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AN ENERGY EFFICIENT DYNAMIC CONNECTED DOMINATING SET WITH MULTI POINT RELAY FOR WIRELESS MESH NETWORK

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ABSTRACT

A wireless mesh network is a collection of mobile nodes that can be deployed without the need for centralized management infrastucture.The operation of wireless mesh networks depends on the co-operation among nodes to provide connectivity and communication routes. However, these situations may not always be achievable in practice. Some nodes may result in degradation of the performance and high energy consumption. To mitigate the effect of such nodes and to save the energy level on the network, this paper expands on neuro fuzzy logic concepts to propose an algorithm used for quickly to data transmit and identify the nearby nodes on the source node. To take energy efficient based data transmission on their network using the dynamic connected dominating set with multi point relay. Compare the energy level with existing model by using simulation results. Using NS-2 simulator, the proposed algorithm is validated and further studied. The findings show that the proposed algorithm has low level energy consumption on the network.

Keywords: Wireless Mesh Network, Energy Efficient Neuro Fuzzy, Dynamic Connected Dominating set, Multi Point Relay, Acess Point.

1. INTRODUCTION

A Wireless Mesh Network (WMN) is based on ad-hoc networks, where each node transfers data to and from an Access Point (AP) which is connected to the Internet by a wired or wireless network. These AP need not be in the reach of all the nodes in the network. Nodes in the region of the AP forward the packets from the remote nodes to the AP. If there are a significant number of nodes in the network, faraway nodes can transfer data with the AP in a few hops. Besides mobility, WMN have the advantages viz., they can work in a decentralized fashion, are cheap with minimum investment for initial infrastructure, more reliable, scalable and provide increased coverage [1].

Routing protocols in WMN can be classified into proactive and reactive. Proactive protocols need to maintain routes between all node pairs all the time, while reactive routing protocols only build and maintain routes on demand. Reactive routing protocols perform better in terms of packet delivery ratio and incur lower routing overhead especially in the presence of high mobility. In WMN, transfer of data takes place to and from the AP. Each node sends route requests to its neighbors. When the requests reach the different APs, they send back a route reply. The sending node receives all these replies and decides which route and AP to use based on different conditions. Since transfer of data in ad-hoc networks is similar to this, the existing ad-hoc routing protocols like DSR and AODV were used. But these protocols assume some properties of ad-hoc networks that are no longer true for WMN.

Quality of Service Routing (QoSR) is a key function for the transmission and distribution of digitized information across networks. It has two main objectives; finding routes that satisfy the QoSR constraints and making efficient resource utilization [2]. Unfortunately, several factors can cause poor performance. So many problems still exist such as data loss because of overloaded incoming and outgoing message buffers, packet delay or expiry when residing in large queue or when using unsuitable routes. The complexity in QoS routing comes from multiple criteria, which often make the routing problem intractable.

Despite the efforts made to alleviate this issue, there still exist a number of barriers to the widespread deployment of real-time applications. The most prominent one is how to ensure the traffic adaptation in the case of heavy congestion case. It is important to note that the existing solutions developed for wired networks cannot be deployed directly within WMNs. Difficulties with these models lie in the fact that they are not adapted to different node states and resource variation, as in mesh environments the available bandwidth for each node varies with time since the medium is shared.

In a WMN, mesh routers relay traffic on behalf of clients or other routers and by this form a wireless multi-hop network. Most WMNs are based on IEEE 802.11 commodity hardware. However, the performance of such WMNs can be low. One reason is the inefficient handling of small packets by the IEEE 802.11 MAC layer [3]. The transmission time of a 100 byte packet sent at 54 Mbit/s consists to 95% of overhead created by the IEEE 802.11 MAC layer. For WMNs it is consequently important to transmit small packets in an efficient way. One possibility to increase the efficiency is packet aggregation [4].

WMN is a multi-hop network, which depends on mesh routers to forward the Packets to the destination. Cryptography solutions could be used to protect the mesh routers from most of the routing protocol attacks selective forwarding, black hole, and sinkhole. But, if the routers are compromised, the attacker will gain access to the keys and break through the system. The fuzzy logic is used to evaluate the trust for selecting the monitoring node and for routing decisions [5].The procedure of channel estimation is to estimate the normal loss rate due to bad channel quality or medium access collision.

Broad range of applications like disaster management (systematically sensitive zone), security and military have stimulated the importance in WN during few past years. Sensors nodes are characteristically proficient of wireless communication and are considerably obliged in the amount of existing resources such as energy (power), storage (memory) and computation [6]. These forces make the deployment and operation of WN significantly distinct from existing wireless networks, and demand the development of resource aware protocols and supervision techniques.

2. RELATED WORK

Many ad-hoc networks based routing protocols viz AODV used for Wireless Mesh Networks (WMN) by considering only the shortest route to destination. Data transfer mechanism in the WMN is to and from the access point (AP), these AODV protocol leads to congested routes and overloaded APs. In order to reduce the congestion, routing protocols with Traffic Balancing which chooses routes based on medium usage of the route were used. To provide efficient routing method for WMN, routing decisions based on more than one constraints i.e., buffer occupancy, node energy and hop count have been considered.

Many routing protocols used for wireless mesh network like AODV are also used by Ad-hoc networks by considering only the shortest path. Since data transfer in WMN is from and to the AP’s, these protocol lead to overloaded AP’s and congested routes. To reduce the congestion by routing protocols such as traffic balancing which chooses routes based on medium usage. But routing is a multi-constraint problem. To make a routing decision based on the constraints viz., buffer occupancy, node energy and hop count and to provide an efficient routing method for WMN.

A Fuzzy system is best suited in making optimal routing decisions in a network involving multiple constraints and multiple objectives [7]. There are several studies of fuzzy multi-objective routing where a fuzzy system is implemented over classical methods like DSR to do multi-objective routing. Routes are decided based on the metrics Node Delay, Node loss and node speed. A fuzzy routing algorithm based on several metrics for a mobile ad-hoc network is proposed. A multi-criteria routing algorithm running in mesh structured that overlay an unstructured peer-to-peer network is proposed. This approach aims to improve the quality of service routing (QoSR) of the modern distributed application. Using a grid pattern can improve routing extremely, since it provides alternative and partly disjunctive paths of equal length as well as the ability to measure distances between nodes in the overlay network.

Thermal field approach is used for representing buffer usage level to avoid message loss and long delay times. As well as the distance is applied to present relationship of distance among peer location. The route decision mode uses fuzzy logic technique to select the optimal path considering multiple constraints [8]. The result of fuzzy logic routing shows superior routing performance than others both in delivery ratio and routing time.

A novel QoS model for traffic adaptation based on fuzzy logic that is capable of supporting real-time traffic such as video and voice services are implemented recently. A major factor behind using fuzzy logic theory to ensure the traffic adaptation is its ad equation to the uncertainty, and the information incompleteness of WMN environment characterized by dynamic traffic changes [9]. Wireless mesh networks (WMNs) are wireless Multihop networks in which mesh routers relay traffic on behalf of clients or other routers. It uses fuzzy control to determine the optimum aggregation buffer delay under the current channel utilization. By cooperation among neighboring nodes distributes the buffer delay [10].

The use of fuzzy logic in the decision-making processes of the AODV routing protocol is presented, in order to select the best nodes to be part of the routes. Fuzzy logic improves the selection of routing metrics. It details constraint selection and definition, and fuzzy-rule set design. Finally, we show the results, where our intelligent proposal is compared to AODV, the protocol for mesh network used by the standard, an interesting metric commonly used in wireless networks. In the mesh network two important parameters are considered in wireless mesh networks constraint are: Node Energy: overall energy level is obtainable in each sensor node, expressed by the fuzzy variable energy, the energy value is scaled while representing in the fuzzy set, Node Centrality: how central the node is to the cluster is classified by the centrality property which is expressed by the fuzzy variable centrality [11]. The centrality value is scaled while representing in the fuzzy set.

3. PROPOSED APPROACH

3.1 Route Discovery using Dynamic CDS

In ad-hoc networks using On demand routing protocol like AODV and DSR ,to find the path between source and destination by route discovery process. In the source node initiates the route discovery when it has no route to the destination [12]. It distributes a route request packet

(RREQ) to its neighbor nodes. Each receiving node in turn distributes a RREQ packet. This process is repeated until the packet reaches the destination and the destination node will send the route reply message (RREP) to the source. This method of route discovery process leads to broadcast storm problem. To overcome this problem, we implemented the route discovery process in AODV using the dynamic CDS nodes only. When a CDS node receives a RREQ packet, it broadcasts the packet. The non-CDS are not rebroadcasting the RREQ packets. Thus the number of RREQ packet transmission is reduced and the network congestion is avoided.

3.2 Energy Efficient Neuro fuzzy logic method

An Energy Efficient Neuro fuzzy logic method in wireless mesh network to increasing a network performance. We have to take an Energy Efficient Based data transmission on their network using the dynamic connected dominating set with MPR. A connected dominating set based on multipoint relays. The only facts assumed for a given node is two hop neighborhoods and the lists of neighbors that have selected the node as multipoint relay such neighbors is called multipoint relay selectors. This information can be contained in packets that nodes periodically broadcast to their neighbor in order to monitor links validity [13]. They have to use routing information and neighbor node information collection algorithms are used. These assumptions make the algorithm very attractive for mobile ad hoc networks since it needs just local updates at each detected topology change. If the data transfer from source to destination on the network they have to dynamically change the CDs path and intermediately used the MPR. The multipoint relay set is included in the neighborhood of the node, the element of the multipoint relay set are called multipoint relays or MPR for short of the node, Each two hop neighbor of the node has a neighbor in the multipoint relay set we say that some multipoint relay covers the two hop neighbor [14]. It’s used for quickly to data transmit and identify the nearby node on the source node. Energy Level compare with existing model use low level energy consumption on the network.

In our proposed model used an Energy Efficient Neuro Fuzzy and Multipoint relays which avoid selecting the border nodes as the forwarding nodes [15]. The Architecture of Multipoint relay works on network is depicted in **Fig.1**. They used power adaptive broadcasting by reducing the transmission range of mobile nodes to save energy. The buffer based approach is proposed to further enhance the stability of the forwarding nodes. An algorithm to determine stable connected dominating set based node velocities. Their algorithm prefers slow moving nodes with lower velocity rather than the usual approach of preferring nodes with a larger number of uncovered neighbors. They compared their technique with another work which is based on node degree. A minimum size CDS does not necessarily guarantee the optimal network performance from an energy efficient point of view. This motivated to make an energy efficient stable connected dominating set construction to prolong the network lifetime [16].

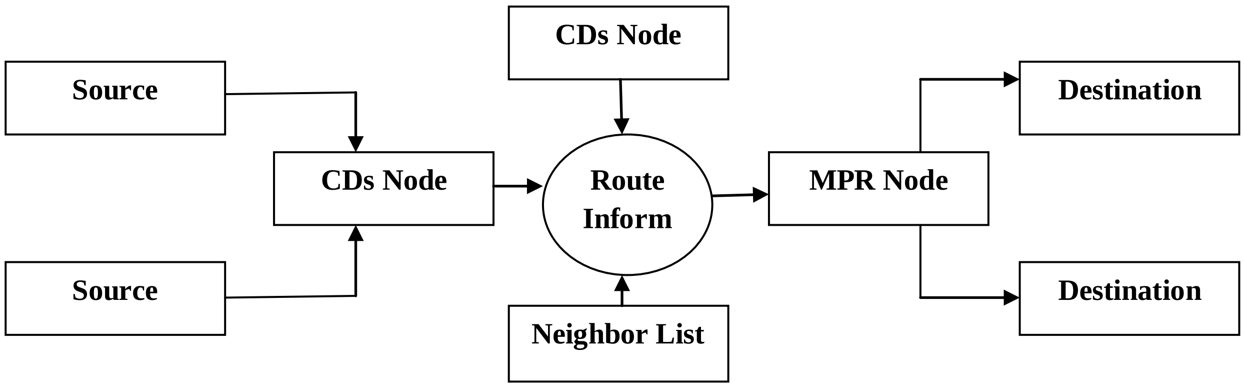

Fig. 1: Architecture of Multipoint relay for wireless mesh network

3.3 Consumption Energy Level

All these protocols strived to reduce power consumption either at node level or on the network in general, all proposed solutions have a kind of trade-off that let go to have conspicuous energy saving. To exposed this performance trade-off, this paper presents, the observed performance metrics based on the simulation results posted by the various algorithms under review. We consider the following as major performance demands for all the protocols: the number of routes established during route discovery, the message overheads the cost of performing the data packet transmission and reception by different nodes, data packet delivery ratio, the network throughput, average energy conserved, the end-to-end data packet delay, computational complexity of the algorithm and finally, the network existence which has a direct relationship with energy conservation.

3.4 EENF- CDs-Multipoint Relay Algorithms:

S-Source, D-Destination, T-Traffic, P-Packets, M-message, CD-Connected Dominating

R-Routing Information, MP-Multipoint Relay, U-uncovered Node, E-Energy

Step 1: Initialize network nodes

Initialize the Topology level

Send S message to D

Step 2: If (M=true)

S sends Packets to D

Step 3: if Else (M=false)

Get T on Network Path

Step 4: Message send using MP

S collects the R

Step 5: Routing Information Saved on the network

Shortest route on Path

Step6: Check if (MP=0)

Goto First Priority Node on CDs Path

CDs Change dynamically on the network

Step 7: if Else (F≠0)

Preprocess of Priority model

Else

Waiting on network request

End

Step 8: Check Available Route otherwise

Step 9: Node's are sleep mode in the network

Step 10: Save E on Network

Step 11: P send to S to D normally

Packets sending to Destination

Else

End

Step 12: Drop the Packets *P*

Exit

Step 13: Every Time update Routing information on network

3.5 Update Routing Table information Algorithm

X, Y are nodes, channel = I,

Step 1: for i ← 0 to num. of time on node x do

Step 2: for y ← 0 to num. of time on node y do

Step 3: if (channel(x) (i) = channel(y) (j)) then

Channel-id ← channel(x) (i)

Step 4: nodes x and y lookup the route, and update routing table with new channel-Id;

3.6 Implementation of the proposed EENF- Dynamic Connected Dominating Sets routing algorithm working steps:

1. The data are sending by wireless mesh network from source (S) to destination (D) on

network topology.

2. Access point collects the neighbor node list and routing information and then collects the dynamic connected dominating nodes to transmit the data to destination intermediately work through AP's from source to destination on network.

3. AP has to gather the data sending and receiving process on the network. The traffic situation to be checked on Access Point. If have any traffic on the network to intimate to the AP.

4. The Multi Point Relay nodes are collecting the route information from source to destination and quickly send the data to the destination on their network process.

5. Finding the high priority node to transfer the data. It's successive work flow on their network.

6. It is reducing the packet's delay and energy level on their wireless mesh network. If the rest of the data transmission time they have to save the energy model on their network.

7. The data transmit from source to destination on the network, connected path are only to spend the energy.

8. When using the same path another time, we have to save the energy model on the network.

4 RESULTS AND DISCUSSIONS

In this simulation we have to using a network simulator to perform a good result on their network. The platform used was the NS2 (Network Simulator version 2). NS2 is a discrete event simulator targeted at networking research. NS2 provides considerable support for simulation of routing, TCP, and multicast protocols over wired and wireless networks. The simulation environment is created in NS-2, a network simulator that provides carry for simulating mesh wireless networks. NS-2 was written using C++ language and it uses the Object Oriented Tool Command Language (OTCL). It has been used to get a good throughput and graph and report results are have to implemented their on the network [17]. It came as an extension of Tool Command Language (TCL). Dynamic CDs based Energy Efficient Based Fuzzy Routing Decision was implemented using the Fuzzy Logic. The simulator with various input configuration settings and the statistics collected were analyzed in comparison with other well-known on demand routing protocol AODV. Our simulation modeled a network of nodes placed randomly within 1500 × 1500 meter area. Each node had a radio propagation range of 250 meters and channel capacity. Two-ray propagation model was used. The IEEE 802.11 distributed coordination function was used as the medium access control protocol. If all network topology to be set at the MAC based data representation on the progress [18].

It describes the no of nodes included in the CDS to act as broadcast relay nodes. The average no of nodes included in the CDS with different mobility values 5m/s, 15m./s and 25m/s. The results show that CDS generated by our algorithm is larger than the values. The average size of the CDS increases with network density. The radio and IEEE 802.11 MAC layer models were used .The size of the data payload was 1024 KB. Data sessions with randomly selected sources and destinations were simulated. Each source transmitted data packets at a minimum rate of packets to send the source to destination on the network. Traffic classes were randomly assigned and simulation was carried out with different bandwidth requirements. There were no network partitions throughout the simulation. Each simulation was executed for 600 seconds of simulation time. The parameter values for simulation are shown in **Table 1.**

Table 1: Simulation Parameters

Parameters	Value
Version	Ns-allinone 2.28
Protocols	EENF-AODV
Propagation model	Free Space
Area	1500m x 1500m
Transmission Range	250 m
Traffic model	UDP,CBR
Packet size	1024 KB
Mobility Model	Random Way Point
Node’s Mobility	0-100m/sec

4.1 EENF-AODV Metrics

In wireless mesh network to design with a different movement topology on the network. The impact of network energy model of nodes are low level and to consumption of the energy model on the performance over a fixed topology area of 1500m x 1500m using dynamic connected dominating set for source-destination connections. The following metrics for evaluating the performance is given in Table 2.

Table 2: Metrics for evaluate the performance

S.No	No of Nodes	Protocol	Throughput	Average Delay	PDF	Energy
1.	61	F-AODV	0.29	11.01	98.00	30jules
2.	61	NF-AODV	0.34	8.02	99.10	25jules
3.	61	SNF-AODV	0.45	5.12	99.60	17jules
4.	61	EENF-AODV	0.56	4.05	99.75	12jules

4.2 Throughput Performance

Throughput performance is the ratio of throughput and overall network performance. To improve network performance by minimize the packet delay and maximize the delivery ratio phase.

The average Number of throughput is high with compare the scheduling Neuro fuzzy model. Using the Energy model to increase the throughput level on the network. If the throughput increases, the network performance is increased automatically.It is calculating the performance of throughput level and high accuracy of the data transferring on source to destination of the method. The high in performance is due to the EENF-AODV is presented as an intelligent technique for discriminating packet loss due to congestion from packet loss by wireless induced errors.

The performance of the throughput for Scheduling Neuro fuzzy and the proposed Energy Ef0ficient Neuro fuzzy logic routing is depicted in **Fig.2**. In graph, the X and Y coordinates are to mention the number of bits and time to sending or receiving level respectively.

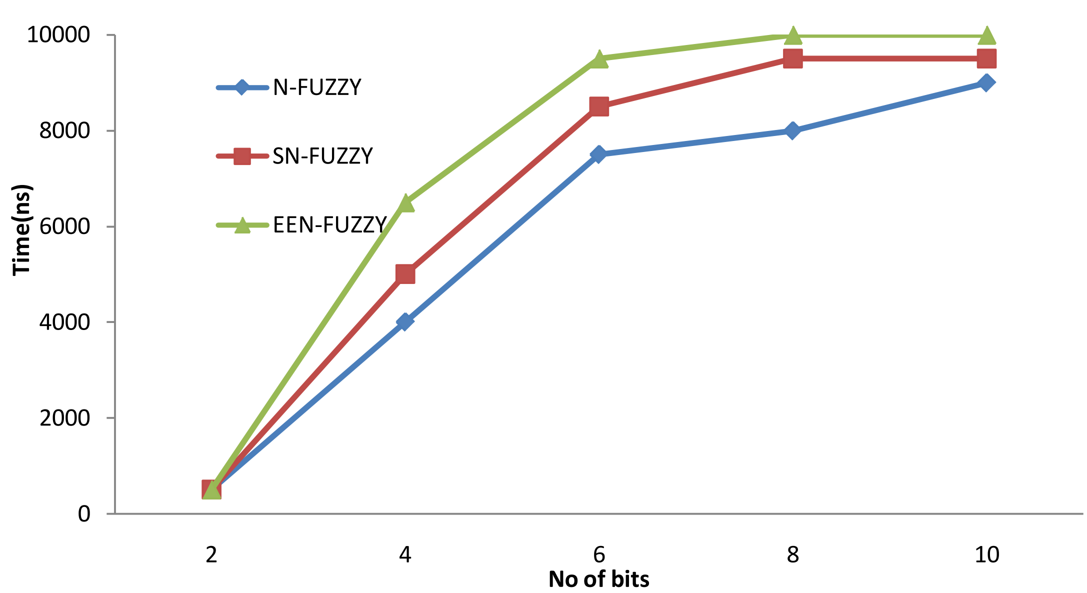

Fig.2 Performance of Energy Effficient Neuro fuzzy logic

4.3 Packet Delivery Fraction

Packet delivery fraction is the ratio of data packets delivered to the destination to those generated by the sources. It calculates by dividing the number of packet received by destination through the number packet originated from source. The DeliveryRatio of Energy Efficient Neuro fuzzy logic is depicted in **Fig.3**.

$$\textbf{PDF = (Pr/Ps)*100}$$

Where, **Pr** is total received Packet & **Ps** is the total Packet send.

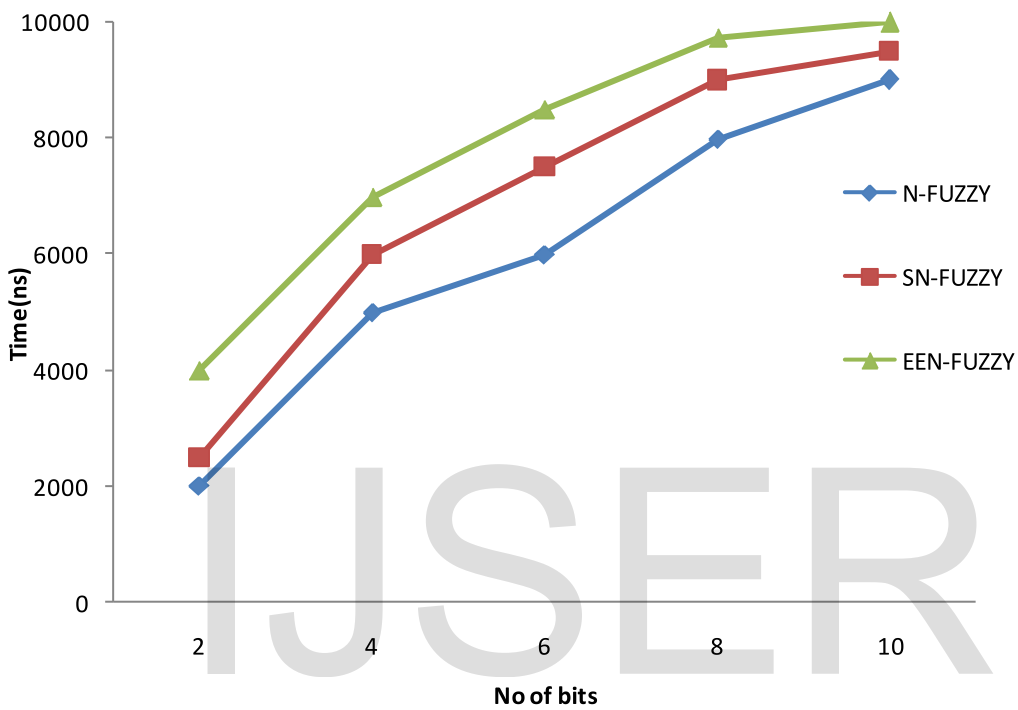

Fig.3 DeliveryRatio of Energy Efficient Neuro fuzzy logic

Delivery fraction is calculating the time taken to data transmission between the one node to another node on the network. The performance of the packet delivery fraction for the proposed routing and the scheduling Neuro fuzzy logic is depicted in **Fig.3**. The performance of the packet delivery fraction for the proposed routing and the fuzzy routing based on manual calculation. Fuzzy Logic has been used for routing and management of an ad hoc wireless network. The neuro fuzzy logic based routing algorithm takes into account input variables, delay, and throughput and energy consumption. It differentiate the performance between existing and neuro fuzzy performance on the network. It is proving that at a time of process how many packets send and received during the process on the transmission and intermediately showing the difference in calculating the time take by packets to reach the destination.

The optimal performance in the network is guaranteed a controlled randomized routing strategy which can be viewed as cost of exploration. The cost of investigation is proportional to the total number of packets whose route deviates from the optimal path. To raise sub linearly with the number of packets delivered and so the per packet exploration cost are the numbers of delivered packets grow. It represented by the number of control packets divided by the total number of received data packets. For this calculation, every time a control packet is retransmitted, it's considered as a new control packet from the energy efficient neuro fuzzy routing on the total area network performance.

4.4 End-to-End Delay

Average end to end delay includes all possible delay caused by buffer during retransmission delay at the MAC, route discovery latency, queuing at the interface queue, transfer and propagation time. It is defined as time taken for a data packet to be transmitted across an MESH network from source to destination. The average end-to-end delay is written as

$$\mathbf{D = (Tr - Ts)}$$

Where, **Tr** is receiving Time and **Ts** is sending Time.

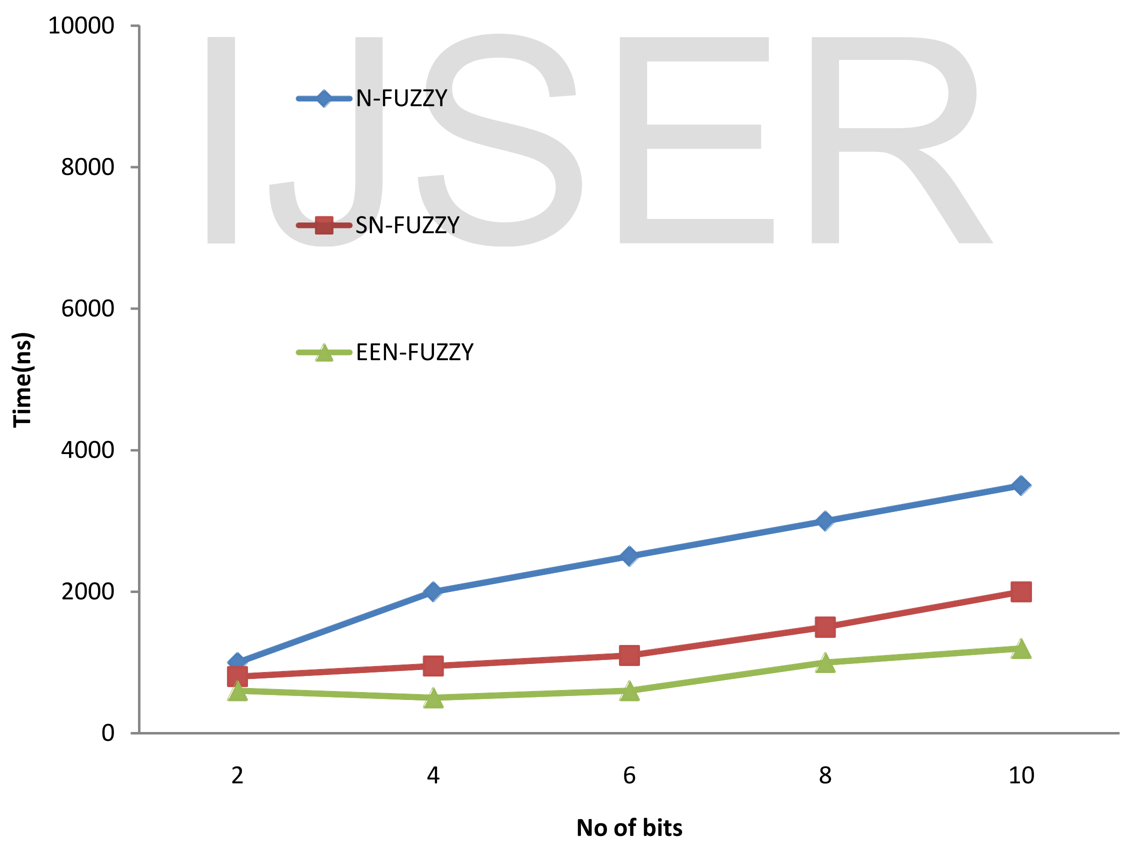

Fig.4 Delay comparision of existing with Energy Efficient Neuro fuzzy logic.

The performance of delay for proposed Energy Efficient Neuro fuzzy based routing protocol is depicted in **Fig.4.** Delay is used to calculate the packet dropping level of the network and then if data are dropped means the time taken by Energy Efficient Neuro fuzzy logic routing is very low but Neuro Fuzzy logic routing is delaying to send and receive the data processing of the networks. The route discovery process take some time and delay can be increased due to problems in the medium access, such as collisions and busy channel. If they have problem in transmitting the data to route, Energy Efficient Neuro fuzzy logic is discovering the neighbour node to get active and send the data quickly when compared to Neuro fuzzy logic routing which delays its process.

4.5 Energy Level on Network

The energy level on the network is most important for quick data transmission on their network. It is calculated by each node energy consumption is on the network. If the rest of the data transmissions time each node have to save the energy model on their network.

Energy consumption = no of packets * initial energy level

Remained energy = Energy consumption – no of packets in node

The energy level of EEN-Fuzzy logic and comparison of proposed protocol energy level with scheduling neuro fuzzy logic and fuzzy logic is depicted in **Fig.5.**

In the mesh network two important parameters are considered in wireless mesh networks constraint are: Node Energy: overall energy level is obtainable in each sensor node, expressed by the fuzzy variable energy, the energy value is scaled while representing in the fuzzy set, Node Centrality: how central the node is to the cluster is classified by the centrality property which is expressed by the fuzzy variable centrality.

By having the above problem discussed are they have much packet loss during transmission, traffic and congestion, jamming are major part on existing method is to recover from our propose model, which we identified, and effects to improve the energy efficient with over loss data model in overall network performance is made, and also time redundancy and low efficient data transmission process on the network.

Over comes the above problem low packet loss, traffic and congestion is very much reduced. Energy efficient data transmission using the MPR and connected dominating sets on this method is used to transmitted the data from source to destination on network, less traffic, no congestion. Fuzzy logic based Dynamic CD’s path for using a data transmission on the network.

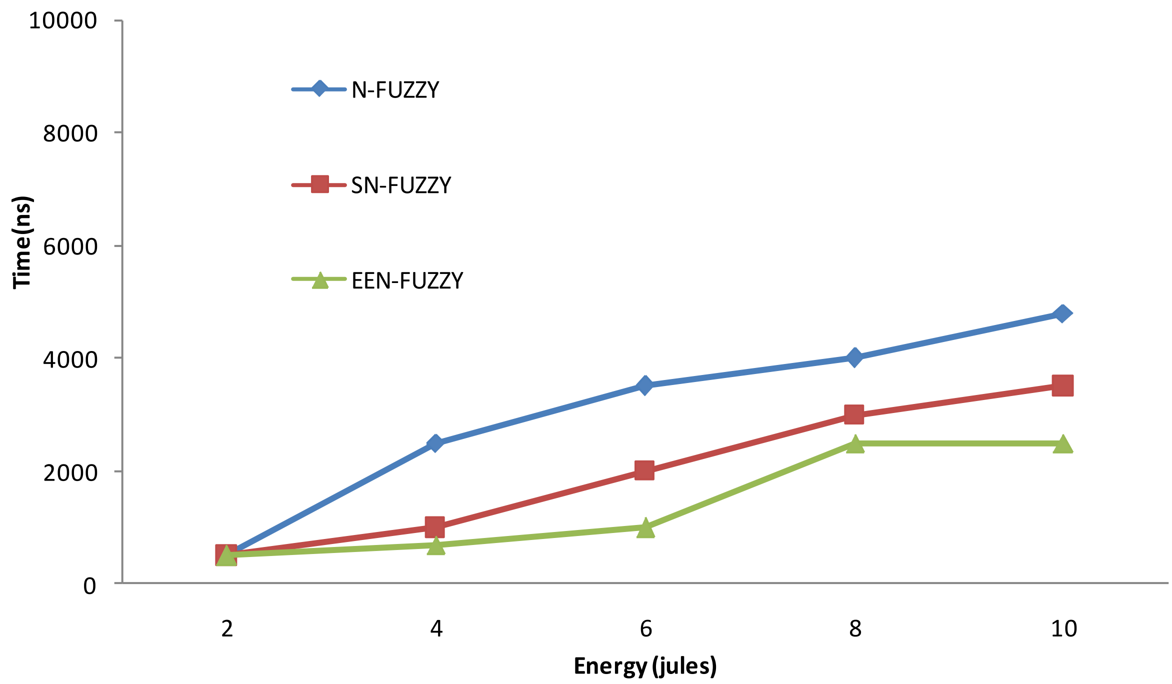

Fig 5: Energy level of Energy Efficient Neuro Fuzzy

5 CONCLUSIONS

In this paper, we introduced a novel Energy efficient Neuro fuzzy logic to improve the data transmission and save the energy model on their network. We presented an Energy Efficient Neuro Fuzzy based dynamic CDs and MPR method on the wireless mesh network. The CDs are dynamically changed the place from one to another on the network. Multi Point relay are used to intermediate data transmission on the network, it's most important for secure data processing on the network and also save the energy level of the system. The proposed algorithm saved the energy and reduced the energy consumption level on their network. The energy efficient neuro fuzzy logic method has to take different parameters for performance throughput, average end-to-end delay, packet delivery ratio and energy level. We evaluated this system in NS-2, and the simulation results showed that our EEN-Fuzzy reduces the energy consumption and saves the energy. The proposed algorithm guaranteed the optimal network performance from an energy efficient point of view.

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