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Energy Efficient Reactive Routing to Enhance QOS of MANETs

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Abstract - *MANETS are the nodes, which are dynamic in nature and keep moving from location to location. When the nodes moves, the network topology changes and the link breaks between the nodes and the new link are formed. To deliver high ratio of data packets we propose energy efficient multipath routing scheme, which is an adaptation of AODV routing protocol to improve network lifetime. The proposed system determines multiple paths from source to destination by selecting nodes having high residual energy and also controls congestion and delivers high throughput. The proposed system is simulated in the NS2 simulator and the network parameters like, throughput, delay, packet delivery ratio, energy consumption and overhead is analysed*

Key Words: **Mobile Ad-hoc Networks (MANETs), Reactive Routing Protocol, Ad-hoc On Demand Distance Vector Routing (AODV), Energy Efficient Multipath Ad-hoc On Demand Distance Vector Routing (EMAODV);**

1. INTRODUCTION

A Wireless Sensor Network (WSN) consists of hundreds or thousands of low cost nodes which includes heaps and heaps of low value points which can be deployed fixed position or randomly communicating nodes to monitor the surroundings. Deploying big quantity small nodes are included in the WSNs which are trend from past few years. The nodes then experience environmental modifications and document these different nodes over the network design. The sensor network contains several lots of nodes and contains controlled resources. Topology adjustments occurs regularly due to the nodes disasters, it specifically uses broadcast communication. The huge environmental sensor nodes are great for deploying consists of the self-power unit, Sensing unit, Processing unit, memory, self and remote testing unit, sync and time unit, transmitter and receiver, routing tables and also security units. The nodes in the system are spread in the network.

Mobile ad hoc networks (MANETs) consists of mobile nodes which exchange information dynamically among them over wireless links. MANETs are an infrastructure-less, decentralized network which consists of a series of mobile wireless nodes that communicate with each other without any centralized authority being used. By its basic characteristics, such as wireless media, dynamic topology, distributed cooperation, MANETs is vulnerable to various kinds of security. The most important element of MANET is Routing Protocols which are needed to handle dynamic communication and also find route so as to deliver data packets to the correct destination. [1]. The nodes serve as routers to deliver data to their destinations from sources. The routers have to work together efficiently in order to achieve performance requirements of this kind of network. Routing algorithms moreover play a key role in the design for MANET's architecture, so they need presents tests and evaluation of reliability for two types of flat routing protocols: proactive and reactive routing protocols. [2]. Routing information of each node propagates through network by certain routing protocols: Reactive Routing, Pro-active Routing and Hybrid Routing are the three types of routing protocol.

Reactive routing protocol is an on demand routing protocols, when a source node wants to communicate with the destination node then only the route will get searched otherwise, there is no pre-defined routes between any nodes. Updated routing information will not be kept in the nodes when no communication is active. Ad-hoc on demand distance vector (AODV) and Dynamic Source Routing (DSR) are the reactive routing algorithms. Pro-active routing are table driven, they keeps updated routing information of each nodes will be stored in the routing table. Destination Sequenced Distance Vector (DSDV) Routing and Fisheye State Routing (FSR) are pro-active routing protocols. Hybrid Routing Protocols consists of combined features of reactive and pro-active Routing protocols. [3]

In the wireless sensor network as the node moves, the network topology will change this leads to the breaks between the nodes. Due to dynamic characteristics of nodes links are unstable and lossy in such environments. To guarantee QoS parameters it is essential to estimate the link quality among nodes to increase the performance of routing protocol. Single path between source and destination was the principle of routing protocol and it was limited with minimum hop counts. In case of route fail, new route is evaluated this led to high communication cost and more resource consumption. Multipath routing provides key solution under various conditions to achieve QoS requirements. QoS based protocols have to find a trade-off between energy consumption and the quality of service. The network has to balance between energy consumption and data quality. In particular, the network has to satisfy certain QoS metrics, e.g., delay, energy, bandwidth, etc. when delivering data to the BS.

This paper proposes an Energy Efficient Multipath Ad-hoc on demand distance Vector Routing. It specifies the level of energy a node has in the network. The node owns the initial energy value of 100 joules, which is referred as the energy level the node has at the start of the simulation. This energy level is called initial energy. The node reaches certain energy

level after transmitting and receiving the data, hence that energy level is referred as tx-Power and rx-Power. In this we have considered energy module which assign nodes initial energy, by calculating the consumed energy and residual energy of individual nodes is carried out. By calculating the residual energy of the each node the path which is more energy efficient can be found. So by this the network resources can be utilized effectively. The calculation of energy of nodes is very important as the nodes lifetime has to be increased, for prolong network lifetime, many optimization techniques have to be used to optimize and monitoring of the nodes.

Simulations were carried out on NS2 to compare the existing Reactive protocol to the proposed EMAODV based on packet loss, packet delivery ratio, end to end delay throughput and energy. The results shows that proposed protocol works better in five aspects.

The organization of this paper is as follows. Section 2 discusses about related work. Section 3 describes the proposed EMAODV with energy module. Section 4 presents simulation techniques and result justifications, finally, section 5 presents concluding remarks.

2. RELATED WORK AND PROBLEM STATEMENT

2.1 Related work

MANET routing protocols are based on the premise that all nodes comply without the routing protocol being maliciously disrupted. MANET is affected by a large number of attack forms of varying severity. Dynamic Source Routing (DSR) is a well-known MANET reactive routing protocol, path finding and maintenance are the two important phases of this protocol. It can send the packets to the destination by choosing alternative route at any time since, the nodes keep the multiple routes information. When the source node wants to communicate with the destination it will send the route request packet which is RREQ, it consists of source, destination address and ID number. After receiving route request packet the sink or intermediate nodes generates replay message which is route replay packet in the same path. DSR does not support routing messages protection. [5].

In AODV all the nodes in the network need to keep a routing table that stores routing information of its neighbor nodes. Node sequence number and a broadcast-id will be maintained for each of the nodes. When a source node wants to communicate with destination node, it first increments its broadcast-id and broadcast a request packet to its neighbors to set up the route.

In this protocols route discovery is done by blindly forwarding route request packets from source to all its neighbor nodes in the network. Then, the neighbor nodes will receive and process the information. Nodes which receives the request packet checks there routing table for the possible route. If there is a route, the nodes send out RREP packet to its neighbors. Nodes silently discards the RREQ packet that do not arrives first. The other node at the destination, it sends out a route replay error packet (RREP). It blindly floods the entire network with route request packets for route discovery, congestion builds up in the network.

2.2 Problem Statement

Existing system schemes deals with the alternates routes methods, which was not energy efficient and time consuming. The existing systems update the node position using localization algorithm and shortest path, which does not relate to energy efficiency. The problem of this is to find proper positions for the sensors at any point in time such that some desired specifications are satisfied, while the total energy consumption of the sensors is minimized. When a source node wants to communicate with the destination it should find a path which is efficient, the nodes which are involved in the path should have maximum energy which is sufficient for the transmission and reception of packets, so by finding the residual energy of a nodes efficient path can be discovered, which is energy efficient path. So which yields the prolong increase of network lifetime.

3. IMPLEMENTATION

3.1 Existing System

The existing system proposes an Efficient Multipath AODV (EMAODV) which decides whether a node in a network is forwarding or mute to send data packets from source through destination in the context of route discovery. This could be achieved by using the Time to Live (TTL) value, that decides how many hops a route request can go through, as well as the Predecessor address by adding an extra field.

EMAODV defines a route discovery path while using the factor Time to Live (TTL). TTL is a component deciding the hop distance until it is possible to transfer a RREQ packet. The TTL value throughout the RREQ packet is initially set by the origin node to a certain initial value INITIAL TTL and the RREQ packets being distributed over a hop array equal to TTL cost. If the source does not obtain a RREP packet from a destination within in the discovery duration of the path, the destination is not within initial hop distance. The source node instead increases the TTL value to improve its lookup range and transmitted in the new range the RREQ packets.

3.2 Proposed Architecture and Methodology

The below fig-1 shows the architecture of the proposed system,

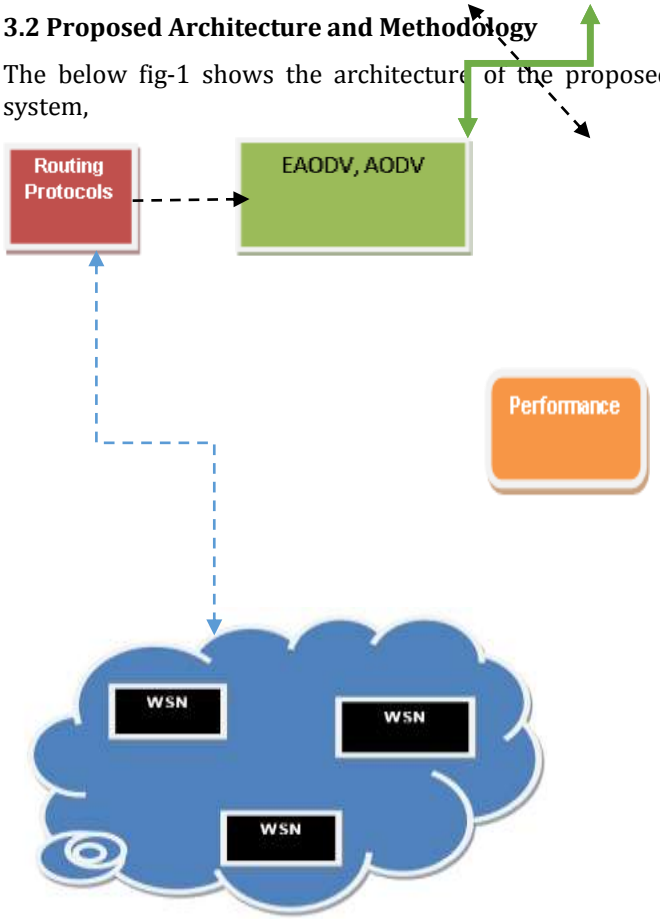

Fig-1: Architecture of proposed system

Sensors are deployed and it is communicated. When it is communicating with nodes the routing protocols like AODV and EAODV is analysed and performance of the routing protocols by considering network parameters is verified for better results.

This design scheme is iterative and requires attention of various options at each stage. Several assumptions regarding the hardware required and the operating surroundings of the system influence design selections. The assumptions have been made after giant consultation with the cease user and are greater or much less affordable. The gadget might be applied at the Ubuntu working gadget, using C++ and TCL Script.

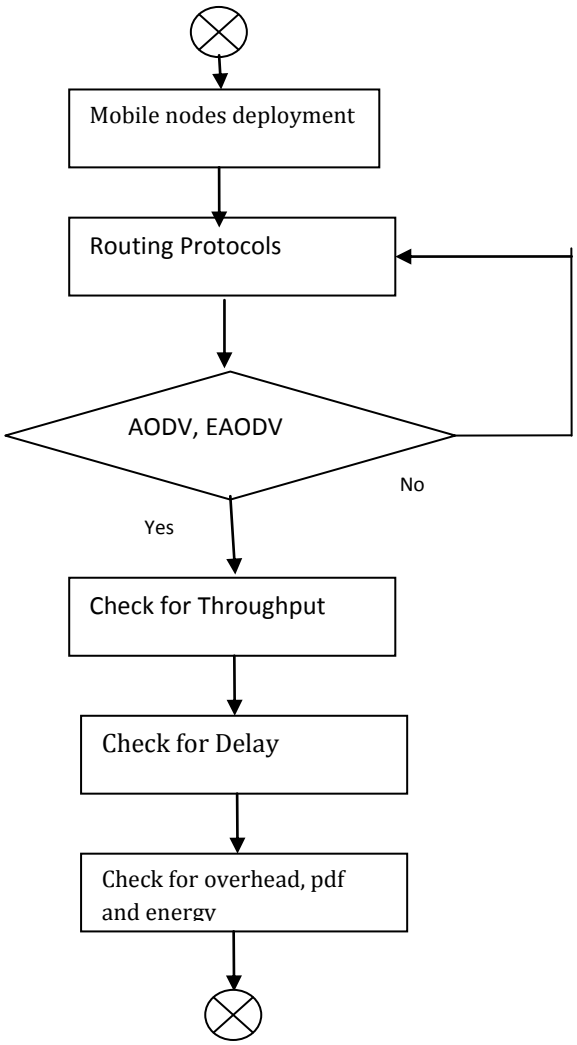

Fig-2: Data flow model for performance analysis

Fig-2 Describes the data flow of the model for the performance analysis, in which the nodes are randomly deployed and routing of packets using different routing protocols are used to analyse the efficient transmission and to evaluate the parameters like throughput, delay, overhead and packet drop ratio. The network topology design gives the information about how the nodes are deployed, what is its configuration. It consists of the network parameters like, MAC protocol, Network area, No of nodes, Propagation Model, Queue type used.

3.3 ENERGY MODULE

In this energy module, the nodes are assigned with initial energy and the nodes are homogeneous. The energy of the node is calculated as, at the start time of simulation all the nodes has higher initial energy, as the nodes moves randomly the nodes energy decreases. Each node consume energy while transmitting and as well as receiving data which is represented as t-x and r-x power. For saving energy the parameter like sleep power, idle power and transition power are assigned for awake and sleep modes. These modes will be automatically be shifting to awake when the

node has data transmission and goes to sleep after transmission. The residual energy is defined as remaining left out energy after data transmission. The residual energy should be balanced among nodes to extend network lifetime. The residual energy is formulated as

RE = IE (initial energy)- CE (consumed energy)

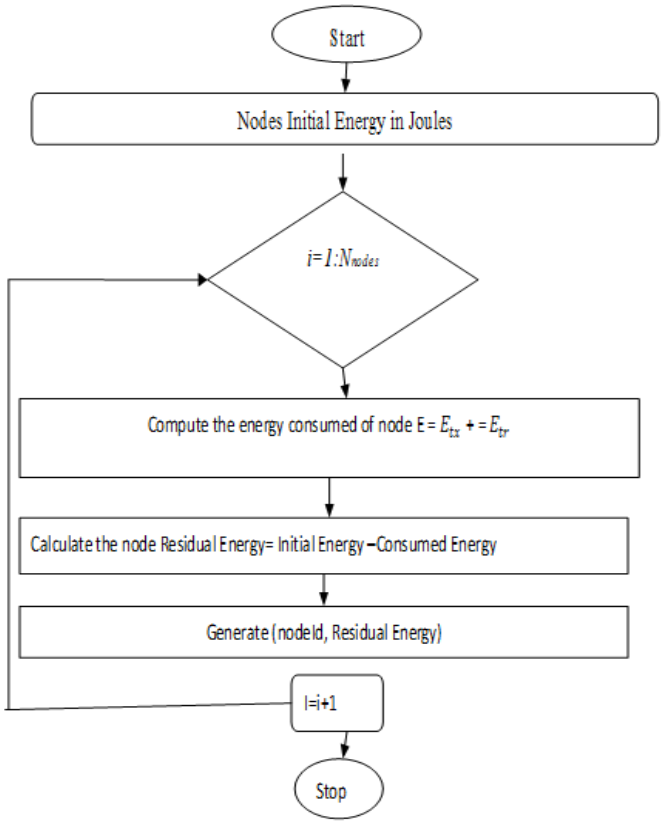

Fig-3: Energy calculation Algorithm for Nodes

4. RESULT AND PERFORMANCE ANALYSIS

The Network Simulator-2 has been used to carry out the simulation, parameters which are used to set up the simulation environment is as shown in the Table-1.

Table-1. Parameters

Parameters	Value
Operating system	Ubuntu 11.10
Simulator	NS2 (ns-2.35)
Channel type	Wireless channel
Number of nodes	20,40,60,80
MAC protocol	802.11
Data packet size	512
Simulation area	1000*1000
Radio propagation model	Propagation model/Two Ray ground
Routing protocols	AODV, EMAODV

These parameters setup for simulation have been kept same for different number of nodes. i.e. 20, 40, 60, 80, and 100. Few parameters are considered in this project which yield in estimating the system performance and also which provides proof for network lifetime improvement. Based on five performance metrics, the network quality of services (QOS) is checked using proposed energy efficient protocol.

4.1 Simulation Results

We compare the performance of proposed system with an existing system. In Existing system alternate routes methods are used, which was not energy efficient and time consuming. The existing systems update the node position using localization algorithm and shortest path, which does not relate to energy efficiency. Where in proposed system we provides alternative path with high residual energy. It controls congestion in the network and performances like throughput, delay, packet delivery ratio, overhead, and energy of existing and proposed systems are compared, this also checks performance for varying network size. The simulation is carried out in network simulator 2, NAM window provides the graphical representation of the simulation. The result and performance analysis are discussed below, the red line indicates the existing system and green color indicates the proposed system.

1) Throughput

The number of packets sent and received per unit time. It is expressed in kbps. The throughput values of the proposed system and existing system is given in Table-2

Table-2. Throughput

Number of Nodes	Existing system (MAODV)	Proposed system (EMAODV)
20	23.60	35.30
40	35.99	37.74
60	36.84	38.03
80	37.56	37.95

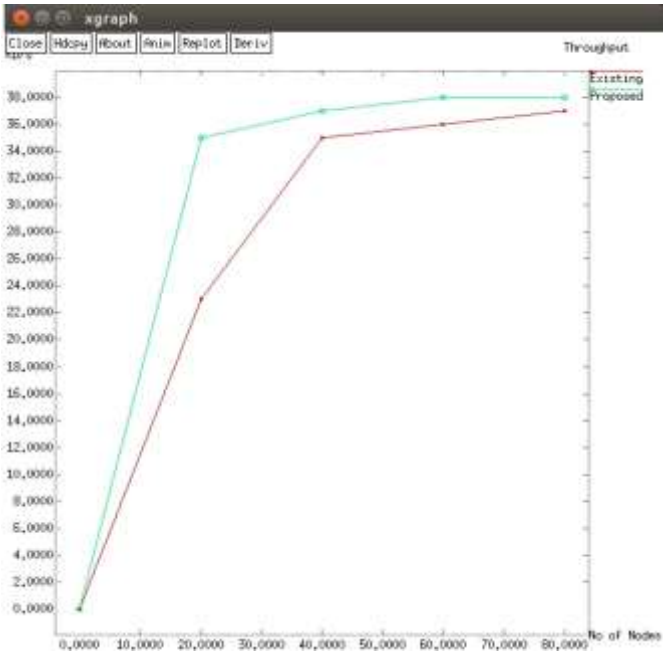

Chart-4: Throughput w.r.t existing and proposed system

The above graph shows the throughput of existing system v/s proposed system. For the proposed system the X axis indicates the number of nodes and the Y axis indicates Throughput. As the node number varies, the number of bits processing time per seconds increases in existing system. Thus delivering less throughput in existing system. But in the proposed system, due to high frequency cycles and data processing rate, delivers high throughput.

2) End to End Delay

End to end delay can be calculated by sent time of packet by source – received time of packet by destination. It is expressed in milli seconds (ms). The below table-3 and graph shows the end to end delay of existing system v/s proposed system. For the proposed system the X axis indicates the number of nodes and the Y axis indicates delay in terms of seconds.

Table-3. End to End delay

Number of Nodes	Existing system (MAODV)	Proposed system (EMAODV)
20	725.393	168.182
40	162.293	43.489
60	49.44	14.62
80	35.179	128.255

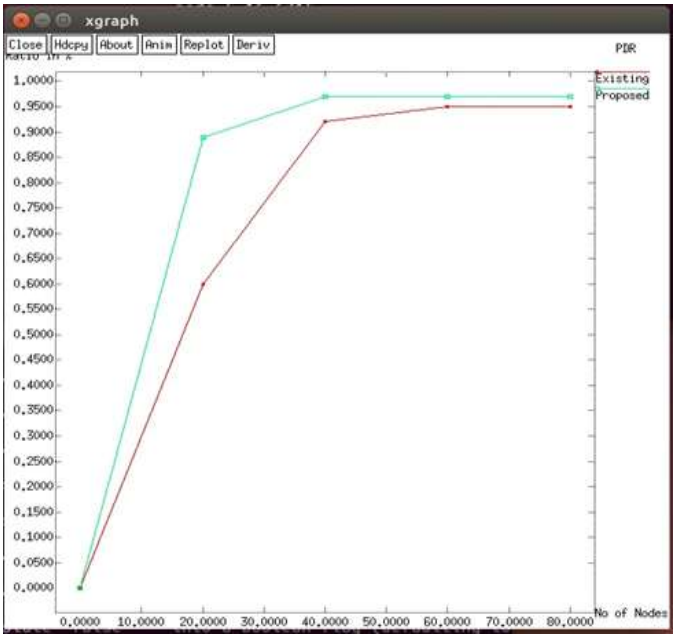

Chart-5: End to End Delay w.r.t existing system and proposed system

As the number of nodes varies and due to nodes mobility, packet arrival time increases in existing system which reflects the delay of existing system to increase. Due to high data processing rates, packet sends time and arrival time are less in proposed system.

3) Overhead

It is the number of routing packet processed in a network. The overhead values and simulation results of existing and proposed system are given below.

Table-4. Overhead

Number of nodes	Existing system (MAODV)	Proposed system (EMAODV)
20	6.086	4.122
40	8.019	4.736
60	6.869	4.896
80	8.305	6.312

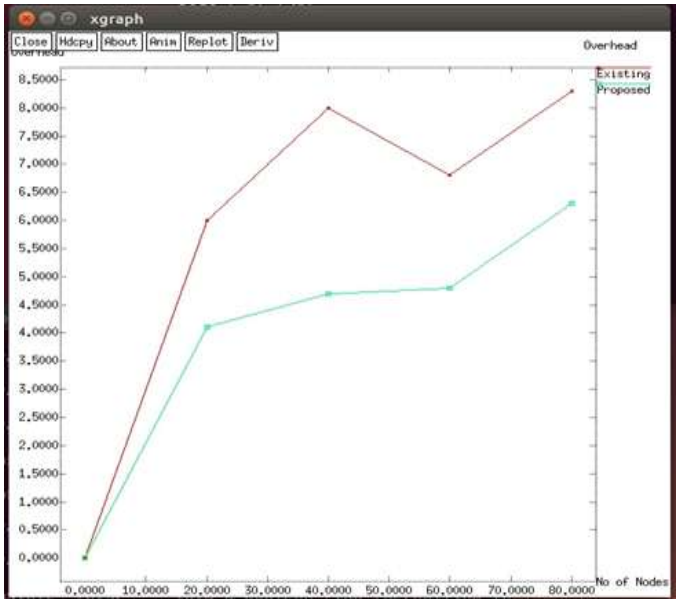

Chart-6: Overhead w.r.t proposed system and existing system

The fig-6 shows the overhead of existing system v/s proposed system. For the proposed system the X axis indicates the number of nodes and the Y axis indicates overhead in terms of load. As the number of nodes varies overhead of the proposed system increases due to computational function. In the proposed system the overhead is low due to increased processing rates.

4) Packet Delivery Ratio

It is the measure of ratio of number of packets transmitted by source and the number of packets acknowledge by destination.

Table-5. Packet delivery ratio

Number of nodes	Existing system (MAODV)	Proposed system (EMAODV)
20	0.6014	0.8
40	0.9289	0.9707
60	0.9595	0.9709
80	0.9562	0.9792

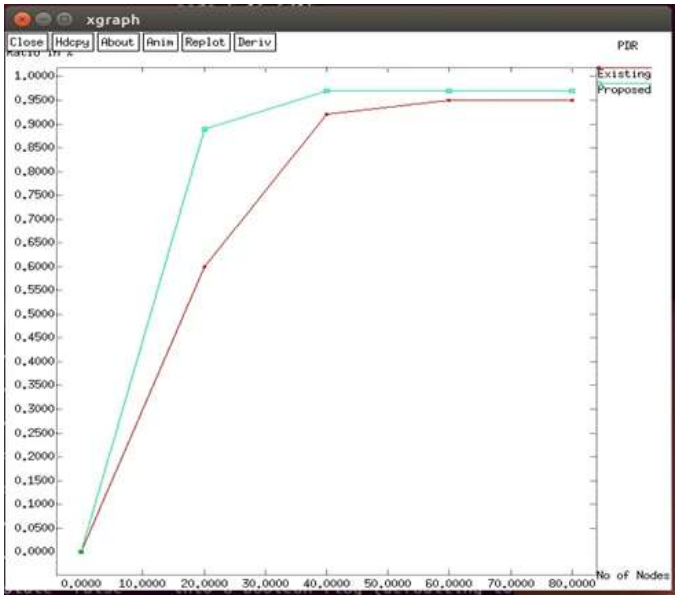

Chart-7: Packet Delivery Ratio w.r.t existing system and proposed system

The graph shows the PDR of existing system v/s proposed system. For the proposed system the X axis indicates the number of nodes and the Y axis indicates PDR. In the existing system due to large data rates packet processing takes more time and as the node moves apart the link between two nodes is not stable enough to deliver the packets. In proposed system enhanced data rate increases PDR and achieves more reliability in delivering the packets.

5) Energy

The sensor nodes are battery operated so, the nodes require some energy for communication. Below table simulation result shows energy of existing system v/s proposed system.

Table-6. Energy consumption

Number of nodes	Proposed system (MAODV)	Existing system (EMAODV)
20	21.7	12.3
40	31.2	10.1
60	23.7	8.6
80	26.3	9.45

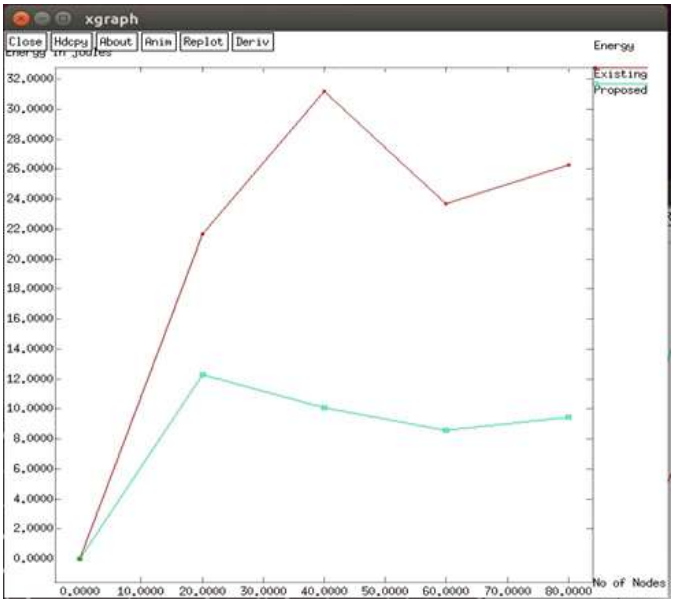

Chart-8: energy consumption w.r.t existing system and proposed system

For the proposed system the X axis indicates the number of nodes and the Y axis indicates energy. As the number of nodes varies average energy consumption of existing system increases. If the nodes are not energy efficient, network lifetime can't be increased. In proposed system energy consumption gradually decreases due to tune up in the MAC layer thus, extending the network lifetime.

5. CONCLUSION

The multipath AODV system schemes deals with the alternates routes methods, which was not energy efficient and time consuming. In this paper we focuses on energy efficiency of AODV routing protocol by finding high residual energy of each node. As per the simulation results after considering energy module the variation in the network parameters can be seen. So that the route which is having higher energy will be considered to create path for route discovery in the proposed EMAODV routing protocol rather than just flooding the network with route request packet every time, which leads to congestion in the network. the problem of this is to find proper positions for the sensors at any point in time such that some desired specifications are satisfied, in proposed system total energy consumption gradually decreases due to tune up in the MAC layer so this will increases the network lifetime, overhead and congestion in the network can be minimized.

In the future we can use light weighted key management system for secure and efficient data management.

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