ANALYSIS OF POWER EFFICIENCY IN CLUSTERING BASED ROUTING FOR HETEROGENEOUS MANETS

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Abstract: In the near future, computing in environment can be expected based on the recent progresses and advances in computing and communication technologies. A Mobile Adhoc Network is a collection of wireless nodes that can dynamically form networks and which do not require a base station for providing network connectivity. The routing protocols and algorithm meant for wired networks cannot be used for mobile ad hoc networks because of the mobility of nodes. Many common issues occurred in Manet are Power heterogeneity. To address this we present a controlled-loose-virtual-clustering algorithm for power heterogeneous MANETs to improve the throughput, end to end delay, packet delivery ratio up to 90% in infrastructure less networks compared with previous results in DSR algorithm.
Keywords: Mobile Adhoc Networks, CLVC algorithm, Cluster Formation, Routing

I. INTRODUCTION

Recent work on MANET routing protocols have focused on stability and reliability to reduce packet loss, increase the data delivery ratio. MANETs arise due to the mobility such as high data delay and low packet delivery ratio. In 802.11-based power heterogeneous MANETs each mobile nodes have different transmission power, and power heterogeneity. Ad hoc networks are a collection of wireless mobile nodes forming a temporary wireless network and ad hoc networks are specially important and useful in battlefield or disaster area. Routing in wireless mobile ad-hoc networks should be time efficient and resource saving. Routing protocols are the set of rules or standards which controls the nodes in which way to route the packets between the nodes in the network. Clustering makes possible a hierarchical routing in which paths are recorded between clusters instead of between nodes. Energy efficient routing has a significant impact on the MANETs due to the limitation of mobile node's battery power

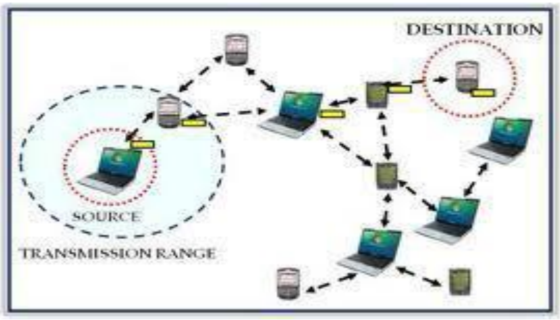

Fig. 1: Mobile Ad hoc Network

II. CLUSTERING IN MANET

Clustering based routing is a solution to address nodes heterogeneity and to limit the amount of routing information that propagates inside the network. Inside the cluster node that coordinates the cluster activities is cluster head .Inside the cluster there are ordinary nodes also that have direct access only to this one cluster head and gateways.

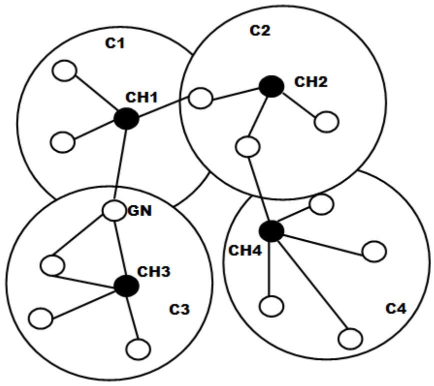

Fig. 2: Clustering architecture

A. Cluster Formation

Initially each node is assigned a random ID value. It broadcasts its ID value to its neighbours and builds its neighbourhood table. Initially each node is assigned a random ID value. It broadcasts its ID value to its neighbours and builds its neighbourhood table. Gateway nodes are generally used for routing between clusters.

Node connectivity is introduce between the number of nodes that can communicate directly with the given node in its transmission range of cluster. Battery Power can be the power currently left in each node. The energy is consumed in each by sending and receiving of packets to each node Mobility of the node is running average of speed of each node.If time is less than data size the node is more suitable to become cluster head. Distance of node is sum of distance of the node from all its neighbours.

B. Cluster Maintenance

Cluster maintenance is needed when a node moves out of the range of its cluster head, if a new node is added or the cluster head fails. If new node is added it calculate its time duration of particular node. It is used reduce unnecessary overhead in selection of the cluster head each time a new node is added. In case the connection fails, the nodes attached to that cluster head recalculate their time of node and select new node with the maximum time. Mobility of node we assign a random value to each node and a threshold value is taken. When a node moves from one position to other in the random manner its parameters change. A new node *a* may join the network after the clustering procedure is finished. Node a would collect the cluster information and choose the node form its 1-hop neighbours. New link between clusters has formed when there is a new link between nodes *a* and *b*, *dom* (*a*) and dom (*b*) are different one of these two nodes may join the other's cluster. After nodes update the cluster information. New link in a cluster obtain when a new link occurs between two nodes in a cluster, node a and b may change due to the new link, nodes should update the cluster information which ensures the cluster head knows the up-to-date link state in the cluster. Link failure in a cluster occurs if nodes *a* and *b* belong to a same cluster, the topology of the cluster would be changed when the link between *a* and *b* breaks. In that time nodes a and *b* have to notify their cluster head about this change. After receiving the message, cluster head will update its link state and check if it can still dominate node *a* and *b*.

III. PROPOSED SYSTEM

A. CLVC (Controlled-Loose-Virtual-Clustering) algorithm

We introduce the CLVC algorithm. In CLVC the unidirectional links in the network can be discovered using a Bidirectional Node discovery scheme. To establish the benefits of high power nodes and CLVC algorithm has been introduce for a hierarchical structure for the network.

B. Bidirectional Node Discovery (BND)

To eliminate unidirectional links, we present an effective scheme to discover bidirectional links. Each node periodically sends a bidirectional neighbour discover packet which containing its own information like ID of the particular node and the information about discovered neighbours information. The discovered neighbours refer to the nodes identify by the received Bidirectional Node Discovery packet. All nodes build aware neighbour and Bidirectional Node tables based on the received Bidirectional Node Discovery packets.

C. Working Of Controlled Loose Virtual Clustering

To know the benefits of high power B-nodes, we design a novel CLVC algorithm. In CLVC a high power B-node is chosen as the cluster head and establishes a free coupling relationship with general G-nodes. When the strong coupling clustering is access only G-nodes under the coverage of B-nodes will participate in the clustering.

Advantage of CLVC are the free clustering avoids heavy overhead caused by reconstruct and maintain the cluster when the density of high power B-nodes is small. CLRPH protocol can be adaptive to the density of high power B-nodes, even when all general G-nodes are in the uncovered state.

D. CLVC Maintenance:

When links between nodes fails within the cluster the maintenance of CLVC will be activated. All nodes detects the conditions based on the periodical Bidirectional Node Discovery packets and it enters the procedure of CLVC maintenance and this procedure is maintain until the packets reach from source (S) to destination (D). Route Discovery Procedure will activate when source node (S) wants to send a data packet to destination node (D) and (S) first search the route to (D) exists in its route cache. If the route is already present (S) directly sends the data packet otherwise S activates the route discovery procedure to find a route to (D). Same procedure can be obtained by local routing and global routing. Route Request and Route reply forwarding procedures can access when a node obtains a complete source route to (D) it replies with a RREP packet to (S) directly and intimate S about the discovered route. Route Reply packet is delivered using unicast the bidirectional links will be used. The links between high power B-nodes and general G-nodes in the discovered route may be unidirectional. The fact that transmitting through high power B-nodes can dramatically degrade the throughput of a network. Our scheme will try to exclude high power B-nodes in the path by replacing B-nodes with multi hop general G-nodes. This scheme may increase route hops and decrease the delay, network throughput and energy efficiency can be ultimately improved.

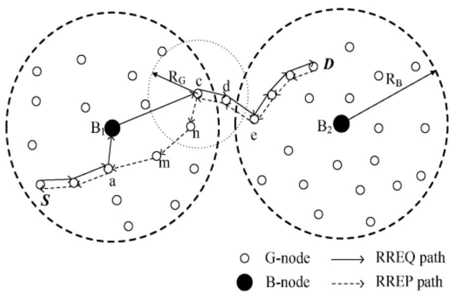

Fig. 3: Processing a RREP packet

IV. PROPOSED WORK

A. Link Duration Method

In multihop mobile networks, each node is free to move and each link is established between any two nodes. A link between two nodes is established when one node enters the transmission range of the other node and the link is broken when either node leaves the transmission range of the other. The time interval during the link remains active is referred to as the link duration. In the analytical model for link duration in multihop mobile networks, it is found that the link duration for two nodes is determined by the relative speed between the two nodes and the distance during which the link is connected determined by the angles between the two node's velocities and the angle of one node incident to the other node's transmission range. A probability density function is developed (pdf) of link duration for multihop mobile networks. Each node is assumed to use the same transmission power and independently move.

The link Duration is given by,

$$T_{ij} = \frac{D_{ij}}{V_{ij}}.$$

Where

- Dij = active distance between the two nodes i and j
- Vij = relative velocity of i and j

$$V_{ij} = \sqrt{V_i^2 + V_j^2 - 2V_iV_j \cos \alpha_{ij}}.$$

B. CLVC algorithm with Link Duration

The link duration is also a part of the enhancement of the LVC algorithm. The bidirectional links of the neighbor discovery process are calculated and stored along with the link duration information dynamically. This enables the source node to dynamically decide on transmitting data to the destination node through bidirectional links with greater link duration. A small architectural modification is proposed in this work. In the architectural modification proposed on CLVC algorithm, the source to node is link duration is greater and so the transmission takes place through this path even though it uses the bidirectional path as in LVC

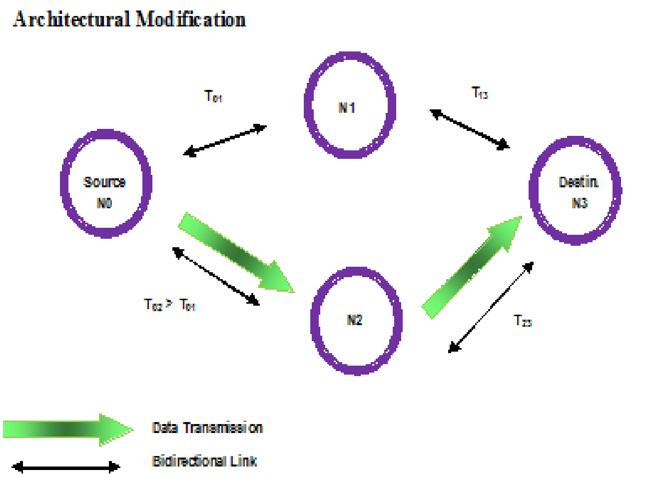

Fig. 4: Architectural Modification

V. ENERGY CONSERVATION IN MANET

Efficient Routing Algorithms are used to minimize the total energy consumption of the route and also to maximize the lifetime of each node. In Mobile Adhoc Networks energy consumption is done in three states of the nodes which are transmitting state, receiving state and sleeping state. For minimizing total transmission power of the node have to change the route request packet by adding some new variables like data size, unstable nodes count with cluster, sum of neighbours and sum of buffered packets. Each node is able to calculate its energy and nodes will be selected according to the time duration before it broadcast route request that it should not change certain rate of its neighbours in specific time. They proposed an adaptive low battery alert mechanism to overcome the overuse of the not accessed route and energy consumption is analysed. It used only 30% or 40% of the new battery capacity. A source is having all the information so it is easy to calculate the power loss by subtracting the received power from the transmitting power and loss of packets from source to destination. The result shows that this algorithm can improve network lifetime in mobile adhoc networks.

Maximizing the lifetime of networks requires the average residual battery level of the particular node in cluster. To calculate the average energy used for Route Request packets used two process i) average transmission power of the nodes on the path ii) link duration time of each node.

A. Mathematical Model

For mathematical analysis MANET is represented by a connected to undirected graph. Let G (C,E) represents the mobile ad hoc network. Here C denotes the set of network nodes and E denotes the set of bidirectional links.The metrics with respect to each link eÎE is delay (e), link expiration time (e). With respected to node nÎV, it is delay (n), energy (n).It is necessary to find paths between nodes within cluster. The main motivation of the proposed algorithm is to find path from source to destination which will satisfy the requirements such as end to end delay, energy, link expiration time. Let path (a, b) or R is entire path from node a to b where constraints have to satisfy from an arbitrary node a to an arbitrary node b the end to end delay, throughput,energy consumption, link expiration time is calculated (path (a, b)) or D (R) = *delay (e) + delay (n)*

Where delay (e) is the transmission and propagation delay of the path (a,b) and delay (n) is the processing and queuing delay of node 'n' on path(a, b).

VI. SIMULATION RESULTS

Simulation model is carried out using Network simulator -2 and the algorithm is implemented. In simulation model the main process is node creation, CLVC clustering, Route discovery to node for routing, performance analysis of packet receive ratio, energy efficiency, packet delivery ratio. The network animator results show all those process by using NS-2 simulation software. The mobile nodes are created for the transmission and the reception process, mobile nodes are capable of transmit and receive the packets with in particular time of nodes.

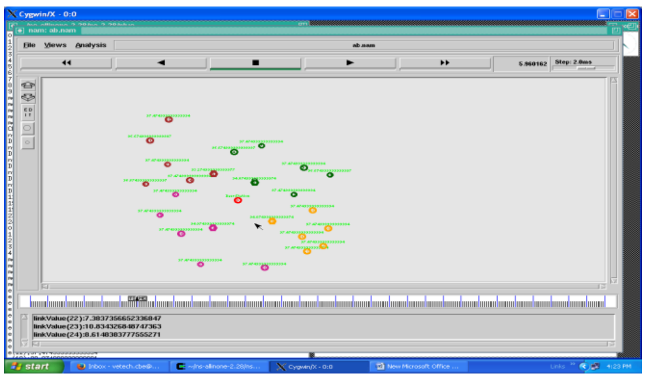

Fig. 5: NAM output showing node creation Process

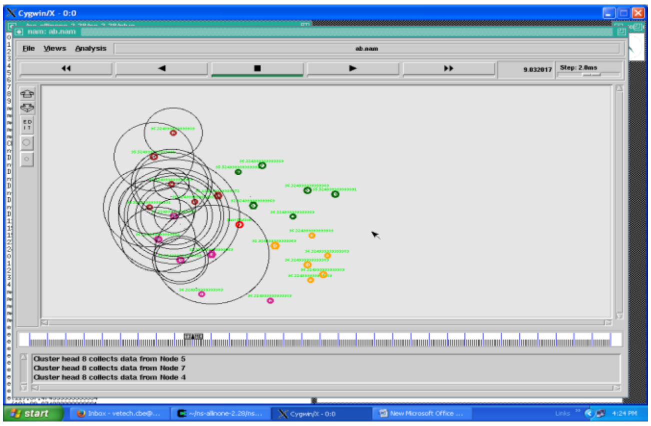

Fig. 6: NAM output showing clustering formation and collecting the information with other node.

Fig. 7: Xgraph output showing packet received ratio

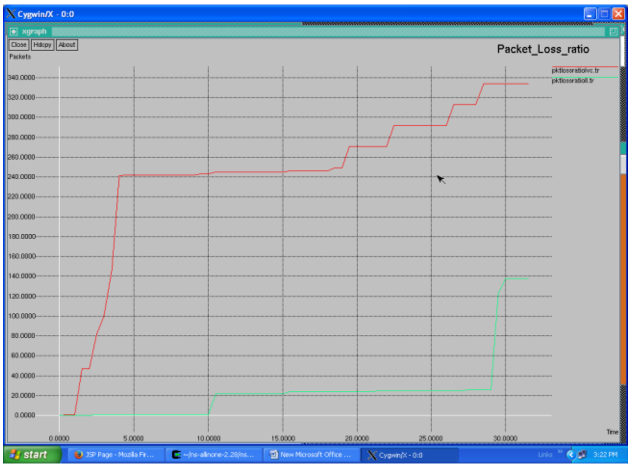

Fig. 8: Xgraph output showing packet loss ratio

VII. CONCLUSION

In this paper, we propose an efficient cluster based routing that supports bidirectional network environments and to improve the throughput, energy efficiency, packet delivery ratio and decrease end to end delay. A Mobile adhoc networks does not have any fixed infrastructure it forms cluster and sends packet from source to destination. It is very efficient and useful for real time communication with heterogeneous type of nodes. The scalability also increases

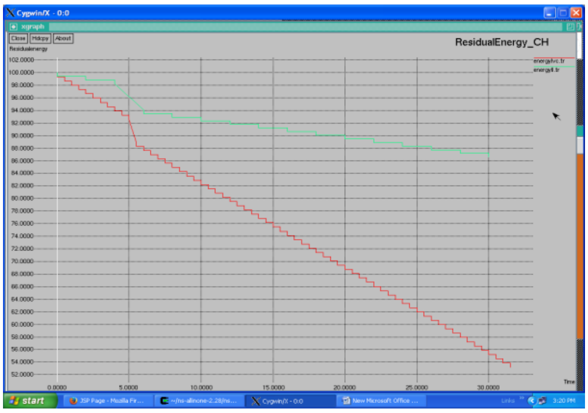

Fig. 9: Xgraph output showing energy consumption during transmission of packet.

in this CLVC algorithm scheme. An efficient clustering formation is used for handling the increased number of nodes and coverage area. The algorithm shows minimize total transmission power of nodes and maximize the throughput of network. More works was carried out to investigate the problems that rise within heterogeneous networks. The energy consumed in each node compared to the existing energy models with respect to node speed, packet size, average transmission rate, number of nodes, packet arrival time. Simulation has been done by using Network Simulator-2 and comparison results also shown.

REFERENCES

[1] Y. Huang, S. Yang, X. Yang W. Yu "A cross-layer approach handling link asymmetry for wireless mesh access networks" *IEEE Trans.* vol. 60, no. 3, pp. 1045–1058- Mar. 2011.

[2] X. Jiang, H. Nishiyama and N. Kato "Exact throughput capacity under power control in mobile ad hoc networks" in *Proc. IEEE INFOCOM*, Mar. 2012.

[3] Johnson. D and Y. Hu, and D. Maltz "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks for IPv4" February 2008.

[4] X. Xiang and Y. Yang "Supporting efficient and scalable multicasting over mobile ad hoc networks" IEEE Trans. Mobile Comp., vol. 10, no. 4, pp. 544–559, Apr. 2011.

[5] Y. Wang, H. R. Chen, X. Y. Yang and D. Y. Zhang, "Weight Based Adaptive Clustering for Large Scale Heterogeneous MANET: WACHM" International Symposium on Communications and Information Technologies, Sydney 2008.

[6] A. A. Jeng and Rong-Hong Jan "Adaptive topology control for mobile ad hoc networks" IEEE Transactions on Parallel and Distributed Systems vol.22, no 12, pp. 1953–1960, December 2011.

[7] Leonardi E. Garetto, M. Giaccone "Capacity scaling in ad hoc networks with heterogeneous mobile nodes" *IEEE/ACM* Transactions on Networking, vol. 17, no. 5,pp.1522–1535, October 2009.

[8] A. Sharif-Nassab and F. Ashtiani "Connectivity analysis of one dimensional ad hoc networks with

arbitrary spatial distribution for variable and fixed number of nodes" *IEEE Trans. Mobile Computation.*, vol.11,no. 10, pp. 1425–1435, Oct. 2012.

[9] S. Zhao, L. Fu, X. Wang, and Q. Zhang "Fundamental relationship between node density and delay in wireless ad hoc networks with unreliable links," in Proc. ACM Mobile Comp, Las Vegas, NV Sep. 2011,pp. 337–348

[10] B. Liang and Z. J. Haas "Hybrid routing in ad hoc networks with a dynamic virtual backbone routing " IEEE Transactions on Wireless Communications, Vol. 5, 2006, pp. 1392.

[11] TKunz and R. Alhalimi, "Energy-efficient proactive routing in MANET: Energy metrics accuracy," *Ad Hoc Networks*, 2010 vol. 8, no. 7, pp. 755-766.

[12] L. Gallina, "A Probabilistic Energy-Aware Model for Mobile Ad-Hoc Networks "in Analytical and Stochastic Modelling Techniques and Applications. vol. 6751, K. Al-Begain, S. Balsamo, D. Fiems and A. Marin, Eds., ed: Springer Berlin Heidelberg, 2011, pp. 316-330.

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