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AN EFFICIENT TRACE ORIENT CLUSTER HEAD SELECTION FOR ADAPTIVE CLUSTER BASED ROUTING IN MANET'S

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ABSTRACT

To minimize the overheads of routing and to reduce energy loss on mobile nodes, various routing strategies has been adapted in literature for Manet. Most of the methods, suffers with cluster head selection problem and which generates energy holes in the co-operative routing. To overcome the problem of energy holes and cluster head selection, we propose a trace oriented approach for cluster head selection problem which selects based on various parameters like movement trace, mobility speed, and earlier transmissions. We also focus on the selection of co-operative nodes, where the energy efficiency has to meet to overcome the energy holes in the boundary. For given cluster C_i, the selection of cluster head CH is performed based on node weight which is computed using above said parameters and a set of co-operative nodes Co is selected according to boundary closure measure and energy constraints. The proposed approach has minimized the overhead of cluster head selection by $N\log10_2$ and overall throughput has been increased.

Keywords: *Manet's, Cluster Based Routing, Mobility Trace, Chs, Energy Holes.*

1. INTRODUCTION:

The mobile adhoc network has collection of mobile nodes whose mobility could not be predicted and controlled; also the mobile nodes are free to move at any direction. This phenomenon makes the network as dynamically changing one with the topology. The routing in Manet is highly based on the mobile nodes where co-operative routing is performed and the dynamic nature of the network increases the frequency of computing routes to deliver any transmission. Among available routing methods, cluster based routing is one, in which a subset of nodes are grouped according to the geographic locations or region based to form clusters. There will be a cluster head which act as a gateway for the group to reach the nodes of the network. The internal nodes also could reach the nodes of same or other clusters only through the cluster head.

The problem is the selection of cluster head because, in Manet the nodes will be moving always and the topology will also changing at all the moments. We assume that all the nodes in the network have same set of configurations so that it has bounded energy, which will be drained at subsequent transmissions. In a cooperative transmission the cluster head will affect with more energy depletion due to the reason that it has participate in all the transmission of the cluster and has to participate in all the contention access periods.

The co-operative nodes which participate in almost all the transmission of the cluster by forwarding packets to other cluster lose energy rapidly. This generates energy holes i.e. the boundary node will drain more energy and become dead mode at later stage quickly. This has to be considered in extending the lifetime of the network and has to use the energy efficiently by using appropriate routing protocol. The selections of co-operative nodes are considered here and we use an efficient approach to select the boundary nodes and co-operative nodes.

The mobility trace and packet traces could be used in selecting co-operative nodes and route the packets in efficient manner. The mobility traces are the movement traces of the mobile node and traffic traces specifies the traversal path of the packet which is maintained by the cluster head. The cluster head is responsible for the selection of co-operative nodes in forwarding the data packets in energy

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efficient route. We propose such an power efficient route selection algorithm to increase the quality of service of the network.

2. BACKGROUND:

There exists many approaches discussed earlier for routing in manet, we discuss few of them according to our problem statement here.

ALERT: An Anonymous Location-Based Efficient Routing Protocol in MANETs [13], dynamically partitions the network field into zones and randomly chooses nodes in zones as intermediate relay nodes, which form a non traceable anonymous route. In addition, it hides the data initiator/receiver among many initiators/receivers to strengthen source and destination anonymity protection. Thus, ALERT offers anonymity protection to sources, destinations, and routes. It also has strategies to effectively counter intersection and timing attacks. We theoretically analyze ALERT in terms of anonymity and efficiency.

MAR-AODV: Innovative Routing Algorithm in MANET Based on Mobile Agent [15], focused on the AODV routing protocol and proposed a novel routing algorithm, named MAR-AODV (Mobile Agent - AODV) to enhance the AODV protocol based on mobile agent.

Prediction based Link Stability Scheme for Mobile Ad Hoc Networks [19], propose Prediction based Link Stability Scheme (PLSS) to make a correct balance between stability of path, link, neighbor node and total mobile nodes to extend the network lifetime. The main of the proposed work is to reduce the packet loss and provide better stability using the stability model. The proposed scheme consists of four phases like determination of stability of neighbor node, link, path, total mobile nodes and prediction of total network lifetime.

Krunal Patel and Tejas Vasavada [24] evaluated the performance of stable and normal AODV routing under different mobility models like Random Way Point, Manhattan Model, Reference Point Group Mobility and Gauss Markov Model. Performance measures of interest were Packet Delivery Ratio (PDR) and routing overhead. It was found that RPGM results in better PDR and lowest routing overhead compared to other models. Manhattan model results in lowest PDR and highest routing overhead.

Suman halder et.al [23] introduced the novel mobility-aware routing protocol based on the well known Ad-hoc On Demand Distance Vector (AODV) routing protocol called: MA-AODV (Mobility Aware Ad-hoc On Demand Distance Vector) in an attempt to improve the handling of high mobility factor in ad-hoc networks. MA-AODV protocols performed periodic quantification of nodes mobility for the sake of establishing more stable paths between source/destination pairs, hence, avoiding the frequent link breakages associated with using unstable paths that contain high mobile nodes. The protocol reduce the topological changes, on the other hand it will also minimize the overhead of broadcasting messages. This protocol can be very efficient at the time of sending the large data where continuous connection among the source and destination is more preferable.

A cross layer design of fragmentation and priority scheduling in vehicular ad hoc network [8], presents a cross layer scheme of fragmentation and priority scheduling, which is approach focusing on time varying property of the wireless channel and networks load condition. Simulation results show that our cross layer scheme may provide timely delivery guarantees to different classed of real time date traffic, and increase the vehicular ad hoc networks throughput.

All the above discussed methods has used different routing approaches in manet , but suffers with the problem of selecting cluster heads and we propose a new cluster head selection algorithm to maximize the throughput of the network.

3. PROPOSED METHOD:

The trace oriented cluster head selection has following stages: Cluster Generation, CH Selection, CN-Selection, and Trace Generation. The clusters are generated using the network topology and CH selection is based on movement traces and other constraints. The CN selection is performed using the packet traces and other constraints.

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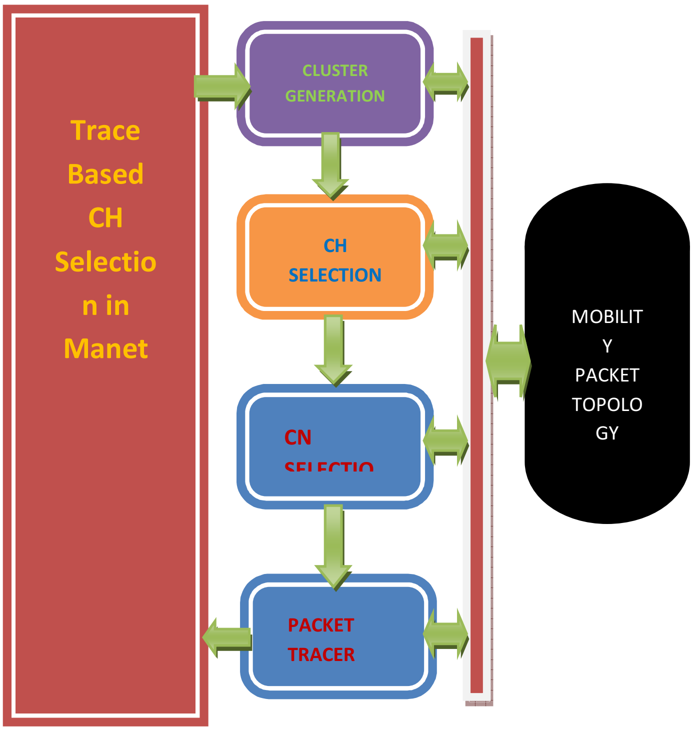

Figure1: Proposed Method Architecture.

3.1 Cluster Generation:

At this phase, each node broadcasts group join request by sending CF-Cluster Formation message, and on receiving this message each node responds to this message based on computed centric measure CM. The centric measure specifies the density of cluster and the distance from geographic location of the cluster. The procedure will be repeated until it receives further CF request, and the centric measure and density measure will be compute for each of the CF request received.

Algorithm:

step1: start

step2: initialize neighbor table N, Cluster group CG, Cluster ID CID, Density CD, Center Distance CCD, and Node List NL.

step3: while receive CF request

Compute distance with the requested node.

Node Distance ND = $\sqrt{(Dx - Sx)^2 + (Dy - Sy)^2}$

if ND< DTH then //DTH-Distance threshold

Add node id to Group list Gl.

Gl = $\sum_1^N Gl$ + N_{id}.

End.

End

step4: compose Neighbor Request Message NREQ.

step4: for each node N_i from Gl

send NREQ.

receive NREP.

Identify list of neighbors and locations NList = $\sqrt[Ni]{(ND < DTH)}$

Compute Density D = $\sum_1^N Ni \times$ (ND (i) <Th)

if(D<Dh)

send Group Join Request to Node N_i.

end.

end.

step5: stop.

3.2 Packet Tracer:

The packet tracer which works over cluster head and responsible for generating trace of packets being pass through the cluster head. The cluster head handles both incoming and outgoing packets of the cluster , to support packet forwarding at inside outside manner. Whenever it receives a packet , the packet sequence number , source address, destination address, co-operative node addresses are extracted and generated as a log in the data set. The packet tracer also generates the location details as mobility trace and speed details of the cluster head all the times. This will support the protocol in computing the future cluster head and co-operative nodes.

Algorithm:

step1: start

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step2: read neighbor table N, Cooperative node list Cpl, trace log Tl from data base.

step3: receive incoming packet P.

if Packet.Type= incoming then

else

extract the following features from P.

Feature F= $\int_1^N \emptyset \times (P.Seq, P.Saddress, P.Daddress, P.Caddress)$

Mobility Speed Ms = Node.speed.

Location Ml = {Node.X,Node.Y}.

Generate Log L.

L = {F, Ms,Ml}.

Fl = $\sum_1^N Fl_l$ + L.

end

step4: stop.

3.3 Cluster Head Selection:

The nodes of mobile adhoc network are not restricted in any way to keep moving at all the time. This makes the cluster head to move forward to some other location, which makes necessary to select some other cluster head immediately to provide quality communication. The proposed cluster head selection approach has the following steps, initially the cluster head which moves out of cluster broadcasts CH-Cluster head willingness message to nodes in the cluster. On receiving this message, the other nodes with higher energy and less mobility speed, sends reply with its details. Like this all the nodes reply to the CH message and the cluster head will receive the willingness message. Now the cluster head selects the higher energetic node with less mobility and with higher density factor. The density factor shows the size of nodes presents around the node, so that the energy depletion of all the nodes could be reduced. Apart from this with the location and energy, we use the eccentric measure which shows the presence of the cluster head at the boundary so that it could be reached by the other cluster heads. The eccentric measure is computed using the location details of all the nodes of the cluster. Finally we compute the cluster weight, based on which the cluster head is selected.

Algorithm:

step21: start

step2: initialize Em-Eccentric Measure, Energy Depletion ED, Density Measure Dm, Mobility Factor Mf, Energy Factor Ef, ClusterHeadList CHL.

step3: read Neighbor matrix N, Group Details Gd.

step4: compute CH willingness message.

CH= {Seq.no, Source Address, Dest Address, ED, MF);

broadcast CH all over cluster.

Receive Reply CHREP-Cluster head reply.

CHL = $\int_1^x \{P.SAddr, P.Ed, P.Mf, P.Location\}$

extract source address, residual energy , mobility speed, location from CHREP.

step5: for each CHL_i from CHL

Compute density factor DF = $\sum Node \in (CHL_i \times N)$

Compute Eccentric measure EM = $\phi(N) \times (CHL_i.Boundary)$.

Compute cluster weight CW = (DF× EM) × (NLog×CHL_i.Ef).

end

step6: select least weighted node as Cluster head Ch.

$$CH = \int_1^n \min(cw)$$

step7: stop.

3.4 Co-operative Node Selection:

The cooperative transmission is performed using the support of neighbor nodes of the cluster head. The co-operative node selection is performed based on packet traces and

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the energy constraints of the nodes. We select the boundary nodes for this process and from selected boundary nodes, set of nodes are selected for co-operative nodes selection. Using the selected nodes, a single node will be selected as a co-operative node for single transmission based on energy constraints and packet traces. The packet traces consist, the addresses of source, destination and co-operative node, using which we compute the co-operative weight to select a single node as co-operative node.

Algorithm:

step1: start

step2: initialize boundary nodes set Bs.

step3: read cluster group Cg, packet trace Pt, Node details Nd.

step4: Identify eccentric nodes set ENs.

$Ens = \phi(Node) \in (Cg)$

ϕ - set of all nodes located at boundary

step5: for each node N_i from ϕ

Compute co-operative weight cow.

$Cow = Node.Energy \times (\int_{i=1}^{Pt} Pti(N_i) \times \mu)$.

end.

step6: select node N_i top weighted Cow.

step7:stop.

4. RESULTS AND DISCUSSION:

The proposed trace aware routing protocol has been implemented in Network simulator NS2, and we have defined various packet types and structures to get the protocol into the simulator. The proposed approach has produced efficient result and reduces the overhead of cluster formation, routing occur in other routing protocols. In our proposed method the cluster is formed at single step and later the cluster is maintained by the selected cluster head. Each cluster head hand over the node details and trace information available to the newly selected cluster head before leaving the cluster. This helps the nodes of the cluster in avoiding the unnecessary cluster formation and reduces the energy loss occur on that.

The simulation environment is created in NS-2, a network simulator that provides support for simulating multi hop wireless networks. NS-2 was written using C++ language and it uses Object Oriented Tool Command Language (OTCL). It came as an extension of Tool Command Language (TCL). The simulations were carried out using a MANET environment consisting of 71 wireless mobile nodes roaming over a simulation area of 1000 meters x 1000 meters flat space operating for 60 seconds of simulation time. The radio and IEEE 802.11 MAC layer models were used. Nodes in our simulation move according to Random Waypoint mobility model, which is in a random direction with maximum speed from 0 m/s to 20 m/s. A free space propagation channel is assumed for the simulation. Hence, the simulation experiments do not account for the overhead produced when a member leaves a group. Sources start and stop sending packets; each packet has a constant size of 512 bytes. Each mobile node in the network starts its journey from a random location to a random destination with a randomly chosen speed.

Table 1The Parameters Used In Our Simulation

Parameters	Value
Version	NS-allinone 2.35
Protocols	ETO-CBR
Area	1000m x 1000m
Transmission Range	250 m
Traffic model	UDP,CBR
Packet size	512 bytes

5. SIMULATION RESULTS

The simulation scenario is designed specifically to assess the impact of network density on the performance of the protocols. The impact of network density is assessed by

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deploying 20 –71 nodes over a fixed square topology area of 1000m x 1000m using 5m/s node speed and 3 identical source-destination connections. We have grouped the nodes of the network into 5 different clusters in such a way that there must be 15 nodes in a single cluster. ETO-CBR network describe a number of quantitative metrics that can be used for evaluating the performance of MANET routing protocols. We have used the following metrics for evaluating the performance.

Table 2 Comparison Results

S.No	Number of Nodes	Protocol	Throughput	Average Delay(ms)	PDF
1.	78	CBRP	0.5	18	86.70
2.	78	RDCLRP	0.62	9.02	93.50
3.	78	ETO-CBR{	0.89	4.05	97.62

5.1 Throughput:

Throughput is the rate of packets received at the destination successfully. It is usually measured in data packets per second or bits per second (bps). Average throughput can be calculated by dividing the total number of packets received by the total end to end delay.

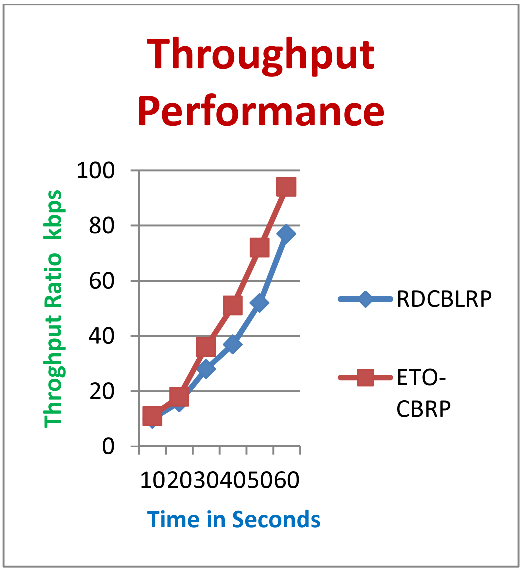

Fig. 2 Throughput Performance Comparison

5.2 Packet Delivery Fraction

Packet Delivery Fraction (PDF) is defined as the ratio of data packets received by the destination to those generated by the source. It is calculated by dividing the number of packets received by the destination through the number of packets originated from source.

PDF = (R / S) x 100

where R is the number of packets received by the destination and S is the number of packets sent by the source. PDF indicates the loss rate, which shows the maximum throughput that can be achieved with the network.

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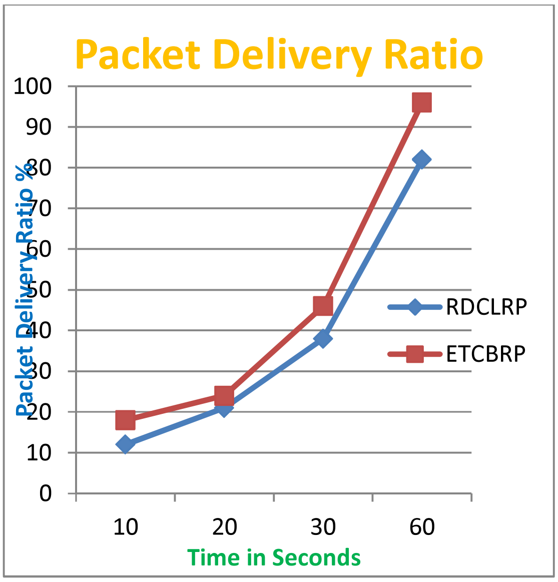

Fig. 3Packet Delivery Ratio Performance

5.3 Average End-to-End delay

Average end to end delay includes all possible delay caused by buffering during route discovery latency, queuing at the interface queue, and delay at the MAC due to retransmission, propagation and transfer time. It is defined as the time taken for a data packet to be transmitted across a MANET from the source to destination.

Delay = t_R - t_S

wheret_R is the receiving time and t_S is the sent time.

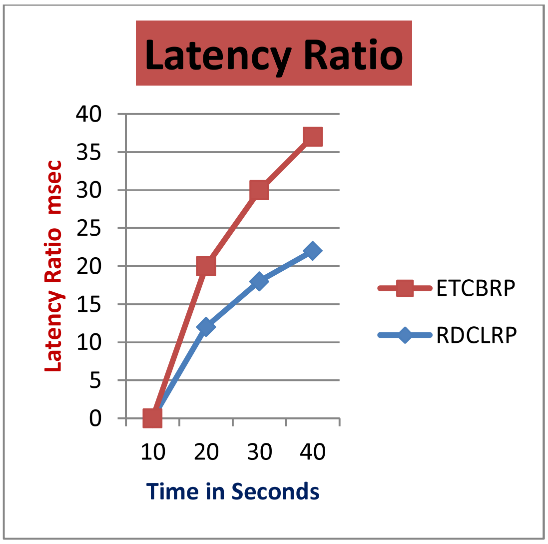

Fig. 4 Latency Ratio

6. CONCLUSION:

we propose an energy efficient trace aware cluster head selection algorithm for the development of quality of service in manet. The proposed method uses various metrics to select the cluster head also the co-operative nodes to participate in the transmission. The cluster head is selected based on cluster weight , which is computed using location, mobility, density measures. The co-operative node is selected using the cooperative weight, which is computed using packet traces and energy depletion measure of the node. The proposed method has produced efficient results and could be adapted easily with little changes of the existing protocols like Cluster based routing protocol. The proposed method has reduced time complexity of route selection and cluster head selection, which reduces the space complexity than other methods.

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