ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, January 2016

Throughput Analysis of Cluster Based Dynamic Node Energy Consumption Management in Wireless Sensor Network

Saumya Sharma[1], Krishna Kumar Joshi[2], Neelam Joshi[3]

Currently Pursuing Masters Degree, Dept. of CSE, MPCT College, RGPV University, Gwalior, India[1]

H.O.D, Dept. of CSE, MPCT College, RGPV University, Gwalior, India[2]

Assistant Professor, Dept. of CSE, MPCT College, RGPV University, Gwalior, India[2]

ABSTRACT: In wireless sensor network, nodes are usually powered by batteries with limited amount of energy. 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 neighbour nodes are in mobile state. The main challenging task in WSN is routing. There are various types of routing protocols available for WSN. Ad hoc On-demand Distance Vector (AODV) routing protocol is one of routing protocols for mobile sensor networks. Energy efficient Ad hoc On-demand Distance Vector (EAODV) routing protocol is developed by incorporating energy aware algorithm along with the shortest route in the existing Ad hoc On-demand Distance Vector Routing protocol to reduce battery power and lifetime of WSN. The simulation results obtained show that the combination of the both bandwidth and energy in management performs better than the existing protocols the routing protocols have been proposed considering mobile nodes in the network focusing on research issues like packet loss, energy consumption, and delay. In this paper, the cluster based routing protocols that have been proposed for mobile wireless sensor network comparison is done among them the simulation result shows that the proposed energy efficient routing algorithm consumes low energy and gives high throughput In this paper, throughput performance of AODV protocol has been examined, packet rate, coverage area and number of packets. Our simulation results show that network lifetime significantly without sacrificing packet delivery performance the simulation is run on NS-2.34 with 11 nodes in total.
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KEYWORDS: Power Management, WSN, Duty cycle, Routing Protocol, Energy efficiency, Power management.

I. INTRODUCTION

A wireless sensor network is made by a large number of low power sensors. Now days, wireless sensor network having various applications such as radiation level control, battlefield, noise pollution control, biological detection, structural health monitoring etc. 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. First, due to the relatively large number of sensor nodes, it is impossible to build a global addressing scheme for the deployment of a large number of sensor nodes [4-5]. Thus, traditional IP based protocols may not be applied to WSNs. Second, sensor nodes are tightly constrained in terms of energy, processing, and storage capacities [6]. So they require careful resource management. Third, as node failure is occurred frequently in WSNs which results in unpredictable and frequent topological changes. So the routing protocol must adapt to frequent changes of the WSNs topology. 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

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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 paper.

II. AD HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL

The AODV [8] protocol is an on-demand routing protocol, which accomplishes the route discovery whenever a data transfer is requested between nodes. The AODV routing protocol searches a new route only by request of source nodes. When a node requests a route to a destination node, it initiates a route discovery process among network nodes [9]. Once a route is discovered in the AODV routing protocol, the route will be maintained in a table until the route is no longer used. Each node in the AODV protocol contains a sequence number, which increases by one when the location of a neighbour node changes. The sequence number can be used to determine the recent route at the routing discovery. The AODV protocol utilizes a similar routing discovery process as the DSR (Dynamic Source Routing) protocol but uses a different process to maintain and manage a routing table. The nodes of the DSR protocol maintains all routing information between source and destination but the nodes of the AODV protocol have path information in a brief routing table, which stores the destination address, destination sequence number and next hop address.

In AODV protocol, the flooding of RREQ messages is done as shown in Figure 1. Each entry of a routing table has a lifetime field which is set when its routing information is updated and changed. An entry will be removed from the routing table when its lifetime is expired. Moreover, to maintain a routing table, the AODV protocol periodically exchanges routing messages between neighbor nodes [10]. Such processes typically raise significant overhead and wastes available bandwidth.

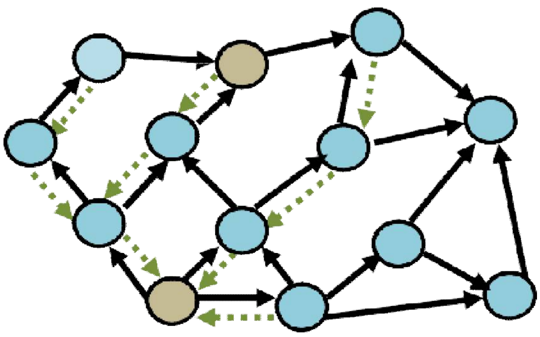

Figure 1: Flooding of RREQ messages

However, the AODV protocol reduces the latency time of the routing discovery and determines efficient routes between nodes. After flooding the RREQ messages in a network, a route is established between source and destination. The AODV routing protocol determines a least hop-count path between a source and a destination, thus minimizing the end-to-end delay of data transfer. Since the protocol uses the shortest route for end-to-end data delivery, it minimizes the total energy consumption.

However, if two nodes perform data transfer for long time on the specific path, nodes belonging in this path use more battery power than other nodes, resulting in earlier powering out of nodes [11-13]. The increase of power-exhausted nodes creates partitions in the wireless sensor network. The nodes belonging to these partitions cannot transfer any further data, thus killing the lifetime of the network.

In order to extend the lifetime of the network, one possible solution is to make equally balanced power consumption of sensor nodes. Since AODV routing mechanism does not utilize the residual energy of nodes at the

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routing setup, and since it considers only routing hop count as a distance metric, such unbalanced node energy consumptions occurs. Hence, energy efficient routing algorithm is developed [14] by considering both node hop-count and node energy consumption.

III. DYNAMIC POWER MANAGEMENT

The problem of power consumption can be approached from two angles: one is to develop energy-efficient communication protocols (self-organization, medium access and routing protocols).The other is to identify activities in the networks that are both wasteful and unnecessary and mitigate their impact. Most inefficient activities are, however, results of non-optimal configurations in hardware and software components. 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. There are different ways to achieve this goal. One way is to let individual nodes define their own sleeping schedules and share these schedules with their neighbors to enable a coordinated sensing and an efficient inter-node communication. This is called synchronous sleeping. The problem with this approach is that neighbors need to synchronize time as well as schedules and the process is energy intensive. Another way is to let individual nodes keep their sleeping schedules to themselves; and a node that initiates a communication should send a preamble until it receives an acknowledgment from its receiving partner. This approach is known as asynchronous sleeping schedule and avoids the needs to synchronize schedules. But it can have a latency side-effect on data transmission. Once the design time parameters are fixed, a dynamic power management (DPM) strategy attempts to minimize the power consumption of the system by dynamically defining the most economical operation conditions. This condition takes the requirements of the application, the topology of the network, and the task arrival rate of the different subsystems into account. Whereas there are different approaches to a DPM strategy, they can be categorized in one of the following three approaches:
1. Dynamic operation modes.
2. Dynamic scaling.
3. Task Scheduling

IV. RESULT ANALYSIS

The model of wireless sensor network using AODV and EAODV protocol is simulated by using ns-2 [15]. The simulation model is performed for 11 nodes by considering the coverage area of 773×571(m^2) and simulation time of 100 seconds. The traffic model considered in the simulation is UDP/CBR traffic model. Size of data packet in CBR traffic is varied from 64 to 500 bytes, packet rate varies from 25 to 500k packets/sec and maximum no. of packets in queue is varied from 1 0 0 packets. Each sensor node in the network is assumed to have an initial energy level of 0.5 Joules. A node consumes the energy power of 175mW on packet transmission and energy power of 175mW on packet reception.

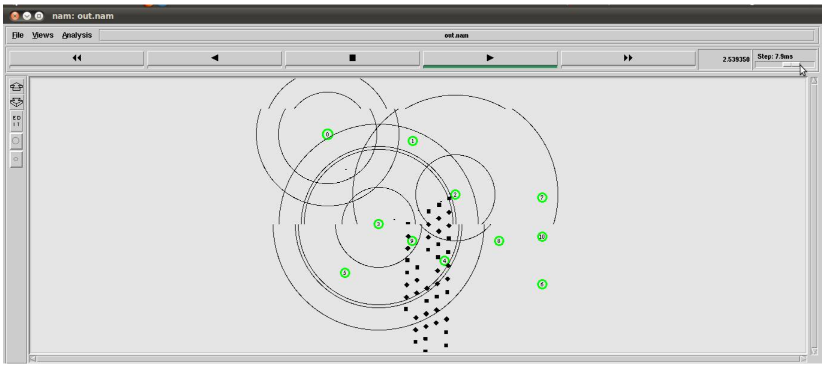

Fig2: Snapshot of the simulation in NAM for 11 mobile nodes.

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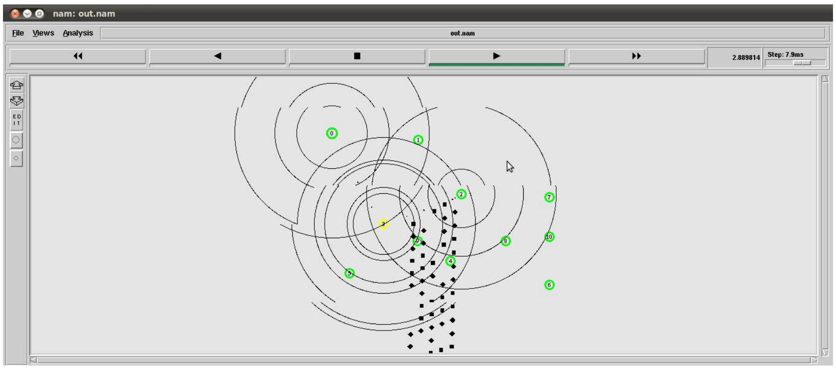

Fig3: Snapshot of the simulation in NAM for 11 mobile nodes.

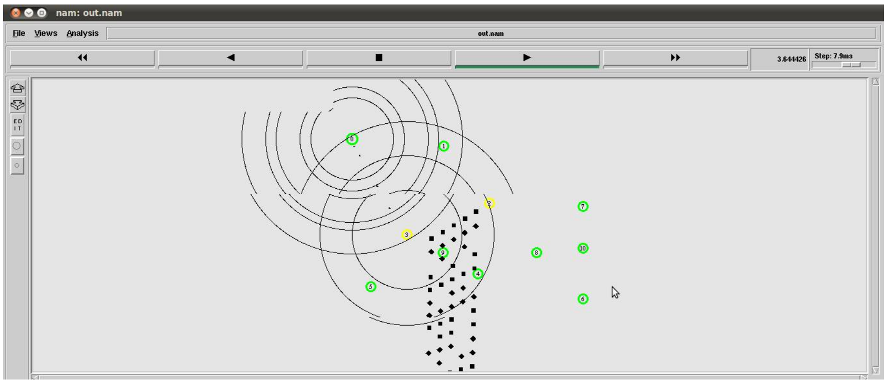

Fig4: Snapshot of the simulation in NAM for 11 mobile nodes.

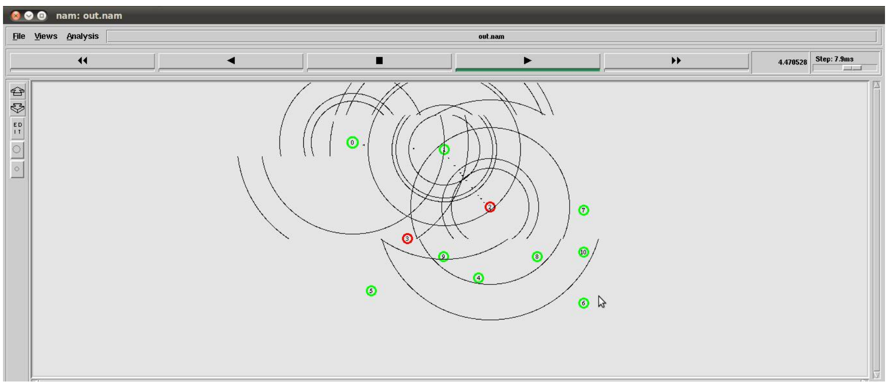

Fig5: Snapshot of the simulation in NAM for 11 mobile nodes.

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Fig6: Snapshot of the simulation in NAM for 11 mobile nodes.

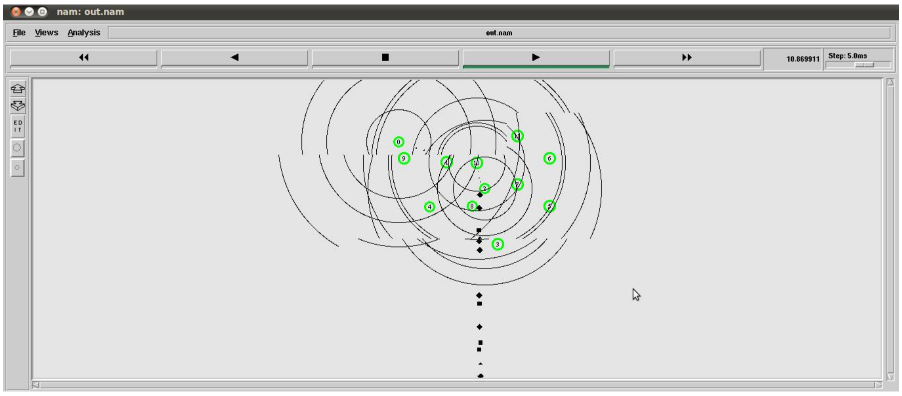

Fig7: Snapshot of the simulation in NAM for 11 mobile nodes.

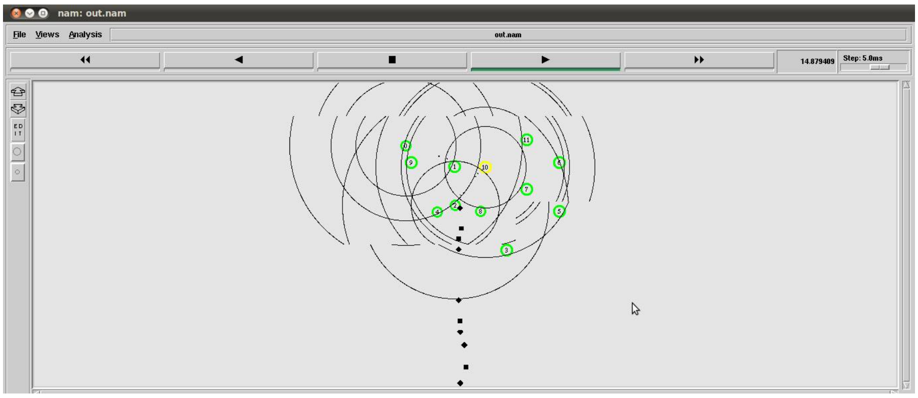

Fig8: Snapshot of the simulation in NAM for 11 mobile nodes.

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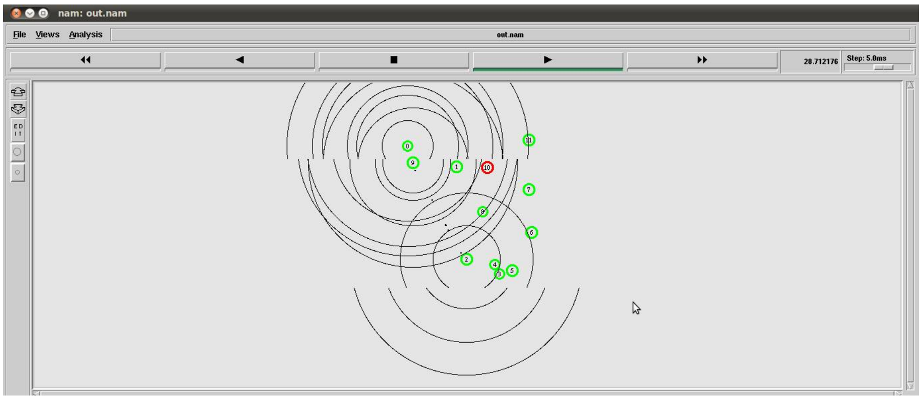

Fig9: Snapshot of the simulation in NAM for 11 mobile nodes.

Fig10: Snapshot of the simulation in NAM for 11 mobile nodes.

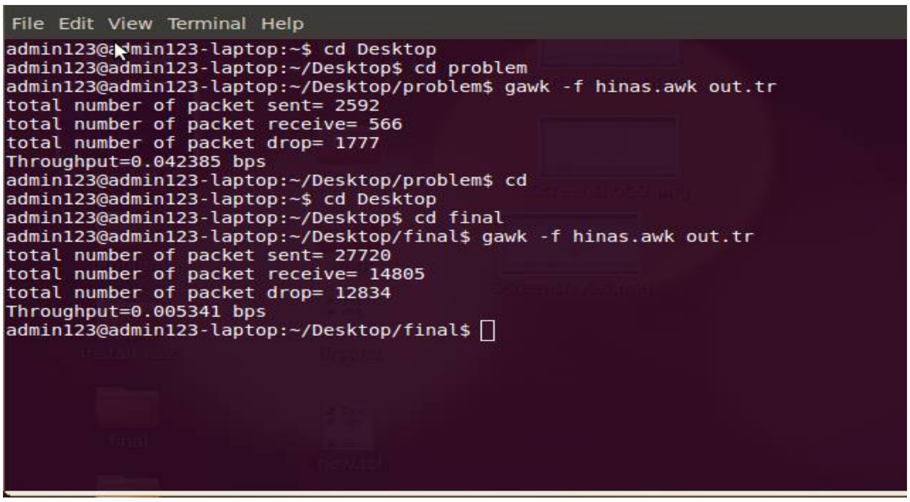

Fig11: Throughput analysis with packet sent and receive

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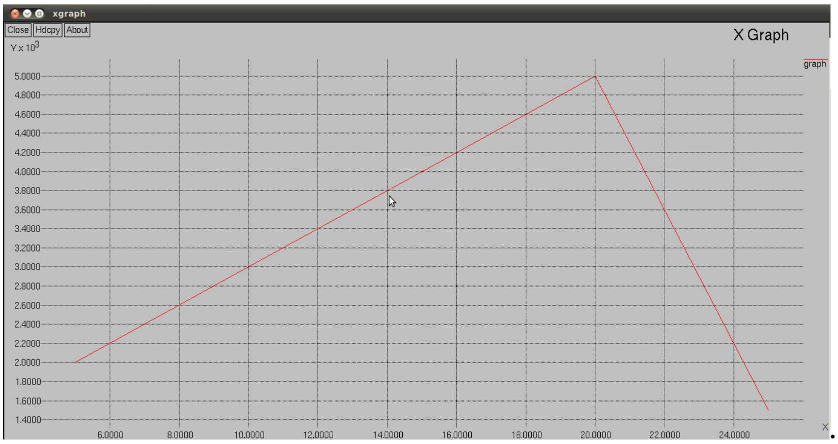

Fig12: Throughput analysis with packet sent and receives

IV. CONCLUSION & FUTURE WORK

Energy efficient Ad hoc On-demand Distance Vector (EAODV) is thus a decentralized energy aware routing protocol which can be implemented for wireless sensor networks by using ns-2. EAODV uses the residual energy along with the hop count. It extends network lifetime by arranging almost all nodes to involve in data transfer. By varying the packet size, packet rate, coverage area and no. of maximum of packets in queue length and packet rate in the simulation, the throughput performance of WSN by using the AODV and EAODV is analyzed and compared for 50 nodes with the simulation time of 20 seconds and coverage area of 400x4400 (m^2). From the simulation results it can be concluded that the throughput performance of EAODV is much better than the AODV routing protocol. The throughput of the EAODV routing is 40-65% higher than the AODV routing. Thus EAODV can be implemented with the improved routing performance in terms of throughput

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