A Novel Energy Efficient Cluster Based Routing Protocol for MANET with Related Metrics

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Abstract
With the growth of Mobile Ad-hoc network communications, the need for recent research to moving towards the better and capable routing protocols. The efficiency of the routing protocols depends on the metrics as communication cost, packet delivery, energy consumption, delay, throughput, packet loss. Nevertheless, due to the nature of battery power devices in the network for MANET and WSN, the power consumption of the routing protocols also to be consider for the betterment of the routing algorithms. Henceforth the applicability of the energy efficiency became the one of the most important criteria for performance evaluation. Thus, this work evaluates the performance of fish-eye state routing algorithm, order-one Manet protocol and cluster based routing protocol. The outcome of this work is to advise a novel cluster based algorithm with low energy consumption and evaluate improvement over the earlier system with all the above said metrics.

I. INTRODUCTION

Now a day the modern technologies like wireless and embedded computing, day to day improvement reducing the size of the device, and improving the high performance levels. Communication devices have capable of join less communication and ad hoc wireless networking. An ad hoc wireless network is a self organize and self configuring network with the ability of quick operational response to use various applications. Ad hoc network is a main characteristic it is separate network from cellular network is the reality it do not rely on a permanent communication.
Ad hoc network is very smart for planned communication in various fields like military, law enforcement, it can play main role in civilian forums such as convention centers, conferences, and E- class rooms, It has more number of mobile nodes its provide various resources these are bandwidth and power making routing in ad hoc network enormously difficult.
The routing protocols for ad hoc wireless networks have to adjust fast to the repeated and erratic change of topology and have to be thrifty of interactions and give out property. This paper, we introduce a energy efficient cluster based routing protocol for mobile ad hoc network and evaluate the same Fish eye state routing algorithm and arrange one manet routing protocol.
The rest of the paper is organized as follows. In section 2, describes the survey of the existing wireless routing schemes. Proposed cluster based routing protocol described in section 3. Section 4 presents the performance results and concluded the paper in section 5.

II. RELATED WORK

Existing wireless routing schemes could be ordered under two Classes as stated by their outline philosophy: (a) proactive also (b) on demand.
Proactive scheme figure routes in the conditions, free of movement requests. Previously, the principal sort of directing plan utilized within punctual bundle radio networks for example, such that the PRNET might have been the distance vector type [1].
Those distance vector approach is basic but experiences moderate joining and trend for making routing loops. Merging and looping issue will be after the fact determined earlier resolved those link state (LS) approach, which is broadly utilized within wired nets (e. G. , web [2] or ATM [3]). Link connection State, worldwide system topology data is looked after altogether routers by those cyclic flooding from every link state updates by each node as a final result, those time needed for a router switch to meet of the new topology is considerably short of what in the distance vector approach. Because of worldwide topology knowledge, keeping routing will be also simple. Unfortunately, Concerning illustration link state depends looking into flooding to spread the redesign information, over the top control overhead might a chance to be generated, particularly when secondary mobility triggers incessant updates. The new advance adding to the family unit be the on require routing schemes [4] [5]. The reactive protocol a node discovers

a route in a demand fashion, like it need computers route. Little inquiry responds packets are used to notice one or more route to a set destination. However, since a route need should make actually uncovered former of the data packet transmission, those starting hunt inactivity might corrupt that execution from the intelligent media. Moreover, it is unthinkable should know ahead of time those nature of the way former to bring setup. Such a from the earlier learning (which could a chance to be undoubtedly got from proactive schemes) will be exceptionally alluring in media applications, since it empowers more powerful call acceptance control.

Basically on demand routing perform very well (less traffic and storage OM) in huge networks with less traffic and low mobility. While increasing the mobility pre computed route could break down, it requires various route discoveries to destination. Route caching become unsuccessful in high mobility, since flooding is use for inquiry spreading and route continuation; on demand routing tend to suit inefficient when traffic is more. As discuss in [6] while the traffic load increase routing load will produce for on demand routing protocol. On account about 100 nodes and more 40 resources for uniform traffic pattern, it brings about [6] show that both DSR and more AODV will produce additional routing overhead over real throughput. Comparative analysis also reported in [7].

For example, LAR [9] is a around demand protocol comparable on DSR Yet it limits control packet flooding by utilizing area majority of the data. Dream [10] is an area built proactive plan. Each hub in the organize occasionally exchanges control packets will illuminate every last one of different nodes from of its location.

Each control packet may be allocated an aggregation run through In view of that geological separation starting with that sender. DREAM sends short existed bundle a greater amount habitually over long existed packets because of those something like that called separation effect, i. E. , those more remote two hubs separate, those slower they appear to be to make moving with admiration to one another. That information bundle is show of the hubs in the heading of the end utilizing best area majority of the data put away toward those sender. Over routing, the fisheye methodology translate will keeping up exact separation and way nature majority of the data around the prompt neighborhood of a node, with progressively low point of interest Similarly as the separation packet. FSR will be functionally comparable with LS directing in that it supports a topology map toward each node. The way distinction will be the possibility to get to which routing data is disseminated.

Will LS, join state packets might make and more overflowed under those framework toward whatever side of the point a hub detects topology change, will FSR, connection state packets need aid not overflowed. Instead, hubs maintain a join state table in perspective of the up Furthermore advancing larger part of the information acknowledged beginning for neighboring nodes, What's more here and there exchange it with their neighborhood neighbors just . Through this trade process, those table segments. For greater grouping numbers dislodge the individual’s ones for little plan numbers.

The FSR periodic table return resembles those vector trade clinched alongside distributed Bellman-Ford (DBF) (or that's only the tip of the iceberg precisely, DSDV [12] the place the distances are updated as stated by those occasion when stamp alternately succession number allocated by the hub starting those upgrade. However, in FSR connection states instead of separation vectors would propagate. Moreover, in done LS, a full topology guide will be held during each hub What's more most brief ways would register utilizing this map. To a wireless environment, a radio connection the middle of portable hubs might knowledge incessant disconnects and reconnects. Those LS protocol discharges a link state upgrade for every such modify, its floods that system also reasons unreasonable overhead. FSR abstains from this issue periodic perusing utilizing periodic, As opposed to off chance driven, trade of the topology map, significantly diminishing those control communication transparency. While system extent grows huge, that upgrade communication might expend lot from claiming bandwidth, which relies on the redesign time. So as to decrease the extent about overhaul messages without genuinely influencing directing precision, FSR utilization the fisheye procedure.

Fig. 1 illustrate the provision about fisheye to a mobile, wireless system. The circles with separate shades of ash define those fisheye scopes for admiration to the middle point node (node 11). The scope will be characterized Likewise the situated about hubs that could make arrived at inside a provided for amount of hops. Our case, three scopes need aid demonstrated to 1, 2 and > 2 jumps separately. Hubs need aid shade coded similarly as black, ash Furthermore white as needs be. The number for levels and the span for every degree will rely on upon the extent of the network.

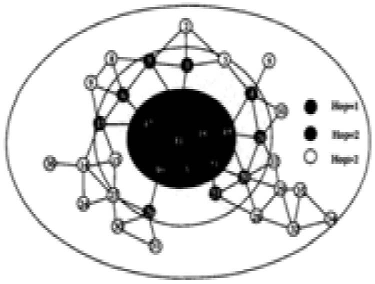

Fig. 1. Scope of fisheye

Those request one MANET routing Protocol may be an algorithm to system communication by advanced mesh in a network organize on find each other, and more send messages to one another along a sensibly productive way. It might have been outlined for, and advertised concerning illustration attempting for wireless mesh networks. OON's designers say it can handle many nodes, the place the vast majority other protocols handle less a hundred. OON employments progressive calculations on minimize the downright add up about transmissions required to directing. Directing overhead may be restricted to between 1% on 5% for hub with hub data transfer capacity done whatever system Also doesn't develop Likewise those organize extent grows.

Those fundamental thought will be that an organize itself under a tree. Nodes help in the root of the tree to create a starting route. The route afterward moves out starting with that root by cutting corners, as ant-trails do. When there are no more corners on cut, a about ideal course exists. This route is continuously looked after. Each procedure could a chance to be performed for confined minimal communication, and thick, as little router tables. OORP obliges regarding 200K about memory. A simulated network with 500 hubs transmit toward 200 bytes/second sorted out it clinched alongside over 20 seconds [13].

III. PROPOSED CLUSTER BASED ROUTING PROTOCOL

The novel cluster depended approach is efficient and effective by the means of energy efficiency. The clustered depended approach is demonstrated in this section.

In order to establish the mathematical model the following lemmas are considered. The lemmas and the subsequent theory will establish the model by analysing the cluster head detection.

Lemma – 1: Any algorithm must change the cluster head randomly and time to time in order to enhance the life time of the network.

Where,

T(CH) denotes the cluster head deciding function and returns the cluster head for any time instance

G is the set of clusters

N is the set of nodes in any cluster

k is the round number

Proof: In order to prove the above lemma, this work demonstrates that,

$$\forall g \subset G \qquad \text{(Eq. 1)}$$

There exists a cluster g in the total network, such that,

$$\varnothing(g) \neq NULL \quad \text{(Eq. 2)}$$

The numbers of non-dead or active nodes are not zero.

Further, the selected node, n

$$\forall n \subset N \qquad \text{(Eq. 3)}$$

And the randomly selected node to be considered as the new cluster head, n'

$$\forall n(t) \subset N' \quad \text{(Eq. 4)}$$

Subsequently to be naturally understood that,

$$N \not\subset N' \ and \ N' \not\subset N \quad \text{(Eq. 5)}$$

So that the recently selected cluster head can be avoided to be similar from the last one.

Considering the R(k) is the percentage of the cluster head available in the N, then

$$1 - R(k)[k \bmod \frac{1}{R(k)}] \quad \text{(Eq. 6)}$$

The remaining percentage of the cluster heads, available in the collection N.

Henceforth, the cluster dead deciding the function can be formulated as

$$T(CH) = \frac{R(k)}{1 - R(k)[k \bmod \frac{1}{R(k)}]} \quad \text{(Eq. 7)}$$

As the Eq. 5 clearly stand the point of not repeating cluster heads in the subsequent times, thus the energy consumption is also evenly distributed.

Lemma – 2: Any algorithm must choose the cluster head based on the comparisons of effective energy available in order to increase the life span of the network.

Where,
Net_LSpan denotes the Life Span of the network
Net_Egydenotes the energy of the network
N_Egy denotes the energy of the node

Proof: In order to prove the above mentioned lemma, this work demonstrates that,

$$\int_{MAX(Net\_Egy)}^{MIN(Net\_Egy)} Net\_Egy \quad \text{(Eq. 8)}$$

Considering the Max and Min denotes the maximum and minimum energy of the network.

Subsequently,

$$\int_{MAX(N\_Egy)}^{MIN(N\_Egy)} N\_Egy \quad \text{(Eq. 9)}$$

Here choosing any node n to be the cluster head, will result in

$$\mathrm{Res}(N\_\mathrm{Egy}) = \frac{N\_Egy(t)}{dx(N\_Egy_n)} \quad \text{(Eq. 10)}$$

Where, Res denotes the effective energy left in the node.

After the random selection of the any cluster head, the energy varies in the utilized and non-utilized node.

$$\mathrm{Res}(N\_\mathrm{Egy})_n < \mathrm{Res}(N\_\mathrm{Egy})_{n+1} \quad \text{(Eq. 11)}$$

Further selection of the same node n, will result in

$$\mathrm{Res}(N\_\mathrm{Egy})_n \to Min(N\_Egy)_n \quad \text{(Eq. 12)}$$

Repeated selection of the same node, will result in

$$\mathrm{Res}(N\_\mathrm{Egy})_n \to 0 \quad \text{(Eq. 13)}$$

Thus having a random shutdown of the node and result in

$$\mathrm{Res}(Net\_Egy)(t) \to \mathrm{Min}(Net\_Egy)(t) \quad \text{(Eq. 14)}$$

Naturally to be understood that, this will result in

$$Net\_LSpan \to 0 \quad \text{(Eq. 15)}$$

This effective will be visible in much lesser amount of time.

Henceforth in the light of the Lemma – 1 and Lemma – 2, this work demonstrates the novel algorithm,

Step-1. In the pre-installation step, the list of active nodes will be accumulated,

$$n \subset N \not\in D \quad \text{(Eq. 16)}$$

Where n denotes the any available node belongs to the cluster set N and does not belongs to the D, the dead cluster set.

From the Lemma – 1, it is proven that the random selection of the cluster head will improve the life span of the network.

Step-2. In the next step, for the selected node, the energy status will be accumulated.

$$\mathrm{Res}(n) \leftarrow \overline{Max(\mathrm{N\_Egy}(n))} \quad \text{(Eq. 17)}$$

From the Lemma -2, it is also proven that the consideration of the available energy will improve the life span of the network.

Step-3. Henceforth, the cluster head will be decided considering the weight function consisting of the available energy and selection of non-repeating nodes.
Where,
CH denotes the cluster head

From the Eq. 7, Eq. 14 and Eq. 15,

$$CH = \prod_{\mathrm{Res}(N\_Egy(n))}^{Max(N\_Egy(n))} n \oplus [n \subset N \not\in D] \quad \text{(Eq. 18)}$$

Step-4. The information captured for all the nodes in the network will be maintained in the routing table RTab with the following parameters.

$$RTab(\mathrm{N\_Egy}_n, \mathrm{n}_{Source}, \mathrm{n}_{Destination}, \mathrm{n}_{Next}) \quad \text{(Eq. 19)}$$

Step-5. In the next step, the nearing neighbour node to be decided repeating the step – 1 to 4.

Step-6. After the path is been decided, the data transfer is carried out.

Step-7. In case of the network topology change repeat the step – 1 to 5.

Henceforth the novel cluster based algorithm may show the higher latency, however the algorithm will demonstrate the higher energy awareness compared to the existing algorithms.

In order to prove, the improvements in the next section, this work furnishes the comparative study.

IV. RESULTS AND ANALYSIS

The figure2 to figure31 shows the results of Communication cost, Delay, Energy Consumption, Packet loss, Packet delivery ratio, and throughput for 25, 50, 75, 100 and 500 nodes.

The simulation results proves that communication cost is decreased in proposed cluster based algorithm, delay is decreased, throughput increased, Energy consumption decreased, Packet loss decreased and packet delivery ratio is increased when compare with Order one manet protocol and fish eye state protocol.

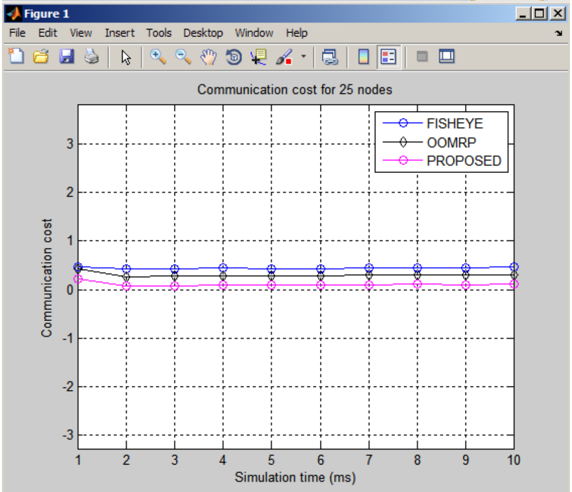

Fig 2. Communication cost for 25 nodes

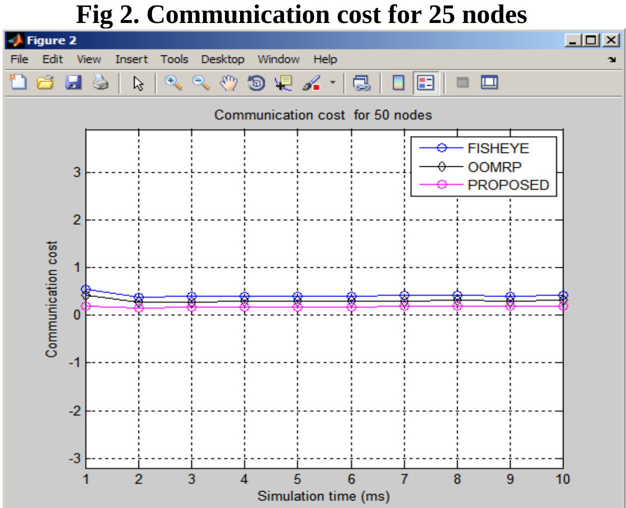

Fig 3. Communication cost for 50 nodes

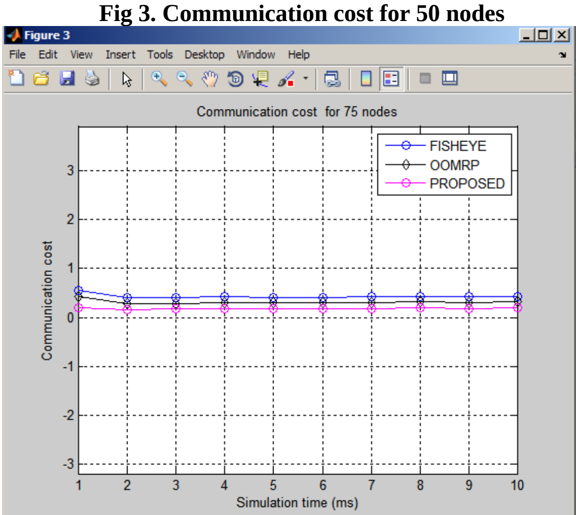

Fig 4. Communication cost for 75 nodes

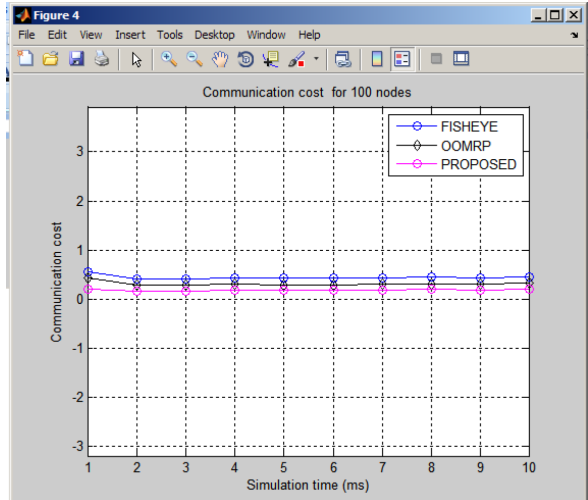

Fig 5. Communication cost for 100 nodes

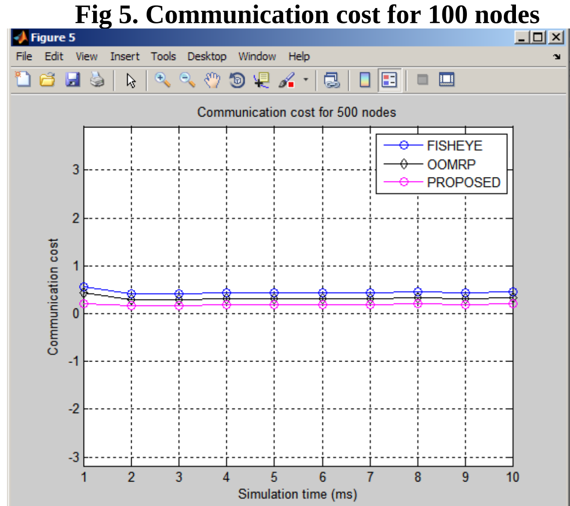

Fig 6. Communication cost for 500 nodes

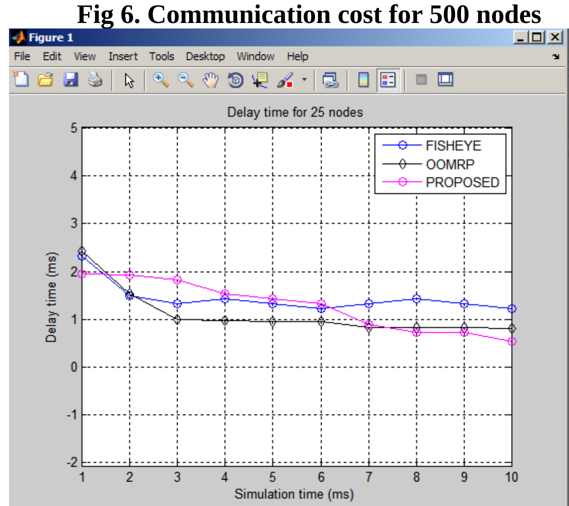

Fig 7. Delay for 25 nodes

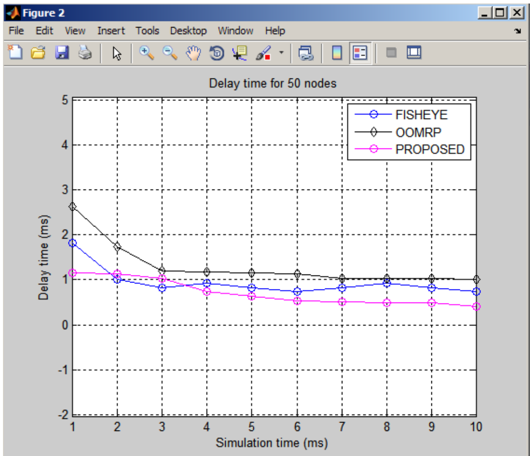

Fig 8. Delay for 50 nodes

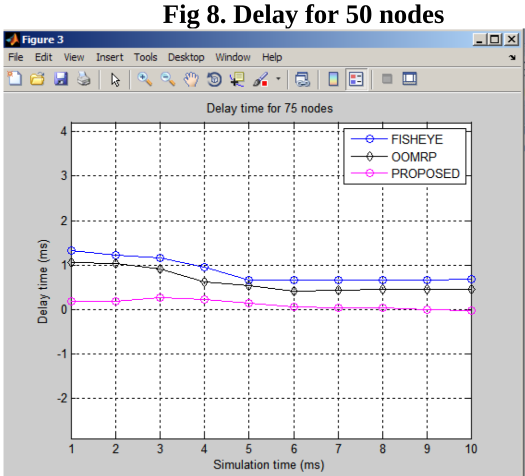

Fig 9. Delay for 75 nodes

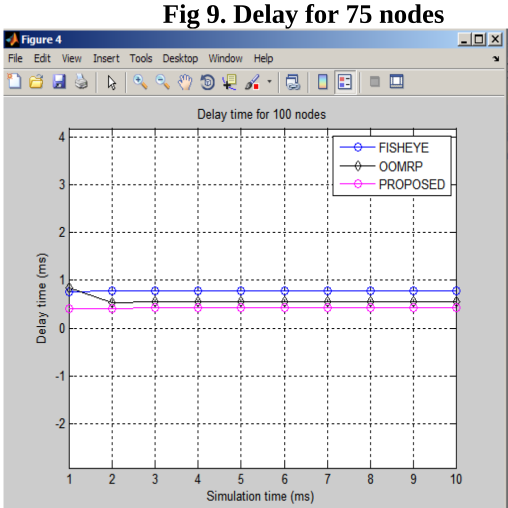

Fig 10. Delay for 100 nodes

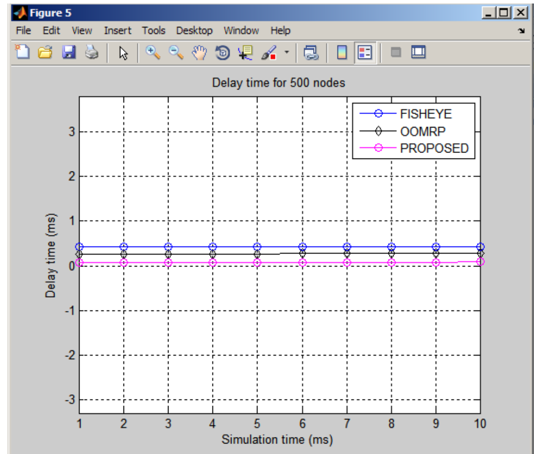

Fig 11. Delay for 500 nodes

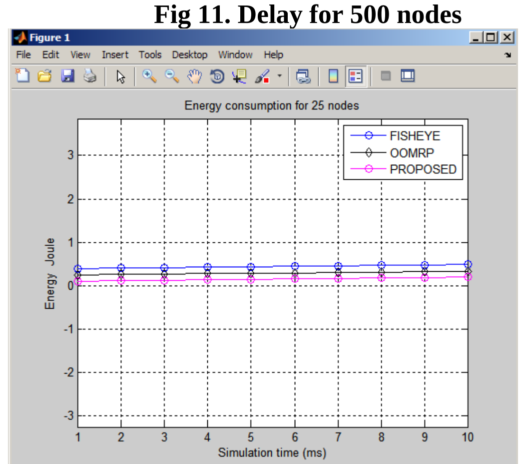

Fig 12. Energy consumption for 25 nodes

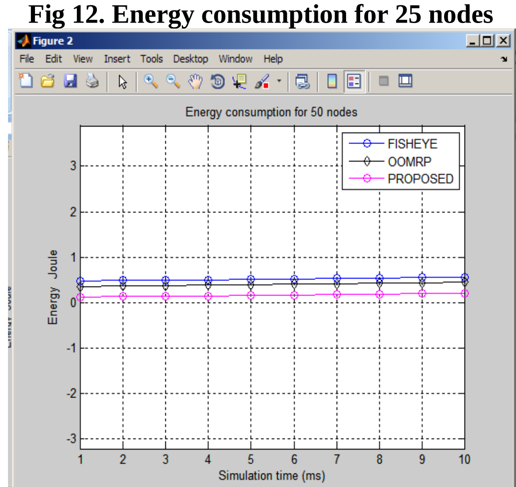

Fig 13. Energy consumption for 50 nodes

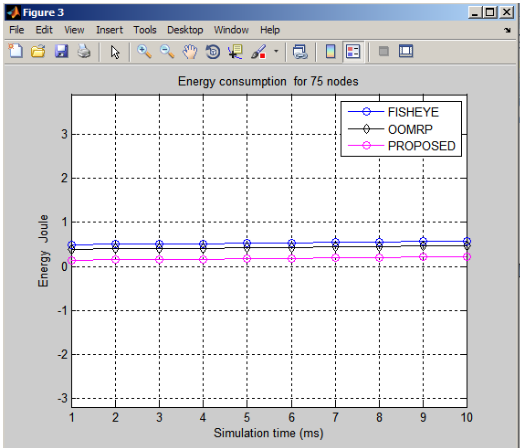

Fig 14. Energy consumption for 75 nodes

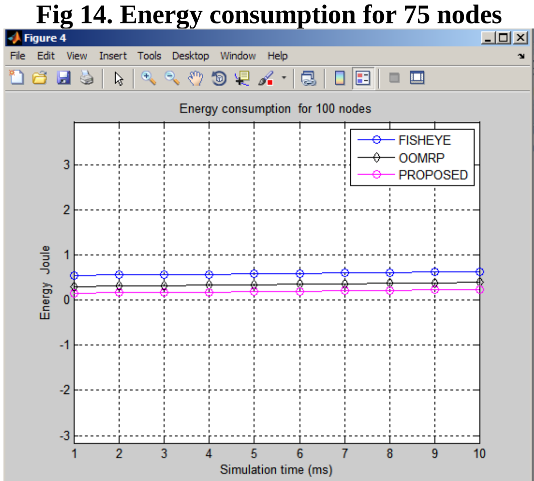

Fig 15. Energy consumption for 100 nodes

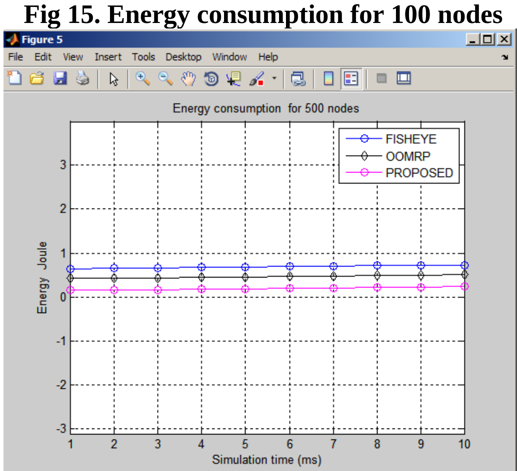

Fig 16. Energy consumption for 500 nodes

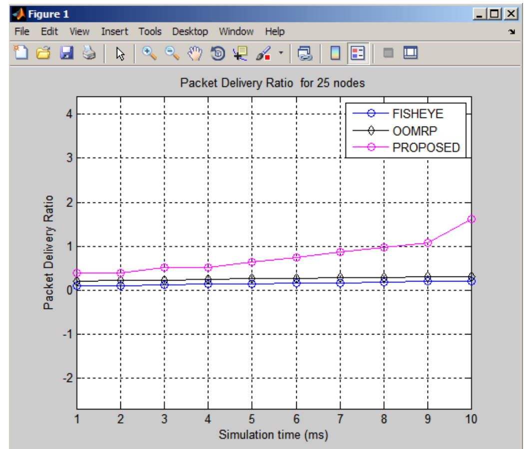

Fig 17. Packet Delivery Ratio for 25 nodes

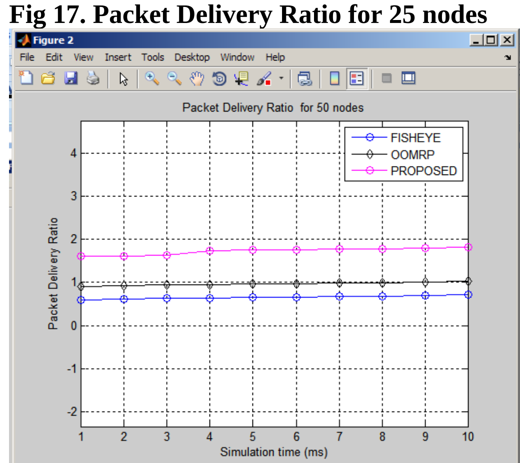

Fig 18. Packet Delivery Ratio for 50 nodes

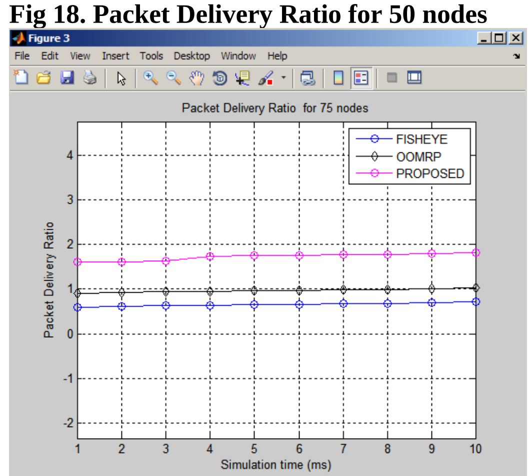

Fig 19. Packet Delivery Ratio for 75 nodes

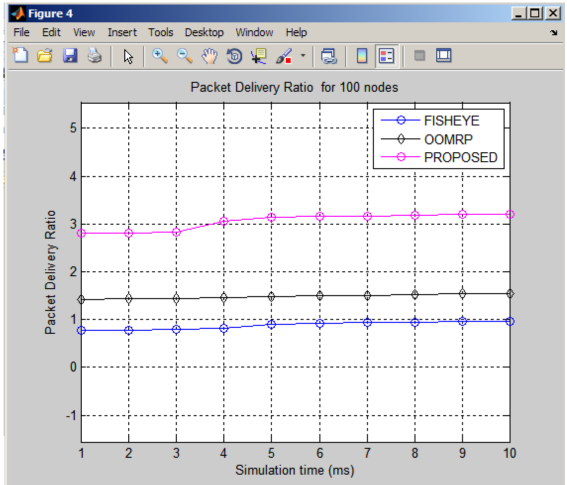

Fig 20. Packet Delivery Ratio for 100 nodes

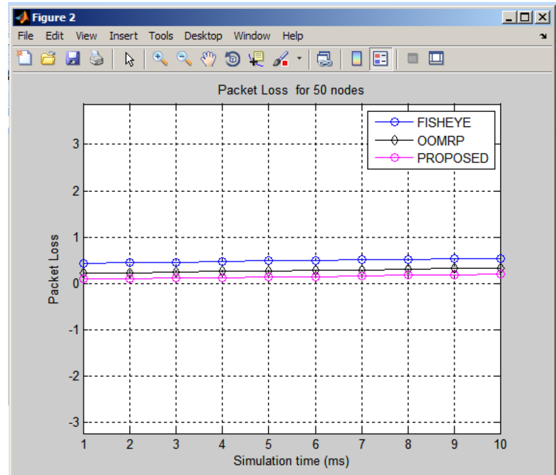

Fig 23. Packet Loss for 50 nodes

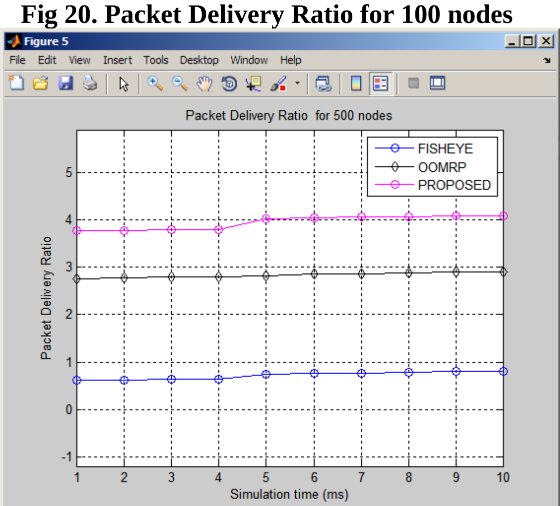

Fig 21. Packet Delivery Ratio for 500 nodes

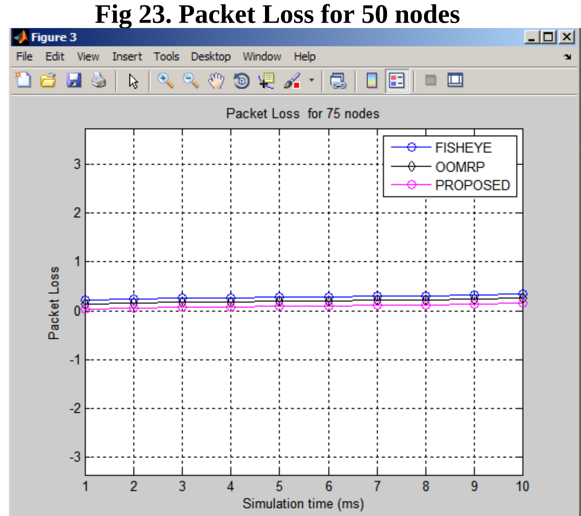

Fig 24. Packet Loss for 75 nodes

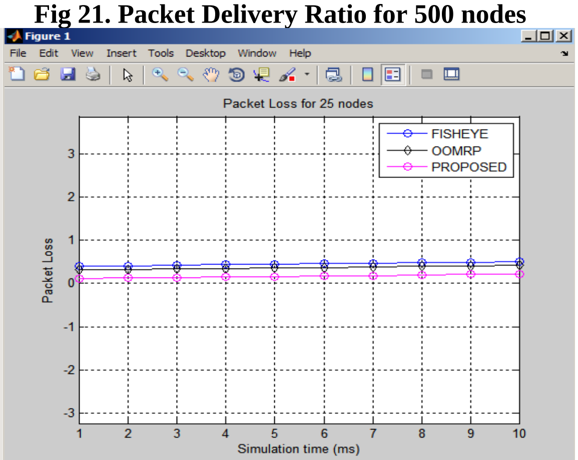

Fig 22. Packet Loss for 25 nodes

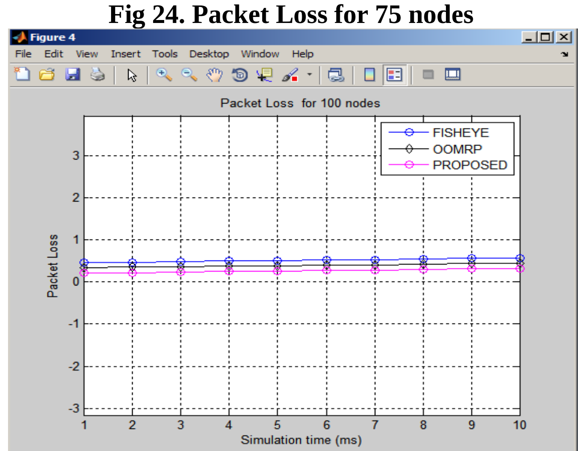

Fig 25. Packet Loss for 100 nodes

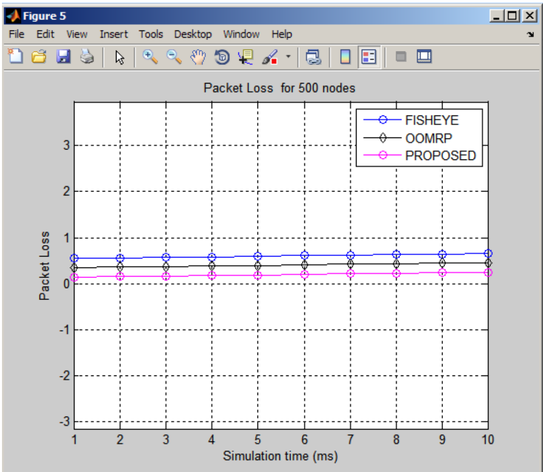

Fig 26. Packet Loss for 500 nodes

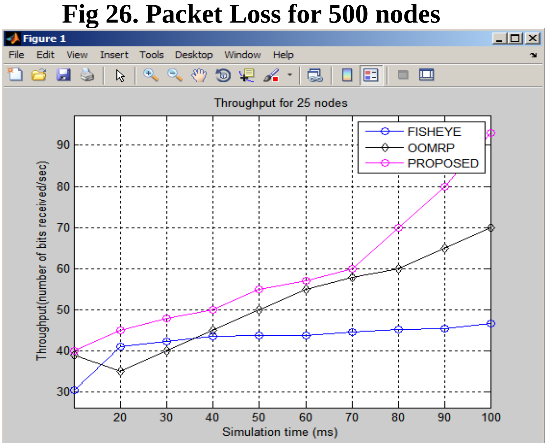

Fig 27. Throughput for 25 nodes

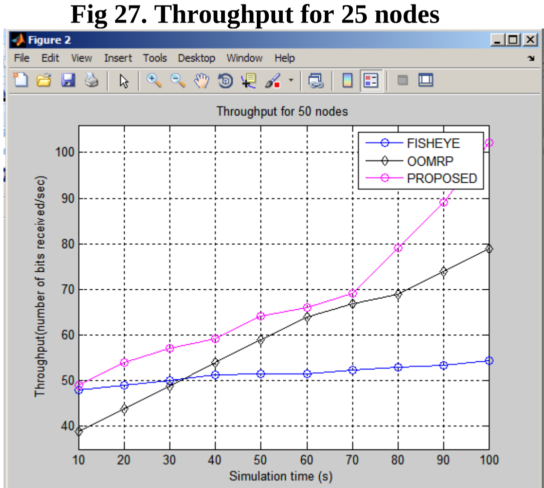

Fig 28. Throughput for 50 nodes

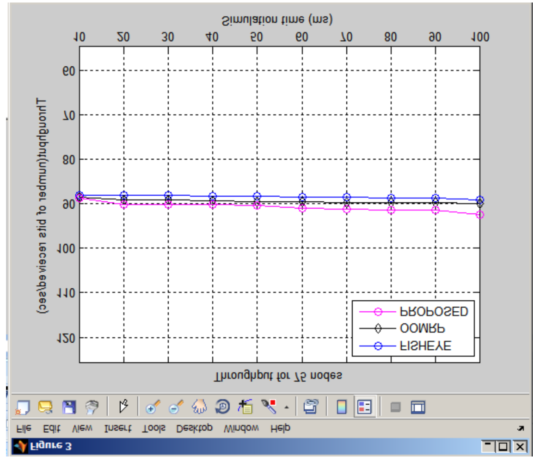

Fig 29. Throughput for 75 nodes

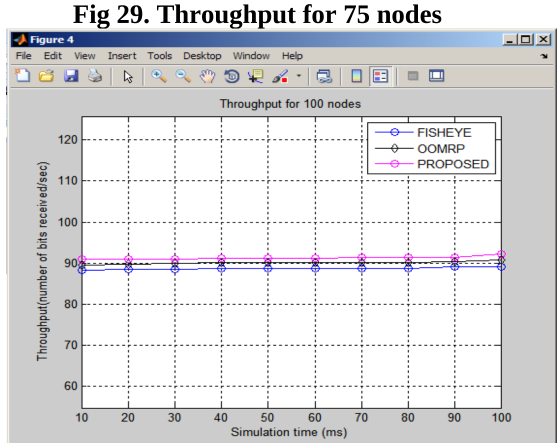

Fig 30. Throughput for 100 nodes

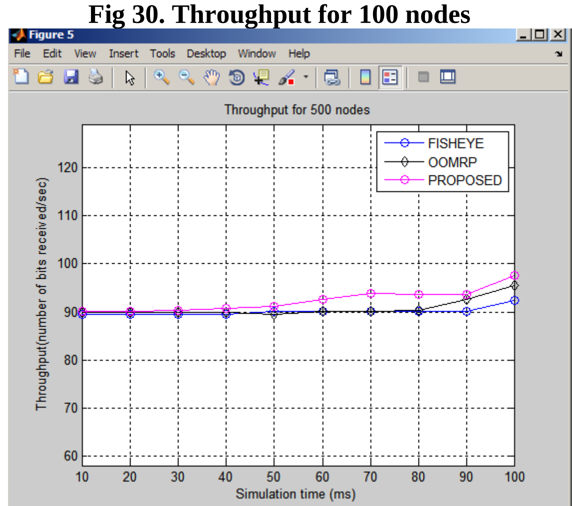

Fig 31. Through put for 500 nodes

V. CONCLUSION

This work proposed the novel cluster based routing algorithm. The work provides the improved results compared to the fish-eye state routing algorithm and order one manet routing algorithms. The algorithm is proven to be having higher energy efficiency, packet delivery ratio, throuput and low delay and packet loss and consistence for a highly dense MANET. This work finally outcomes in the novel algorithm with nearly 50% improvement in the power awareness and the proposed model for calculating the energy efficiency of any given algorithm for further enhancements.

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