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Study of AODV, DSR and EHCERP in WSN

Prashant kumar Singh, Prof. Awadhesh Kumar

***Abstract*— Wireless sensor networks (WSNs) are formed by many randomly distributed sensor nodes, with features of high mobility, and frequent disconnection of nodes. These nodes are capable of measuring physical characteristics of the environment using waves as links between them. The physical characteristics they measure may be whether, humidity, earthquakes, surveillance etc. WSNs are different from wireless Local Area Networks (WLANs) and other computer networks in terms of limited resources like memory, power and life span. Energy usage is the greatest challenge for the WSNs. Today a tremendous amount of testing and researches are being done on the WSNs and its applications but still some issues need to be rectified.**

Many routing protocols are being deployed in this field. Some very important protocols are LEACH,AODV and DSR, DSDV, etc. It is observed that AODV and DSR are found to be very robust routing algorithms. Since AODV and DSR are two routing protocol used in the MANETS hence provides a better algorithm for highly mobile nodes in WSN. Here also in this paper we are integrating the Equalized Cluster Head Election Routing Protocol (ECHERP) which is an energy efficient Protocol.

***Index Terms*— WSN, AODV, DSR, MANETS, ECHERP**

I. INTRODUCTION

The Wireless Sensor Network[1] is explained as a random movement of mobile nodes in wireless scenario, in order to find the best possible path between sources to destination node; routing protocols are employed in wireless communication. As there is no dedicated link between the nodes, a routing strategy is helpful in finding the best and (low cost) shortest path. The wireless networks are mainly categorized into two types of networks these are infrastructure based network and infrastructure-less (also known as Ad-hoc network). In case of infrastructure based networks there is a base station called access point (AP) which establishes a wireless communication link between AP and a mobile data terminal having antenna (can be a laptop or tablet computer).The routing algorithm is also controlled by these access points, in wireless scenario. While in Ad-Hoc network there is no such an central point(or access point).Here nodes are self-configured and connect each other in ad-hoc manner. In WSNs the nodes are distributed in random manner and communicate to the base stations for data packet exchange. The range of transmission is fixed. While in Infrastructure less networks the base station or access point is not used. Here, every node which participates in the network fulfills all the working of base station and routing decisions are also taken by them. In a wireless network which has many distributed devices in random fashion to mutually measure the physical or geographical conditions such as heat, sound, frequencies, pressure, velocity, pollutants and humidity from different locations of the earth. In a typical WSN there exists a lot of small sensor devices in the detection zones and all the sensor nodes uses the radio signals to communicate wirelessly to form a multi-hop and self organized network system. All the sensor nodes communicates with each other to stay connect and with the data in the detected field and then send the result to the observer[2,3]. In addition nodes in WSN are prone to failure due to energy depletion, device failure, disconnection and low security due to malicious attack and so on[4].It results in low reliability of performance of sensor networks.

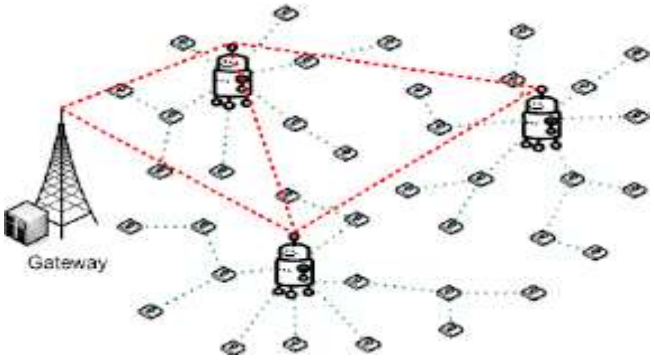


Fig 1.Wireless Sensor nodes with Base Stations

There are already several of AODV based routing protocols has been designed and implementated which are suitable are have been designed for environment of WSN such as AODV jr [5],Gossiping Based AODV, etc. In the Sections below we will discuss about some protocols and their categories.

II. WIRELESS SENSOR NETWORK PROTOCOLS

2.1. MAC Protocols

Medium Access Control (MAC) protocols solve a truly easy task: they coordinate the times where a number of nodes access a shared communication medium.

For the case of WSNs, the balance of requirements is different from traditional (wireless) networks. Additional requirements come up, first and foremost, the need to conserve energy.

2.2 IEEE 802.15.4 Family Protocols

The Institute of Electrical and Electronics Engineers (IEEE) proposed the IEEE 802.15.4 standard in October 2003. The targeted applications for IEEE 802.15.4 are in the area of wireless sensor networks, home automation, home security, etc.

III. AD-HOC ON DEMAND DISTANCE VECTOR (AODV) ROUTING PROTOCOL

AODV uses some features of DSR like on-demand characteristics such like it also find the routes only on "*as required"* basis through a similar route finding procedure.

Prashant kumar Singh, M.Tech. Student Department of Computer Science & Engineering, KNIT Sultanpur
Prof. Awadhesh Kumar, Associate Professor Department of Computer Science & Engineering, KNIT Sultanpur

However, AODV [7] uses a quite different method to manage routing information. It also uses common routing caches in the form of table on the basis of one entry per destination node or sink node that may maintain more than one route cache entries for each destination node in the table. Without any source routing, AODV relays on routing cache data to transmit a Route Reply data packet (RREP) back to the source node and, further, to set the path of data packets to the destination nodes or sink nodes. AODV uses a feature of sequence numbers which is recorded in the header of each destination packet to find that whether routing information is up to date or not ? And also to avoid path routing loop backs. These sequence numbers are then entered in the routing packets' entire header. A really necessary feature of AODV is the preparation and cure of states based on time-value in each node, in context of use of sole routing table entries. A routing cache entry is considered to be *expired* when it is not used for long period of time interval. A cluster of predecessor nodes is made for each routing table entry that indicates another cluster of neighbor nodes which may use that entry to route data packets from source to destination. These nodes are acknowledged with control packets call Route Error (RERR) packets when the next-hop communication path is interrupted. Each antecedent node, forwards the Route Error packet (Control Packet) to its own group of antecedent nodes and therefore very effectively removing all routes using the interrupted communication links. Route Error packets (RERR) in AODV are in this case used to acknowledge all source nodes using a path of communication whenever an interruption in communication route takes place. Route error process in AODV may be interpreted very simply in theoretical form as a tree like data structure whose root is acted as the node at the point of interruption of communication link and all source nodes using the failed communication link are its leaves. According to recent profile of AODV routing protocol it includes a path optimization technique to control the RREQ flooded in the route discovery process for establishing the communication link. It uses an *expanding ring search, in* initial stage it has to discover the routes to an unknown destination sink node. In the expanding ring search, integrating larger neighborhoods are determined to find the destination nodes. The search is then monitored and optimized by the Time to Live (TTL) area block in the IP header of the RREQ packets. When the route to a previously known destination is required, the old hop-wise distance is used to optimize the searching process. This then allows estimating the TTL data engaged in the RREQ packets dynamically, by the process of taking into consideration of the temporal locality of routes.

IV. Dynamic Source Routing Protocol (DSR)

Dynamic source Routing is defined as an auto configuring routing protocol in the wireless network environment.
The protocol uses a reactive paradigm that avoided the need to regularly flood the network with table update messages that may needed during a table-driven paradigm during a reactive (on-demand) paradigm same as this, a path is created only if it is needed and thus the requirement to search paths to any or all different nodes within the network like required by the table-driven approach is not required. The intermediate nodes additionally effectively use the route cache information to avoid the control overhead. The main con of this routing protocol is that in this the route updating mechanism does not necessarily repair a broken communication link. Stale route cache data result in inconsistencies throughout the route reconstruction section. The path setup delay is on the far side in table-driven protocols. Even if the protocol performs well in the static and very low mobility setup conditions, the performance degrades rapidly with increasing mobility of nodes.

V. Equalized Cluster Head Election Routing Protocol (ECHERP)

The ECHERP [8] (Equalized Cluster Head Election Routing Protocol), with the purpose of growth of the network lifespan elects a node as cluster head that reduces the total energy intake in the cluster and not the node with the higher energy. ECHERP also accepts multi hops routing system to transfer data to base station. In ECHERP, the BS is predictable to have unlimited energy residues and communication power. It is also supposed that the BS is located at a fixed position, either inside or away from the sensor field. The longer the distance between the BS and the center of the sensor field, the higher the energy expenditure for every single node transmitting to the BS. Entirely the network nodes, which are presumed to be located within the sensor field, are energetically grouped into clusters. One of the nodes within each cluster is chosen to be the cluster head of this cluster. Therefore, the number of cluster heads is equal to the number of clusters. The cluster heads, which are located close enough to the network base station, are mentioned to as the first level cluster heads. These cluster heads are capable of direct transmission to the base station with sensible energy expenditure. The cluster heads that are situated at large coverage positions from the base station are considered as second-, third-, etc. level cluster heads. These cluster heads pass on data to the upper level cluster heads. Moreover, in order to succeed balanced energy consumption and extend the network's lifespan, the election of the cluster heads is performed in turns. The main distinctive of ECHERP is the cluster head selection process. In this protocol, in order to designate a cluster head, the routing data and the energy consumed in the network are conveyed as a linear system, the solution of which is computed using the Gaussian elimination algorithm. Therefore, cluster heads are nominated as the nodes that minimize the total energy consumption in the cluster. Equalized Cluster Head Election Routing Protocol (ECHERP), pursues energy conservation through balanced clustering for Energy Efficiency.

VI. SIMULATION AND METHEDOLOGY

Methodology Own Implementation algorithms had to be implemented: 4.3 Cluster-Head Generation (Selection) In this model, all nodes maintain a neighboring (next hop) table to accumulate data to neighbors. All nodes to absent in the radio-range (r) of the distribution node are neighbors of the node. All nodes receive the data communication in the radio range and update its neighboring table [48]. Each & every node calculates it distances from its next hop and also they calculate their weighted by following formula:

$$W_i = RE_i \times \sum_{j=1}^{n} \frac{1}{d^2(v_i, v_j)}$$

Calculate node weights with the help of this equation. In written equation W_i is weight of every node i and d (v_i & v_j) is the distance between two node i & node j. Every node broadcasts its weight inside the given transmission range [39]. Node which has the highest weight among all its nearest in transmission range (r) is select as Cluster Head (CH).
These improve are:

- Minimize the amount traffic of the network.
- Minimize the energy consumption of the network
- Increase the network life time.
- Cluster Head selection must be better balanced.
- The Selection of that sensing element node send
- Once redundant information is detected should be higher balanced.
- Cases that pose a danger situation must be reported to the Base Station.
- These improvements are explained in more detail further on.

6.1 System Model and Assumptions The network is divided into n levels (multi-hop communication)

The proposed work is simulated with the help of NS-2.35.
The simulation parameters will be in table 1
The simulation area is 500*500 meter square and the packet size of network is 1000.
 The initial numbers of nodes of each cluster is n nodes and are dispersed randomly [8].
 All the nodes start with the same energy level, 1 (100%) All the nodes generate randomly a temperature between the value of 40 and 7 centigrade.
 The base station (BS) is a node with no energy compensation and increased computation capabilities and placed in the middle next to the level 1.
 Energy consumption of each node who transmit data can be estimated as highest energy model.
Clustering method is used in our wireless communication network. In this case, the data is not delivered directly from CH to BS. Nodes send their data to Cluster-Head and it forwarded the data to another Cluster Head of upper level up to the base station. Cluster Heads, closer to BS, receive data from the others Cluster Heads and have to send the data from their own cluster and the data from other clusters. It means that CHs closer to Base Station have more computational load that means more energy consumption An energy efficient routing protocol Equalized Cluster Head Election Routing Protocol (ECHERP) has been proposed. The current and future estimated remaining energy of the nodes are considered to make the cluster head in every round. The main purpose of using energy for making cluster head is to increase the lifetime of a network. At every round, the proposed algorithm used to calculate the energy consumed in the network and reduce the overall energy consumption in the network. ECHERP also used the multihop routing scheme to force the data send backward to the base station. ECHERP is analyzed and compared with earlier protocol like AODV& DSR through simulation in terms of last node depletion time and first node depletion time. This algorithm could be expanded in terms of QoS and time constrictions. An energy-efficient competitive clustering algorithm has been proposed for wireless sensor networks using a controlled mobile sink. Sensor nodes has effectively organize by clustering algorithm and controlled mobile sink lead to lessen the problem of energy holes problem has used to select the optimal moving for sink nodes. This algorithm has changed the cluster head in each round and selected the cluster head based on their range and remaining energy. Sink has mobile in nature as compares to fixed nature. The sink node has moved in predefined path at certain speed and stayed at park position to collect the data packets. The simulation has done on ns-2.35 environment to analyze the performance of an energy-efficient competitive clustering algorithm and compared with predefined protocol. The simulation result has showed better performance than AODV, DSR, and ECHERP.

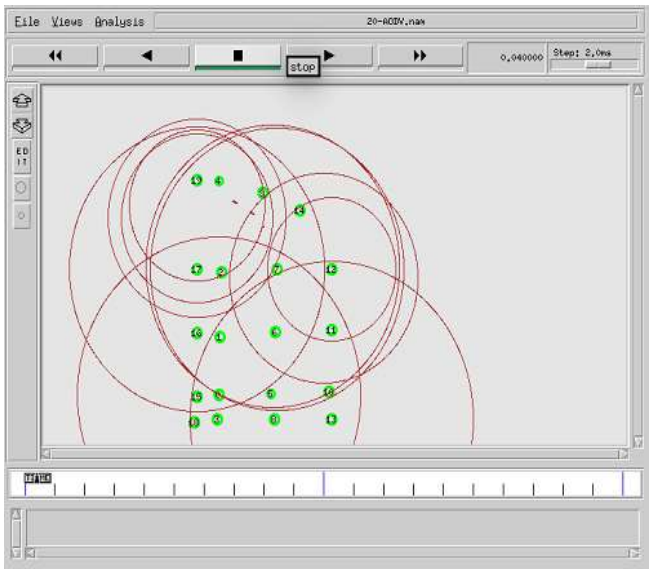
6.2 CONFIGURATION TABLE:-

PARAMETERS	VALUES
Operating System	Linux (Ubuntu 12.04)
NS-2 version	NS-2.35 for IEEE 802.11
No. of Nodes	20,40,60,80,100
Radio propagation model	Propagation/TwoRayGround
Network interface type	Phy/WirelessPhy
Packet Size	1000
Traffic Type	UDP-CBR
Execution Time	10sec
Antenna Type	Omni-Antenna
Transmission Range	500*500 m
Transmitting Power	0.6
Power's watt	0.281838
Receive Threshold	3.652e
Carrier Sense Threshold	1.559e
Initial Energy	90
Performance parameters	Delay, Energy, Throughput, PDR,OverheadS
Routing Protocol (Proposed)	AODV,DSR,ECHERP with Clustering Algorithm

Table 1

VII. RESULT AND ANALYSIS

The proposed work is simulated with the help of NS-2.35. Simulation can be done using 20,40,60,80,100 nodes. The simulation area is 500*500 meter square. The AODV ,DSR and ECHERP routing protocol are used to route the hops using physical and wireless network interface. The packet size is 1000.



VIII. PERFORMANCE PARAMETERS FOR COMPARISON

We will take five performance parameters for study on ECHEP Integrated AODV and DSR which are End-to End delay, Energy, Overhead, Packet Delivery Ratio, Throughput

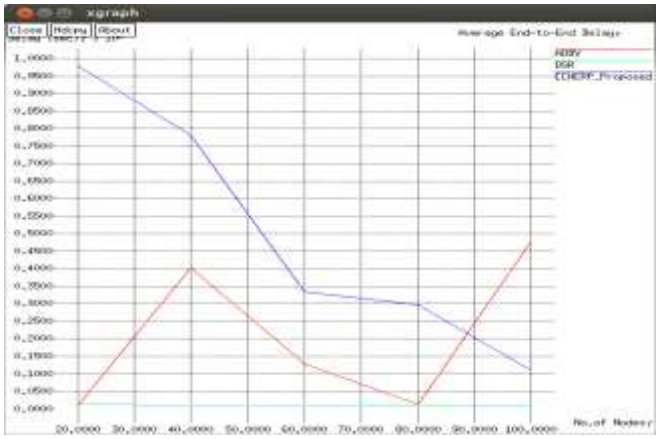
8.1 End -to-End Delay

The average end-to-end delay of data packets is the time interval between the data packet preparation time and the time when the last bit of that data packet arrives at the destination node. A low end-to-end delay is needed in any network.

It is also the average time required for transmitting a data packet from source node IP layer to the destination node IP layer, including transmission, propagation and queuing delay.

Average End-to-End Delay = Σ (Time when Packets enters in the Queue) - Σ (Time when the Packet is received)

Delay shown by graph 1 below



Graph 1

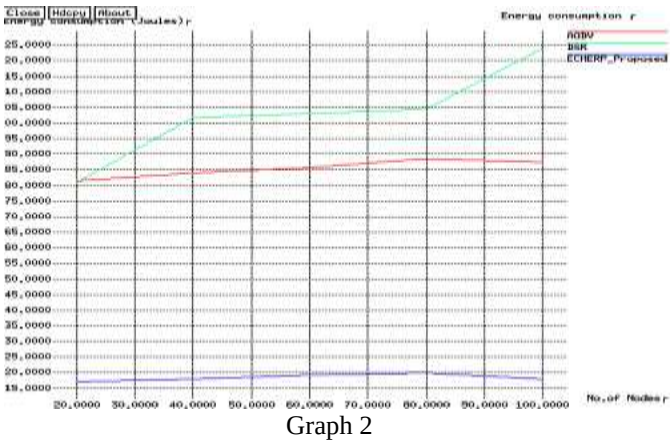
8.2 Energy

The Energy parameter is used to define the total average energy consumed by each node in wireless sensor network. This can be useful in determining the life span of the whole network also the reliability of the network.

The Energy can be calculated by the formula given below:

Energy = Sum of x and y coordinates divided by total number of nodes.

The average energy consumed by each node is shown in the graph 2 below:

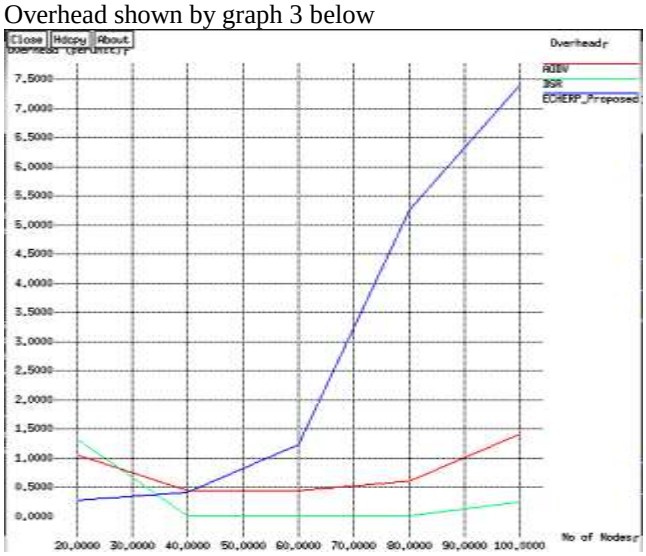


Graph 2

8.3 Routing Overhead

Overhead can be defined as combination of excess or indirect processing time, memory, bandwidth of transmission, or other available resources that are required to perform a specific task.

Overhead shown by graph 3 below

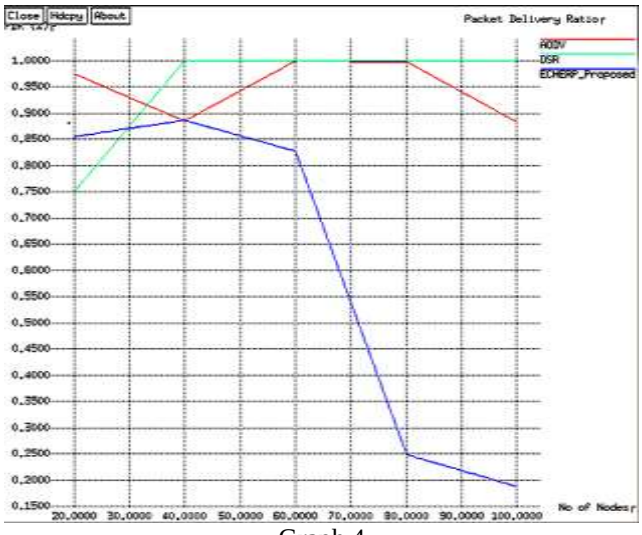


Graph 3

8.4 Packet Delivery Ratio

The packet delivery ratio determines the ratio between the number of packets sent from the source node application layer and the number of packets actually received at the destination node application layer. This is a very important metric of measurement of network reliability because it reveals the loss rate seen by the transport layer protocols and also characterizes the completeness and correctness of the routing protocol in any network

Packet Delivery Ratio shown by graph 4 below



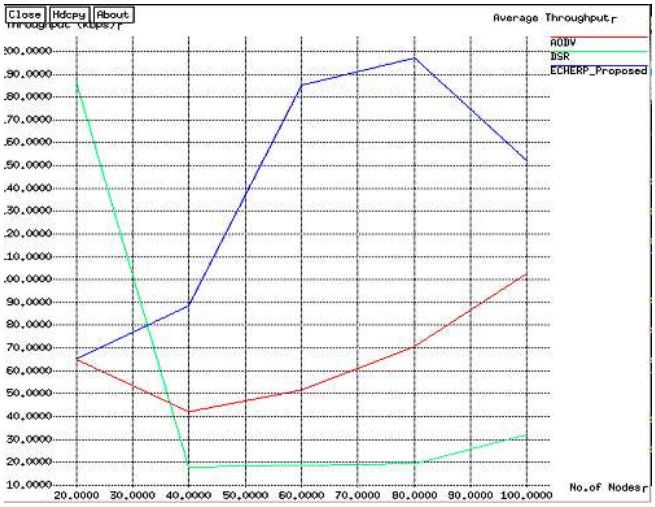
Graph 4

8.5 Throughput

Throughput is the number of packets that are passing through the medium during a explicit unit of your time.

This performance metric shows the overall number of packets that are fully delivered from sender node to receiver node and it may be improved with increasing node density .

Throughput shown by graph 5 below



Graph 5

IX. CONCLUSION AND FUTURE WORK

In this paper we have studied about the WSN protocol and the various routing protocols like ECHEP,AODV and DSR and various performances metric like end to end delay, Energy, Overhead, packet delivery ratio, and throughput.

In future we can simulate the above mentioned routing protocols with the same performance metrics with varying the mobility model and conclude their performance that how they behave with mobility model and packet sizes.

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