. Different constraints such as size and cost results in constraints of energy, bandwidth, memory and computational speed of sensor nodes.

A wireless sensor node in a network consists of the following components are:
1. Microcontroller
2. Radio transceiver
3. Energy Source (Battery)

WSN have the following distinctive characteristics are as follows:
1. They can be deployed large scale.
2. These network are scalable, the only limitation is the bandwidth of gateway node.
3. Wireless sensor networks have the ability to deal with node failures.
4. Another unique feature is the mobility of nodes.
5. They have the ability to survive in different environment surroundings.

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6. They have dynamic network topology.

Further developments in this technology have led to integration of sensors, digital electronics and radio communications into a single integrated circuit (IC) package. Generally wireless sensor network have a base station that communicates through radio connection to other sensor nodes. The required data collected at sensor node is processed, compressed and sent to gateway directly or through other sensor nodes.

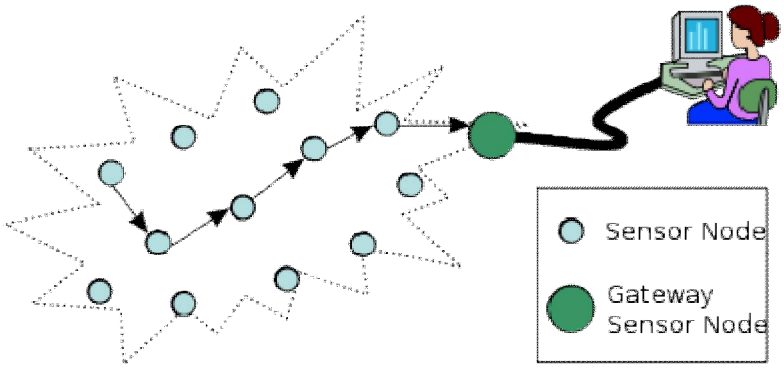

Figure 1: Wireless Sensor Network Architecture

V.CONCLUSION AND FUTURE WORK

The proposed algorithm aims at addressing the problem of improving the energy efficiency and thus maximizing the network lifetime of a MANET deployed in a typical military scenario. Current work tries to suggest methods to conserve and increase the battery life by suggesting an energy efficient routing approach for reactive MANETs.

As a future work, the reliability factor by using a link stability parameter to prevent unstable links from participating in route discovery procedure can be implemented to further improve the energy efficiency, as it would reduce link breakages which cause generation of route error messages leading to fresh route discovery procedure. The work can be extended to see performances with DSR, DSDV, OLSR, hybrid routing protocol and their characteristics be compared.

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