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Enhanced Greedy Perimeter Forwarding Algorithm for Mobile Sensor Network in Cluster region

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Abstract- In mobile wireless networks, path breakage happens frequently due to the movement of mobile nodes, node failure, channel fading and shadowing. It is challenging to combat path breakage at the cost of minimum control overhead, while adapting to topological changes rapidly. We propose a new greedy technique EPFA (Enhanced Perimeter Forwarding Algorithm) for transmitting the mobile nodes from source to destination. The nodes will be communicated and travelled properly by the new technique without a greater loss. Moreover the paper discuss about the cluster or region head, the role of the CH and the subordinate TH node. The algorithm clearly explains about the work flow of the CH and TH. The simulation diagram discusses about the packet delivery ration, collision rate, total delay of the node in the required time and the energy consumption rate of the mobility node.

Keywords— Clutster region, Control overhead, Transition head.

I. Introduction

Wireless sensor networks (WSNs) may consist of a large number of sensor nodes, which are densely deployed in close proximity to the phenomenon. In WSN, sensors gather information about the physical world and the base station or the sink node makes decision and performs appropriate actions upon the environment [1]. Wireless sensor network is used in variety of different category applications such as military service, medication monitoring, and surveillance [2]. In the view of applications, sensor node have characteristic of self-organizing, easy usage, mobility, heterogeneity, and large scale of deployment [3]. In recent years, wireless sensor network application developments have attracted many researchers in this field. Over last few years, applications such as military service and surveillance require position information of other nodes. Position information is taken by the means of using GPS devices or other positioning devices. Using the local position information, source node can forward packet to destination which is called geographical routing protocol. A source node refers to the source of data and the sink refers to the destination [4]. One of the challenges that wireless sensor network faces is the characteristics. In other words, routing protocols compared to traditional routing algorithm have following different characteristics. Remote sensor systems (WSNs) may comprise of an extensive number of sensor nodes, which are thickly sent in nearness to the marvel. In WSN, sensors accumulate data about the physical world and the base station or the sink node settles on choice and performs fitting activities upon the earth.

Energy is one of the most important factors to be considered in wireless network [5]. The reason is wireless sensor nodes have limited amount of energy resource. Designing durable energy consumption algorithms are important in order to increase overall lifetime of the whole network. In geographical routing, it was designed usually under assumption that nodes only know the local topology information. In order to increase overall network performance, there exist problem that energy consumption is to be considered during designing. As the nodes have limited amount of energy therefore, it decreases performance of storing big data packets and complicated calculations.

A MWSN can be considered as a collection of distributed sensor nodes, which are capable of sensing, moving, communicating within its allowable range. The complete system architecture of a MWSN includes a group of mobile and static sensor nodes, a mobile base station (laptop or PDA), and upper communication network infrastructure [6, 7]. Each of these sensor nodes has the capability of collecting data and routing data peer-to-peer to base stations. The mobile sensor node is in fact an enhanced sensor node. It not only has all the capabilities of the static sensor node, but also realizes mobility by adding a robotic base and a driver board. Each mobile sensor node is capable of navigating autonomously or under control of humans. Large numbers of mobile sensor nodes can coordinate their actions through ad-hoc communication networks [7]. A base station or mobile sink is used to bridge the sensor network to another network or platform, such as the Internet. The mobile sink offers many benefits to the network. For instance, it helps to improve scalability, maintain load balance, conserve energy, and prolong the network lifetime.

The general concept of greedy/recovery mode in position based routing protocols is to categorize the data forwarding operations into two set of strategies. In the greedy mode, the sensor node is able to advance the data towards the final destination. Quite a few works have been working on possible solutions about how to select the most suitable next hop towards the final destination, given different considerations, such as geographic distance between each pair nodes or the line connecting the source and destination nodes [8-13]. If a node cannot find the next hop to advance the data in greedy mode, the node will transfer into recovery mode.

Again, various actions have been proposed in the recovery mode by researchers but with the same intension, which is to allow the nodes who carry the data can eventually transfer back to the greedy mode for further data forwarding towards the final destination. Greedy Perimeter Stateless Routing Protocol (GPSR), proposed by Karp and Kung in 2000, is a well-known geographical-based routing protocol for Mobile Ad Hoc Networks (MANET) [14]. GPSR allows nodes in greedy mode to forward the packet through the shortest path between source and destination. The recovery mode makes use of the perimeter of a network area to forward the data by applying a simple right-hand rule. Divisional Perimeter (DP) is proposed in to improve the GPSR performance by employing both right-hand and left-hand rules [15].

A new Enhanced Greedy Perimeter Stateless Routing (EGPSR) was proposed in work recently [16]. The main contribution of this work is to divide a forward region into a few sub-regions with equal area. The sub-region selection is carried out based on the remaining energy of the neighbor nodes in each sub-region. The sub-region with the highest remaining average node energy will be selected. Then the next forwarding node will be selected from this sub-region according to the defined node probability transmission model. The performance of EGPSR was evaluated via simulation on Matlab platform. Compared to GPSR and IGPSR (Improved GPSR), EGPSR outperformed in the aspect of high packet delivering number and low network energy consumption. However, the EGPSR design still overlooked certain issues.

Firstly, only the node’s current remaining energy is considered in EGPSR. In actual WSN, both receiving and transmitting data require energy as well. Whether or not the current remaining energy at each node can fulfill the forwarding tasks is missing in EGPSR. If the answer is false, the next hop selection might result in packet lost. Secondly, both IGPSR and EGPSR scheme aim at the improvement when nodes are in greedy mode. There is no explanation about what are the actions once the nodes fall into recovery mode. Furthermore, no mobile nodes are taken into consideration in EGPSR.

In this paper a new greedy technique EPFA is introduced to transmitting and communicating the mobile nodes from the source to destination. It has been discussed in the first section of the paper. It helps to traverse the information among the nodes without any greater loss. In the second section the cluster head and the role of CH is discussed. The work of the Ch and the subordinate of CH role are sincerely discussed in the second section. The third section describes about the TH and the role of CH-TH. The final section focuses the simulation analysis of the mobile nodes in terms of packet delivery, collision, Delay, energy consumption.

II. RELATED WORK

In geographic directing, the forwarding decision at every node depends on the areas of the node's one hop neighbors and area of the packet destination also. A forwarding node in this way needs to keep up these two sorts of areas. Numerous works, e.g., GLS, Quorum System, have been proposed to find and keep up the area of destination. In any case, the upkeep of one-hop neighbors' area has been frequently disregarded. Some geo-realistic routing plans, e.g, simply assume that a decision node knows the area of its neighbors. While others, utilize periodical reference point broadcasting to trade neighbors' areas. In the intermittent beaconing plan, every node communicates a reference point with a fixed signal interim. On the off chance that a node does not hear any signal from a neighbor for a specific time interim, got neighbor break interim, the node considers this neighbor has moved out of the radio range and expels the obsolete neighbor from its neighbor list. The neighbor break interim frequently is on numerous occasions of the reference point interim.

Heissenbuttel et al have appeared occasional beaconing can cause the erroneous neighborhood topologies in very portable specially appointed systems, which prompts exhibitions debasement, e.g., frequent packet loss and longer delay. The authors discuss about that the outdated entries in the neighbor list is the significant source that diminishes the execution. They proposed a few straightforward enhancements that adjust signal interim to node portability or traffic load, including separation based beaconing (DB), speed based beaconing and receptive beaconing. In the distance based beaconing, a node transmits a guide when it has moved a given separation d.

The node expels an outdated neighbor if the node does not hear any reference points from the neighbor while the node has moved more than k-times the separation d, or after a most extreme break of 5 s. This methodology accordingly is versatile to the node portability, e.g., a quicker moving node sends signals all the more every now and again and the other way around. With the developing notoriety of positioning devices (e.g., GPS) and other confinement plans, geographic directing protocols are turning into an alluring decision for use in mobile ad hoc networks .The basic standard utilized in these protocols includes choosing the following routing hop among a node's neighbors, which is geologically nearest to the destination. Since the forwarding decision depends totally on nearby information, it blocks the need to make and keep up courses for every destination.

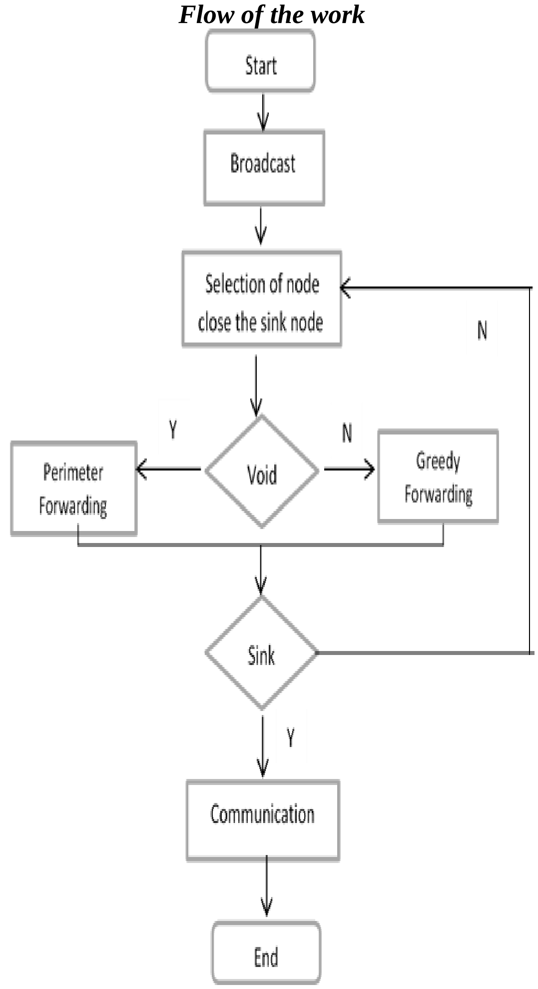
By ideals of these qualities, position-based directing protocols are exceedingly versatile and especially powerful to visit changes in the system topology. Moreover, since the sending choice is made on the fly, every node dependably chooses the ideal next bounce dependent on the most present topology. A few investigations have demonstrated that these routing protocols offer critical execution enhancements over topology-based directing protocols, for example, DSR and AODV. The forwarding strategy utilized in the previously mentioned geographic routing protocols requires the accompanying data. The situation of the last destination of the packet and the situation of a node's neighbors.

III. PROPOSED TECHNIQUE

We propose a new Enhanced Greedy forwarding technique to move the node from source to destination. Moreover the selection of cluster head emphasis the regularity of forwarding. Enhanced Greedy forwarding alludes to an algorithm which expresses that in GPSR, a node forwards packet inside its transmission range to topographically nearest destination node. Perimeter forwarding is utilized when greedy forwarding have neglected to route around the perimeter region. On the off chance greedy forwarding fails to execute because of certain conditions, forwarding is connected immediately.

After rounding around the perimeter if we are able to apply greedy forwarding method then, greedy forwarding method is executed again to reach the destination. It selects a cluster head to proceed the node in the clusters. The Cluster head acts as a head in the selected area or region. Some times in the cluster region the CH plays a major role in forwarding the nodes. Without a head, the nodes cannot forward properly. We propose a new subordinate cluster head called Transmission Head (TH) for forwarding the node inside the cluster or the region. It will acts as a head in the absence of CH

Flow of the work



If greedy forwarding fails to execute due to some circumstances, perimeter forwarding is applied immediately. After rounding around the perimeter if we are able to apply greedy forwarding method then, greedy forwarding method is executed again to reach the destination. GPSR greedy forwarding algorithm looks for the closest node which is closest to the destination node with assumption that all packets in the network topology are marked by their originator and the destination node location.

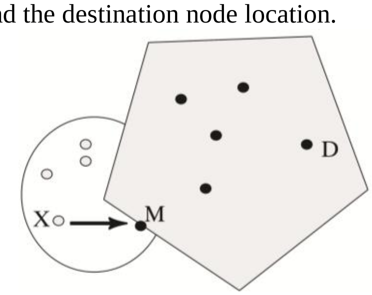


Fig 2: Greedy forwarding procedure

IV. GREEDY PERIMETER STATELESS ROUTING ALGORITHM

Greedy Perimeter Stateless Routing (GPSR) is a standout amongst the most well known routing protocols for area based directing[17]. GPSR utilizes closest neighbor node's data to advance packet geologically which is nearest to destination node and it is named as the greedy forwarding algorithm. Every node in the system topology keeps up data of its area and the neighboring nodes in GPSR. Source node in GPSR not just monitors the data of its area yet additionally the area of the foreordained node together in its table Neighbor nodes within the transmission range of the source node will derive more efficient route to forward packets despite of the interference of network topology. In all probability in GPSR, it is expected that nodes get the area data by GPS gadgets or other such methods. Ordinarily, GPSR comprises of two unique calculations called covetous sending and edge sending to advance packet from source node to destination.

V. ENHANCED GREEDY FORWARDING

As discussed earlier, GPSR greedy forwarding algorithm searches for the nearest node which is nearest to the destination node with suspicion that all packets in the system topology are set apart by their originator and the destination node area. Greedy forwarding algorithm proceeds until the packet effectively comes to at the destination. Neighbor nodes areas through time interim is given by conveying beaconing calculation or just guide messages. During the process of forwarding, when the neighbor node forwards packet to next hop node bound to destination, the forwarding node gets guide including identifier, for example, IP address and the area data to revive its data in the table. Sometimes, if the sending node neglects to get the packet in a specific measure of time then it will erase neighbor nodes from its table.

In the figure above, node x receives a packet aimed to D. The dotted circle around x shows node x’s transmission range and the dotted arc around D shows the radius of D which is equal to the distance between node y and D. By greedy forwarding algorithm, x forwards packet to node y within the x’s transmission range since, M is the closest node to D. This greedy forwarding algorithm continues until the packet successfully reaches destined node D. In GPSR, all nodes in network topology have a local table in which all neighbors nodes are listed by ID and position where a proactive broadcast refreshes this table of each node within the framework of a regular time interval. The destination address is given to packet from the source node. The destination address is fixed and cannot be modified by other nodes which forward the packet. Big advantage of greedy forwarding algorithm is that it only requires information of the forwarding nodes’ adjacent neighbors.

Greedy Perimeter Stateless Routing Algorithm (GPSRA) is an area based directing protocol in sensor network. In a GPSRA routing, the node transmits the information straightforwardly to the destination or transfer through the neighboring node utilizing single or different hops. When the nodes close to the source become dead, the whole system will be futile as there will be no correspondence to the sink node. GPSRA is separated into two stages, Greedy Forwarding and .Perimeter Stateless Forwarding. In Greedy Forwarding calculation, the node transmit the information packet to neighbor node with single or different hop to achieve the sink node.

The Perimeter Stateless Routing pursues the area based routing. When the nodes close to the source become dead, the whole system will be futile as there will be no correspondence to the sink node. To conquer this issue Enhanced Greedy Perimeter Stateless Routing Algorithm is proposed in this paper to set up the insignificant energy change course from source to destination node.

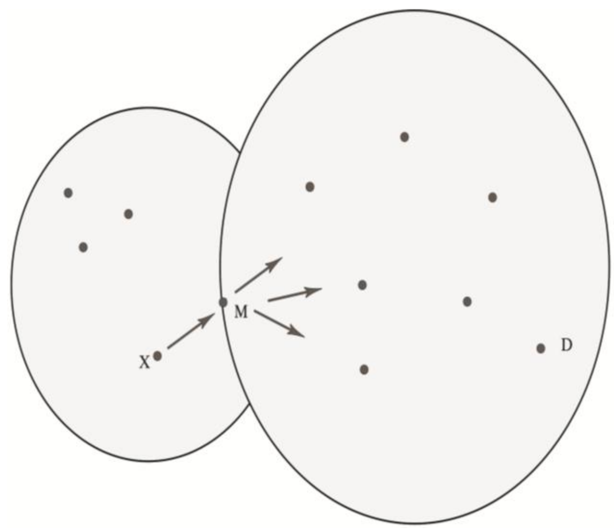


Fig3: Enhanced Greedy forwarding

VI. ENHANCED PERIMETER FORWARDING ALGORITHM

Amid the greedy forwarding process, a node comes to at one point where greedy forwarding algorithm is not preposterous to expect to work legitimately. The reason is on the grounds that the following hop node sending packet is nearer to destination than some other neighbor nodes. Subsequently, an alternate algorithm, for example, perimeter forwarding algorithm ought to be utilized to route the packet. Perimeter forwarding is shown below.

ALGORITHM 2 : SUB-REGION SELECTION AND FORWARDING ALGORITHM

1. Input Neighhop_List, WaitList
2. Add component in WaitList to Neighhop_List
3. For i<NeighHop_List length do
4. Get the area of next hop j
5. if dis_to_nexthop > T r
6. Store j into WaitList, n=0
7. Else
8. Call DivedeSubForwardRegion(List NeighHop_list)
9. End if
10. Call SelectNextHop(List NeighHop_subregion)
11. End for
12. Judge n whether still in NeighHop_list, if not n=0
13. Output n
14. Capacity DivdeSubForwardRegion(List NeighHop_list)
15. Cross the whole NeighHop list
16. Partition these NeighHop into various districts with equivalent region
17. Calculate the normal vitality of each sub-locale ir E
18. Select the greatest the ir E
19. Return the relating rundown of NeighHop_Subregion with greatest ir E
20. End Function
21. Capacity SelectNextHop(List NeighHop_subregion)
22. Cross the whole rundown
23. Figure the likelihood p of every conceivable nexthop as indicated by formula (5) the sink hub
24. Select greatest p
25 Return the corresponding

VII. Cluster head Election

In spite of improving the security and precision of the gathered information, the checking scope of the sensor nodes in the observing region are covered with each other, so the information gathered by the nodes are repetitive. The energy utilization of the nodes is for the most part in the transmission and transmission of information, so a ton of excess information will abbreviate the life cycle of Wireless sensor networks [18].Therefore, subsequent to choosing the primary cluster head, and the second cluster head is chosen.

The primary cluster head is utilized to send the information of the cluster to the sink node and get the message sent by the sink node to the group, and the second cluster head is utilized to get information sent by different nodes in the cluster and send to the main CH. The decision of two cluster heads isn't just to intertwine the repetitive information, yet additionally to disseminate the energy devoured by information combination and information transmission on two nodes, maintaining a strategic distance from the exorbitant utilization of a node, bringing about a diminishment in the general network life cycle. Each time two cluster heads were chosen and the situation of the focal point of the cluster was figured. Ascertaining the separation from each cluster go to centroid, the separation is little as the second cluster head, and alternate as the primary cluster head.

Most energy proficient clustering protocols [18]-[24] consider the residual energy as a critical factor that choose which node to be group head in a bunch, the more vitality a node has, the greater open door it is to end up a bunch head. That can draw out the system lifetime by adjusting the vitality utilization difference to arbitrarily choose node as bunch head. However, the separation is likewise a factor that influences the vitality dispersal. So in view of the thought above, we explains the following probability K(*i*) for node *K* to decide which node to become cluster head.

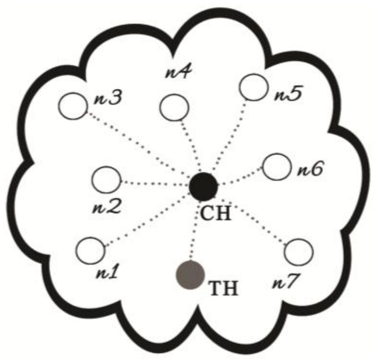
$$K(i) = c_{opt}\left[\begin{array}{c}\beta\frac{En(r)}{E(r)} + \\ (1-\beta)\frac{G(i)}{d_{max} - d_{base}}\end{array}\right] \quad (1)$$

Where C_{opt} defines the ratio of optimum number of clusters, and C_{opt} □□J_{opt} / n, *En(r)* is node *i*'s residual energy during round r , E(r) is the average energy of the alive nodes during the cycle r, d_{max} is the maximum distance of node i to the base station, d_{base} is the average distance between nodes and the base station. $d_{max} - d_{base}$ is the adaptive parameter $\beta = \frac{1}{1+\theta}$ where $\theta = \frac{En(r)}{E(r)}$ and θ varies from 0 to 1.

When Cluster development is done, CH has been chosen every node begin their sensing procedure and sends those sensed information or data to CH while CH wires the information got from SN to diminish the measure of information to be transmitted to BS. At that point each lower level cluster head aggregates the received information from SN and transmits it to the higher lever CHs for instance fifth level CH send the gathered information to 4rd level CH, which at that point transmit it to third level CH until the point when the information achieves the BS.

VIII. Transmission head

Transmission Head is more are less like the cluster head however the part of transmission head differs as indicated by the cluster network. The transmission head goes about as another set out toward each group. The sensor node transmits the messages from node to node in each group. The esteem and the correspondence of every node will be done by a pioneer node called cluster head. The transmission node acts another pioneer with a docile mode. It gets the correct data from the CH and after that it imparts to portal or base station. On the off chance that on account of CH fizzles, the TH will goes about as an unrivalled and it channel the route for another sensor node as a TH.



CH and TH
Fig 4 : Single cluster having

Each node in the cluster gets the total portability esteems from its nearest nodes, and after that contrasts its own versatility esteem and those of its nearest. The node having the most reduced portability esteem among every one of its neighbors is chosen as clusterhead. On the off chance that two nearest nodes in a cluster have undecided state and having a similar estimation of total relative versatility metric, at that point their IDs data is utilized and less - ID calculation is taken after.

a) Cluster Member with lower portability moves into the scope of another CH node which is having higher versatility, at that point reclustering isn't finished.
b) Any two nodes with Cluster Head move into each other's range, reclustering is conceded for Cluster Contention Interval (CCI) to consider accidental contacts between passing nodes.
c) If the nodes are in transmission scope of each other even after the Cluster Contention Interval clock has terminated, re-clustering is activated, and the node with the lower versatility metric chose as cluster head.

Receiving multi-hops to transmit information will cause nodes around base station bite the dust right on time in single cluster head display. It is on the grounds that those nodes need to gather and transmit information in the meantime. To enhance execution of network, a few researchers propose twofold cluster head demonstrate in view of single cluster head. Transmission Head empowered when the essential cluster head invalid or energy depleted.

The transmission Head was chosen within the network region i.e., Inside the cluster. All the sensor nodes in the particular cluster communicate the process directly to the CH. The Cluster head collects all the information and passes through the transmission head to the Base station. In some cases, gateway nodes all inter linked to the base stations. Here we proposed an algorithm for TH and its work as follows.

ALGORITHM 2: SELECTION OF CH AND TH

Step 1: Nodes n1, n2, n3 ....$\propto$ are the nodes within the network range and forms as a cluster.

Step 2: The density of the network is defined as $\boldsymbol{\theta}$ and $\boldsymbol{\theta = \frac{S^2}{N}}$, where $\boldsymbol{S^2}$ is the area of the Network, N is the number of nodes.

Step 3: All member nodes communicates the information about its current energy and locations to its CH in each cluster.

Step 4: The energy value of each node can be calculated and the highest energy node will be selected as a CH.

It acts as a superior in all the clusters.

If N= n1,n2,n3.... $\propto$.} then CH >n1,n2,n3..... $\propto$.

Step 5 : TH -Transmission Head falls within the same network range.

The next energy level node of the cluster will be considered as TH.

TH = TH<CH, where TH acts as CH in some cases. TH plays a vital role in the communication.

CH→ TH→ BS, where all information will receive by CH will be transmitted to TH to BS.

Step 6: The value of TH can be defined as TH $=\boldsymbol{\sum_{n=1}^{\infty} N}$ or $\boldsymbol{\sum n1 + n2 + n3 \ldots \infty}$.

Transmission heads utilize assignments division instrument to stay away from high energy utilization in a solitary cluster head. Cluster heads re-chose while surplus energy not as much as a specific limit not founded on occasional choice. It can lessen the quantities of network remaking and upgrade the soundness of network. Transmission Head lessens cluster head energy utilization successfully, balances energy utilization among part nodes, and expands the survival time of network.

It works that the energy management and distributed cluster set up is done by localizing configuration and reconfiguration of clusters [25]. The expended battery control is a superior measure than the total time amid which the node goes about as a cluster head that is utilized as a light of the fact that it mirrors the real measure of energy use. In the event that there is deficient battery control then lifetime of topology can be increment by exchanging the part of the cluster head to a standard node.

IX. SIMULATI ON ANALYSIS

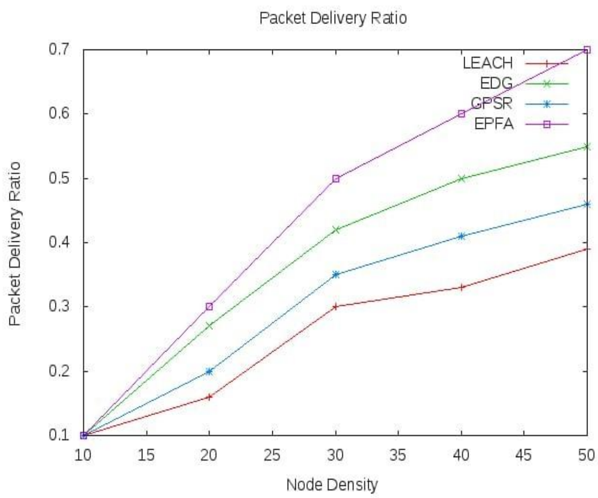


Fig 5: Packet Delivery ratio

Fig. 5 shows the packet delivery ratio with respect to different degree of mobility. Our EPFA outperforms better than the other protocols like LEACH, EDG and GPSR respectively. The improvement is attributed to its responsiveness to topology changes. As all nodes are mobile, it is very likely that some links on several discovered paths break up a short time. Even the network is under saturated; packet loss is high because of the frequent path breakages caused by node mobility. EPFA experiences the same in some times but not at the maximum level when compared with all the three protocols.

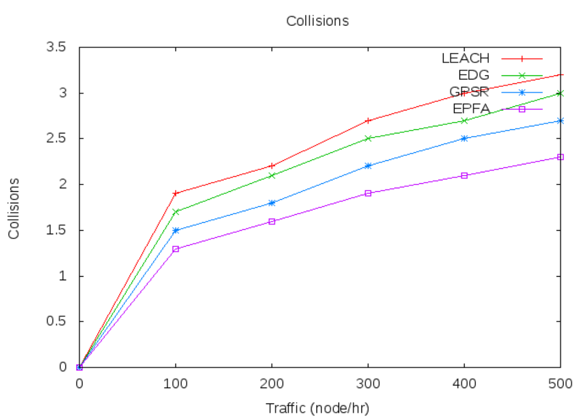


Fig 6: Collision rate among the cluster region

Fig 6 explains about the collision rate of the existing and the proposed technique. Normally the collision will happen in various situations like traffic, mismatching of the node, connectivity problem etc. But in EPFA algorithm the collision rate will be very less when compared with all other protocols. That helps to transmit the information quicker and easier from source to destination.

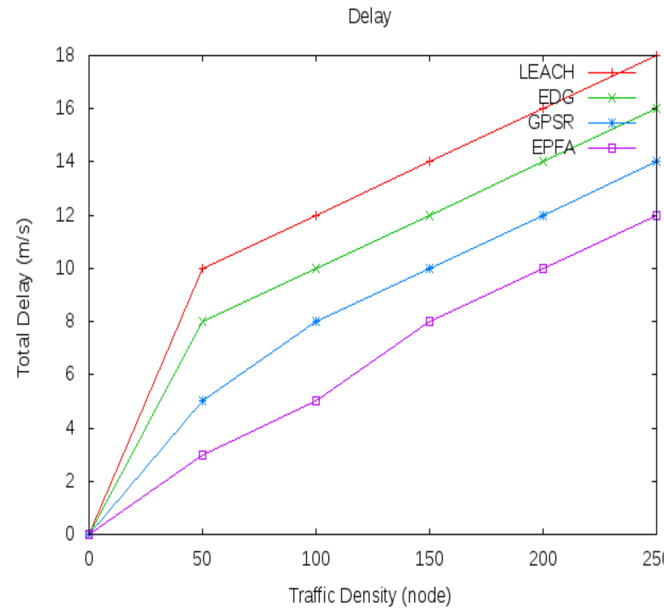


Fig 7: Delay of nodes among the network region

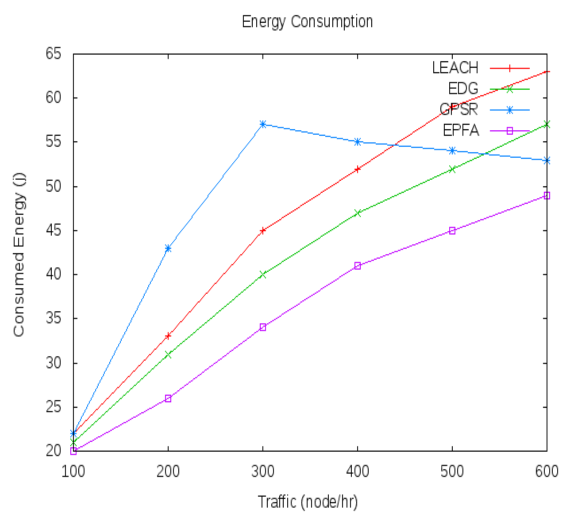


Fig 8: Energy Consumption of the nodes

Fig 7 describes about the total delay of the nodes in the cluster and fig 8 explains about the energy consumption of each node. The energy consumption per bit of our robust routing protocol increases as the node mobility increases. The energy consumption of EPFA is lower than other protocols at relatively low mobility, but slowly grows close to existing as maximum node mobility increases. The reason is that a large amount of packets have to go through the cooperation process with high node mobility.

X. CONCLUSION

Even though we have many standard greedy algorithms which uses many perimeter forwarding technique our proposed enhanced perimeter forwarding technique helps to move the mobile nodes from the end to end point in a proper manner. The time delay, energy consumption, packet delivery ration and the collision rate was analyzed in our paper. The finding of successive route is the highlight in our EPFA algorithm. It helps to forward the node in a successive manner without major loss.

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