An Adaptive Weighted Cluster Based Routing (AWCBRP) Protocol for Mobile Ad-hoc Networks

S.KARUNAKARAN AND DR.P.THANGARAJ
Computer Science & Engineering
Anna University
Perundurai, Erode
INDIA
karunagaranphd@yahoo.co.in

Abstract: - Nodes of Wireless Adhoc networks have restricted bandwidth resource, and comprise high mobility. It has a high link breakage rate and so partitioning rate of the network is considerably high. Routing in MANET's is very complex because of node mobility and limited communication resource. Topology changes and breakage of exiting paths occurs repeatedly due to the mobility of nodes. A routing protocol should quickly adapt to the topology changes and efficiently search for new paths with minimal power consumption.

We propose an adaptive weighted cluster based routing for mobile ad-hoc networks which amends swiftly to the topological changes and establishes the routing efficiently. In our proposed approach, the cluster head selection is performed by assigning a weight value based on the factors Energy Level, Connectivity and Stability. We show by simulations, that the performance of our proposed protocol surpasses the existing adhoc routing protocols in all aspects.

Key-Words: - Ad-hoc networks, MANETs, Clustering, Multipath, Routing.

1 Introduction

A mobile ad-hoc network (MANET) is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which form an arbitrary topology[1]. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet [1].

MANETs are increasingly important because wireless communication is rapidly becoming ubiquitous. Potential applications range from military and disaster response applications to more traditional urban problems such as finding desired products or services in a city [2].Mobile ad hoc networks became a popular subject for research as laptops and 802.11/Wi-Fi wireless networking became widespread in the mid to late 1990s[1].

Analogous to traditional cellular networks, the partitioning in Ad Hoc networks, known as clustering, is used to solve the inefficient use of power and bandwidth for every node to communicate directly. Each cluster elects one cluster head, the upper layer node, to manage the cluster and coordinate with other clusters [21].

The set of clusterheads is known as dominant set. Several heuristic have been proposed to choose clusterheads in ad hoc networks, such as Highest-Degree heuristic [3] [4], Lowest-ID heuristic [7], Node-Weight heuristic [6],[9], etc.

The network topology has a huge impact on the performance of the network. The ad-hoc network maintains a topology control for those links which should be included in the network to achieve network-wide such as decreasing interference or probability of detection, diminishing energy consumption, increasing the effective network capacity, and reducing end-to-end delay.

The topology control is obtained by altering the transmission powers of the nodes. Transmission power modification has been the basis for topology control algorithms where topology control is defined as the problem of assigning transmission powers to the nodes so that the resulting topology achieves certain connectivity properties and so that some function of the transmission powers is optimized.

Centralized algorithms [10],[12] rely on the assumption that the locations of all of the nodes are known by a central entity in order to calculate the transmission powers that result in a topology with strong connectivity. However, these algorithms are not scalable for large ad hoc networks where excessive amounts of information would need to be collected by a central entity.

Distributed algorithms [12],[14], on the otherhand, are generally scalable and adaptive to mobility due to the fact that each node relies on local information collected from nearby nodes to autonomously compute its appropriate transmission power. The information obtained by each node is limited, and the strong connectivity of the node is not achieved in the distributed approach.

Wireless networks have limited bandwidth resource, and their nodes have high mobility. The network experiences a high portioning rate which is due to the increase in link breakage rate. Bellman-Ford based routing protocols take long time to converge and needs too much overhead hence are not appropriate for ad hoc network.

There is a limitation of radio transmission range in every mobile computer and so multihop message transfer should be practiced in MANETs. Finding paths, i.e., routing is an essential mechanism to support multiple hop radio transmissions. Routing in MANETs is very difficult because of restricted communication resources and node mobility. The existing path may break due to the recurrent topology changes.

Low-Energy Adaptive Clustering Hierarchy (LEACH) is one of the most popular distributed cluster-based routing protocols in wireless sensor networks. Clustering algorithm of the LEACH is simple but offers no guarantee about even distribution of cluster heads over the network. And it assumes that each cluster head transmits data to sink over a single hop.

In Routing protocol (CLACR)[23], the entire network is partitioned into square clusters. In each cluster, a cluster head is selected by a cluster head election algorithm. Only cluster heads, source nodes, and destination nodes participate in the route discovery, route maintenance, and data transmission.

Using the cluster mechanism, the number of nodes that is responsible for routing and data transfer is decreased considerably. The routing overhead is diminished and the route lifetime is increased tremendously. CLACR computes path using Dijkstra algorithm in a cluster- by-cluster basis. A dynamic route optimization is applied to adjust the changed path dynamically. and a local repair is applied for route recovery that lengthens the route lifetime effectively.

New paths should be searched effectively and a routing protocol should quickly adapt to the topology changes. It is very challenging to adapt to new changes because of restricted power and bandwidth resources in MANETs. More importantly, resource constraints in MANETs require a routing protocol to fairly distribute routing tasks among the mobile hosts. However, most proposed routing protocol for MANETs [15], [16] do not take fairness into account. A heavy burden exists on the hosts in the shortest path from source to destination. The power energy diminishes in the hosts when it loaded which causes to networks partitions and failure of application sessions. A new routing strategy is needed to solve the above issues.

We propose an adaptive weighted cluster based routing for mobile ad-hoc networks which amends swiftly to the topological changes and establishes the routing efficiently.

In our proposed approach, the cluster head selection is performed by assigning a weight value based on the factors Energy Level, Connectivity and Stability. For topology control, we propose a hybrid topology control framework that achieves both scalability and strong connectivity. Hierarchical structure management of cluster's multipath routing is used to search multiple paths and distribute traffic between them.

The remainder of the paper is organized as follows. Section 2 reviews some of the existing work in this area. Section 3 presents our proposed methodology in detail. The experimental results are presented in Section 4.and conclude the paper in Section 5.

2 Related Work

Stefan Pleisch, Mahesh Balakrishnan, Ken Birman and Robbert van Renesse [2] evaluate the implementation of Mistral through simulation and compare its performance and overhead to purely probabilistic flooding and their results show that Mistral achieves significantly higher node coverage with comparable overhead.

M.Jenla and J.Tsai [3] gives the VC establishment scheme in the face of radio mobility and they shows the efficiency of the Fast Reservation VC scheme for highly mobile applications and their simulation experiments have identified key tradeoffs power and throughput performance and have shown the advantages of CDMA sharing.

Abhay K.Parekh [4] model an adhoc network as an undirected graph and they present a fast distributed algorithm that can act as routers for the adhoc network using a small subset of nodes of the graph that can act as routers for the ad-hoc network.

Anthony Ephremides and Jeffrey E.Wieselthier[5] demonstrate how the execution of fully distributed Linked Cluster Algorithm can enable a network to reconfigure itself when it is affected by connectivity change such as those resulting from Jamming and also they provides a high degree of survivability and flexibility, to accommodate changing environmental conditions and user demands for their design concept.

Stefano Basagni [6] presents A Distributed Clustering Algorithm (DCA) and Distributed Mobility-Adaptive Clustering (DMAC) algorithm that partition the nodes of a fully mobile network into clusters, thus giving the network a hierarchical organization and their DCA is suitable for clustering “quasi-static” ad hoc networks.

Stefano Basagni [7] introduce distributed and mobility-adaptive protocol that partitions the nodes of a multi hop wireless network i.e., a wireless network in which possibly all nodes can be mobile, into graphs (clusters), thus giving the network a hierarchical organization and their algorithm is proven to be adaptive to changes in the network topology due to nodes mobility and to nodes addition\removal.

Lefteris M.Kirousis, Evangelos Kranakis and Danny Krizanc [8] have discussed the problem of assigning transmission ranges to the nodes of multihop packet radio network so as to minimize the total power consumed under the constraint that adequate power is provided to the nodes to ensure that the network is strongly connected.

Errol L. Lloyd, Rui Liu and Madhav V. Marathe [9] found the Topology control problems under several optimization objectives, including minimizing the maximum power and minimizing the total power and they presents an implementation of the approximation algorithm and they found a new approximation algorithm for the problem of minimizing the total power for obtaining a 2-node-connected graph.

Ram Ramanathan and Regina Rosales-Hain [10] presents two centralized algorithms for use in static networks, and prove their optimality and they show that the performance of multihop wireless networks in practice can be substantially increased with topology control.

Li Li, Joseph Y. Halpern, Paramvir Bahl, Yi-Min Wang and Roger Wattenhofer[11] give a detailed analysis of a cone-based distributed topology control algorithm and also they proposes a set of optimizations that further reduce power consumption and prove that they retain network connectivity.

Roger Wattenhofer,Li Li,Paramvir Bahl and Yi-Min Wang[12] proposes a simple distributed algorithm where each node makes local decisions about its transmission power and these local decisions collectively guarantee global connectivity and they give an approximation scheme in which the power consumption of each route can be made arbitrarily close to the optimal by carefully choosing the parameters.

N. F. Maxemchuk [13] presents a novel routing mechanism for store-and forward date communications networks, which route a message along a particular path between the source and destination, this routing mechanism sub-divides the message and disperses it through the maze of paths comprising the network and they illustrate the concept of dispersity routing, consider a system with three paths between the source and destination.

Errol L. Lloyd, Rui Liu, Madhav V. Marathe, Ram Ramanathan and S. S. Ravi[14] found the Topology control problems under several optimization objectives, including minimizing the maximum power and minimizing the total power and they found a new approximation algorithm for the problem of minimizing the total power for obtaining a 2-node-connected graph.

Ram Ramanathan and Regina Resales-Hain [15] analyze the throughput, delay, and power consumption of our algorithms using a prototype software implementation, an emulation of a power-controllable radio, and a detailed channel model and two centralized algorithms for use in static networks, and prove their optimality and they show that the performance of multihop wireless networks in practice can be substantially increased with topology control.

Roger Wattenhofer, Li, Paramvir Bahl and Yi-Min Wang [16] have proposed a simple distributed algorithm where each node makes local decisions about its transmission power and these local decisions collectively guarantee global connectivity and they show that the routes in the multihop network are efficient in power consumption.

Tope, M.A.; McEachen, J.C.; Kinney, A.C.[17] have described a new Cooperative Diversity (CD) methodology for wireless network communications that leverages the fact that RF energy scatters and propagates to many users simultaneously and they evaluate a protocol designed to establish end-to-end communication within a large field of autonomous wireless devices producing reduced latency and greatly increased robustness against signal fading and interference.

Krishnan, R. Silvester, J.A[18] have proposed Multipath source routing schemes in the literature advocate a per-connection allocation wherein all the packets of a connection are constrained to follow the same path and they distinguished these schemes by their choice of allocation granularity and they developed An analytical model to compute the resequencing delay distribution for the per-packet allocation.

Israel Cidon, Raphael Rom and Yuval Shavit[19] conversed the performance of multi path routing algorithms and compare them to single path reservation that might be persistent i.e., retry after a failure and their analysis shows that while multipath reservation algorithm performs comparably to single path reservation algorithms, either persistent or not, the connecrtion establishment time for mutipath reservation is significantly lower.

Asis Nasipuri and Samir R. Das[20] developed an analytic modeling framework to determine the relative frequency of query floods for various techniques and they show how intelligent use of multipath techniques can reduce the frequency of query floods that providing all intermediate nodes in the primary (shortest) route with alternative paths has a significantly better performance than providing only the source with alternate paths.

Yu-Xuan Wang[21] proposes an entropy-based WCA (EWCA) which can enhance the stability of the Network for the high mobility of nodes will lead to high frequency of reaffiliation which will increase the network overhead and they discussed that the revised algorithm (EWCA-TS) has improved performance with respect to the original WCA, especially on the number of clusters and the reaffiliation frequency.

Taewook Kang, Jangkyu Yun, Hoseung Lee, Icksoo Lee, Hyunsook Kim,Byunghwa Lee, Byeongjik Lee, Kijun Han[22] have proposed a new method for selecting cluster heads to evenly distribute cluster heads and they show that their scheme reduces energy dissipation and prolongs network lifetime as compared with LEACH and they tries to evenly distribute cluster heads over the whole network and avoid creating redundantcluster heads within a small range so that it can increase the network lifetime.

Tzay-Farn Shih And Hsu-Chun Yen[23] Developed A Location-Aided Cluster-Based Routing Protocol Called Core Location-Aided Cluster-Based Routing Protocol (Clacr) And They Show Clacr Can Be Extended As A Geocasting Routing Protocol Easily, And The Location Server And Cluster Head Can Provide Location services for different applications that the performance of their routing protocol is better than other protocol.

Marcello Caleffi, Giancarlo Ferraiuolo, Luigi Paura [26] a reliability analysis is carried out to state a performance comparison between two recently proposed proactive routing algorithms. These protocols are able to scale in ad hoc and sensor networks by resorting to dynamic addressing, to face with the topology variability, which is typical of ad hoc, and sensor networks. Numerical simulations are also carried out to corroborate the results of the analysis.

Zeyad M. Alfawaer, GuiWei Hua, and Noraziah Ahmed [27] develops a novel multicast routing protocol for mobile ad hoc networks that adopts swarm intelligence to reduce the number of nodes used to establish multicast connectivity, which allows multicast connections of lower total costs to be learned over time.

3 Adaptive Weighted Cluster Based Routing

This section discusses the proposed methodology for cluster head selection, topology control and routing for mobile ad-hoc networks in detail.

3.1 Clustering

A cluster is a two or more interconnected computers that create a solution to provide higher availability, higher scalability or both. The advantage of clustering computers for high availability is seen if one of these computers fails, another computer in the cluster can then assume the workload of the failed computer. Users of the system see no interruption of access [24].

The advantages of clustering computers for scalability include increased application performance and the support of a greater number of users. There is a myth that to provide high availability, all that is required is to cluster one or more computer hardware solutions. To date, no hardware only solution has been able to deliver trouble-free fail-over. Providing trouble-free solutions requires extensive and complex software to be written to cope with the myriad of failure modes that are possible with two or more sets of hardware.

Clustering can be implemented at different levels of the system, including hardware, operating systems, middleware, systems management and applications. The more layers that incorporate clustering technology to more complex the whole system is to manage. To implement a successful clustering solution specialists in all the technologies (i.e. hardware, networking, software) are required [25].

Clustering can be considered the most significant unverified knowledge problem; so, as every other problem of this type, it deals with discovery a arrangement in a group of unlabeled data.

Clustering in Ad Hoc networks are partitioning through which the usage of power and bandwidth is efficient for every node to communicate directly. One cluster head (CH) is selected which manages and synchronizes other clusters. Dominant set is the set of cluster heads. The set of clusterheads is known as dominant set. To fix cluster heads in ad hoc networks a number of heuristics are proposed. In our approach, the following aspects decides the weight value of the cluster head selection

(i) Power Level
(ii) Connectivity
(iii) Stability

Generally the cluster head is selected based on any one of the above factors and there is no approach which considers all these factors to select the cluster head.

3.1.1 Cluster formation

From time to time every node sends a beacon called Alive Beacon (AB).Time stamp and NODE ID field are present in AB. The neighbor data table is checked by the nodes that hear AB. A new entry is created for the sender of AB when there is no entry with AB's NODE ID it creates a new entry for the sender of AB, AB sets it's AT field to zero and initiates a timer. Earlier to expiration of timer, if the NODE ID received in AB is same, it sets AT corresponding to that node to 1 and restarts the timer. The corresponding entry in the NDT is removed. ABs are not forwarded. Before the arrival of AB node if a timer expires the following node is considered to have moved and the CH is informed about this.

Cluster head Beacon (CHBs) is heared by every node. There are four possible cases:

1. The CH and the node are inside the cluster when a CHB is heard.
2. When a node listens to one more cluster's CHB with its CHB, then it inserts the CH ID of the former's CHB in a gateway table (GT). If within a specified period of time (GETTHRESHOLD) it hears both the CHBs once again, it affirms itself as the gateway between these two clusters by sending a "gateway assert"(GA) packet to both the Hs.A GT is checked by CH when it receives GA packet and looks for other gateway.
   i) GA is affirmed of the absence of another gateway by registering the gateway's NODE ID in its GT and a "gateway registered" packet.
   ii) When a cluster has a gateway entry the hop count of the current gateway is compared with the GA sender by the CH .When the hop count of the GA is less than CH a "gateway registered " packet is sent to the GA after CH is deregistered.

   Otherwise GA packet is ignored. The GA packet is not sent for a particular period of time and the process is repeated again.
3. It register's with the cluster using a "register me" packet when it hears the CHB of that cluster. The table of nodes which are available in the cluster of the CH is updated and a "registered packet " is sent to the node.
4. If no CHB is heard two possibilities happen
   i) The node moves from the cluster. As described earlier the required steps will be taken when those nodes that have less hop count distance from the CH detect mobility
   ii) When CH moves to a considerable distance the nodes start the cluster formation phase once again by reversing for a random time interval.

3.1.2 Cluster Head Selection

Cluster heads are selected based on the following weighted sum

$$W = w1D1 + w2D2 + w3D3 \quad (1)$$

Where $D1$ is the power level of the node , $D2$ is the connectivity factor and D3 is the stability index and $W1, W2$ and w3 are the weighting factors. Cluster head has the least W value. After the node is formed as a cluster head, the node or the members of the node will be discerned as "considered". Every "unconsidered" node undergoes the election process. After the selection of "considered nodes" the election algorithm will be terminated.

3.1.2.1 Measuring Stability:

We have proposed an algorithm to calculate the stability of a node

Assumptions

N_{Ref} → Reference Node
T_t → Total time
I_t → Interval time
d_t → Distance threshold
n_{iv} → Number of nodes in N_{Ref} 's immediate vicinity

$d[N_{ji}]$ → Distance of node N_j in the interval

Δd → Relative distance

Algorithm:

For given any reference node N_{Ref}
  for i interval values upto Total time
    for j nodes in $N_{Ref's}$ immediate vicinity
      $d[Nji] = distance(N_{Ref,}N_j)$
      $\Delta d = \left| d[Nji] - d[Nji-1] \right|$
      If $(\Delta d > d_t)$
        $Unstablecount[N_{ji}]++$
      end
    sleep(interval)
  end

$$D_1 = 1/n_{iv} \sum_{1=1}^{n_{iv}} \left| 1 - unstablecount[N_i]/time \right]$$

Where time $= T_t / I_t$

3.1.2.2 Measuring Power Level:

The power assignments of the cluster members can be obtained by applying an appropriate centralized algorithm, such as those presented in [11], [12].The power assignments calculated will be distributed to the cluster members.

But, the cluster members will not yet begin transmitting at these powers[28]. Rather, it may be that these powers will be found to be inadequate. Note that some clusters may not be able to achieve a k-connected topology at any legitimate power level. The nodes in these weak clusters will transmit at full power. Clusters that are able to achieve a k-connected topology are termed strong clusters.

For each pair of adjacent (strong) clusters, this step ensures that there are k disjoint links between those clusters when k such links exist. For a given cluster, this calculation relies on information from the nodes of all clusters containing nodes adjacent to a node of this cluster.

In order to allow adjacent clusters to discover each other, every node periodically broadcasts a hello message containing its current coordinates, its ID, power level and its current cluster ID. When a node A hears a hello message from a node B that belongs to a different cluster, A will place B's information in its border list. This border list will subsequently be reported to the cluster head.

3.1.2.3 Measuring Connectivity

The movement of mobile host v is observed to be simultaneous or non simultaneous link connections and disconnections. During the movement of the mobile hosts many disconnections to its neighbor host may occur. Similarly within its transmission range many new link connections may occur and later get disconnected. Initially all mobile nodes assume a uniform connectivity factor F.

A special signal is sent before the movement of mobile host v, I {reg(v), begin}, then when the host v moves it sends {reg(v), Tick} at time interval T , and when it stops it sends {reg(v), End}.

When a host u receives signal {reg(v), begin}, it starts to monitor host v's movement. If host u continuously receives signal {reg(v), Tick} at every T time interval, and at the end, it receives signal {reg(v), End}, then no action is needed at host u.

On the other hand, if host u does not receive a {reg(v), Tick} or {reg(v),End } signal after T time interval since last time it received a {reg(v), Tick} or {reg(v), begin} signal, then host u immediately concludes it has a broken link to host v, and it will reduce F by 1.

When a host u receives signal {reg(v), Tick} without receiving signal {reg(v), Begin} previously, host u can conclude that it has a new link to host v, and it immediately Increment F by 1.

This connectivity factor F can be replaced for D2 in (1).

3.2 Cluster Based Routing

Each cluster head maintains a neighbor table which contains the details of other cluster heads within its neighborhood. Also contains the details of all its cluster members in its routing table. The information of cluster members and neighbor cluster heads are obtained by exchanging the HELLO message.

3.2.1 Optimal Route Discovery

When The Source node (Ns) in any cluster willing to communicate to another node or destination Node (Nd), To resolve the IP address of the destination node the source node sends request to the Cluster Head. The Ns then charts all possible paths to the Ns and picks up the one that satisfies highest reliability and has low loop-free attribute.

If the node to be communicated is assumed to be present on another cluster, then Cluster Head of the source node transmits a Route Request Message to the Cluster Heads of the remaining Clusters. The Cluster Heads on the reception of the request searches for the presence of the required resource in the nodes of their respective clusters. On finding the searched resource the address of the concerned node Nd is passed to the requesting node Ns. The source node then discovers all the available paths to the destination node and establishes a connection through all of these paths. It then appraises the validity of the available paths based on two primary attributes.

1. Highest Consistent or Non-Failure and
2. Low Loop-free attribute

Finally, it picks up the one that satisfies fulfills these conditions.

When a Source node (Ns) from cluster Cc willing to communicate to another node or destination Node (Nd),

Type	J	R	G	Reserved	Hop Count
RREQ ID					
Destination IP Address					
Destination Sequence Number					
Originator IP Address					
Originator Sequence Number					

Table 1:Route Request (RREQ) Message Format

Type	R	A	Reserved	Prefix Sz	Hop Count
Destination IP Address					
Destination Sequence Number					
Originator IP Address					
Lifetime					

Table 2 : Route Reply (RREP) Message Format

Proposed Algorithm:

```
Ns send RREQ to its cluster head CHc of Cc
  if Nd ε Cc , then
    Nd send RREP to CHc
      CHc sets all link-disjoint paths from Ns to
      Nd
      CHc selects the paths that satisfies highest
        consistency and has
        low loop-free attribute.
  else
      findAnd Forward(Nd, Cc) ;
      CHc sets all link-disjoint paths from Ns
      to Nd .
      CHc selects the paths that satisfies
      highest
      consistency and has
      low loop-free attribute.
  End
  Func findAndForward(Nd, Cc)
    if (Nd!ECc−)
      findAndForward(Nd)
    else
      forward RREP to Cc+
    end
  end func
```

$Cc-$ represents downstream, $Cc+$ represents upstream clusters

4 Experimental Results

4.1 Simulation model and parameters

We use NS2 to simulate our proposed algorithm. In our simulation, the channel capacity of mobile hosts is set to the same value: 2 Mbps. We use the distributed coordination function (DCF) of IEEE 802.11 for wireless LANs as the MAC layer protocol. It has the functionality to notify the network layer about link breakage.

In our simulation, 50 mobile nodes move in a 1500 meter x 500 meter rectangular region for 100 seconds simulation time. Initial locations and movements of the nodes are obtained using the random waypoint (RWP) model of NS2. We assume each node moves independently with the same average speed. All nodes have the same transmission range of 250 meters.

In this mobility model, a ode randomly selects a destination from the physical terrain. It moves in the direction of the destination in a speed uniformly chosen between the minimal speed and maximal speed. After it reaches its destination, the node stays there for a pause time and then moves again.

In our simulation, the minimal speed is 5 m/s and maximal speed is 10 m/s. We change the pause time as 10, 15, 20… 25 seconds to investigate the performance influence of different mobility. The simulated traffic is Constant Bit Rate (CBR). For each scenario, ten runs with different random seeds were conducted and the results were averaged.

4.2 Performance Metrics

We use two different ways to study AWCBRP algorithm. In one method, we compare AWCBRP and unipath routing DSR.. We evaluate mainly the performance according to the following metrics:

Control overhead: The control overhead is defined as the total number of routing control packets normalized by the total number of received data packets.

Average end-to-end delay: The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

Average Packet Delivery Ratio: It is the ratio of the No. of packets received successfully and the total no. of packets sent.

4.3 Simulation results

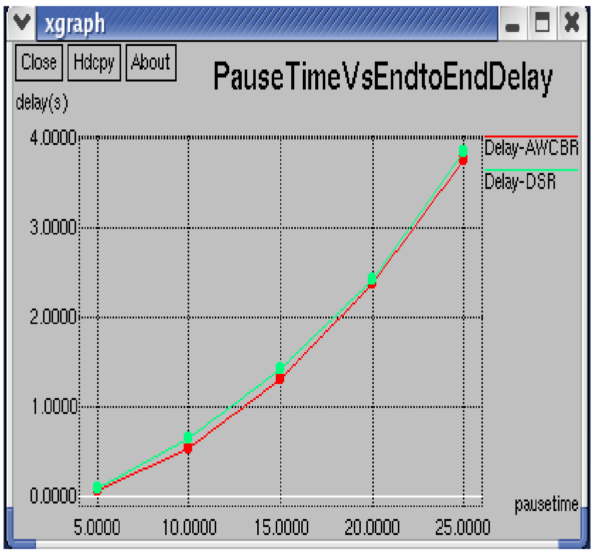

Fig 1: Pause Time Vs End to End Delay

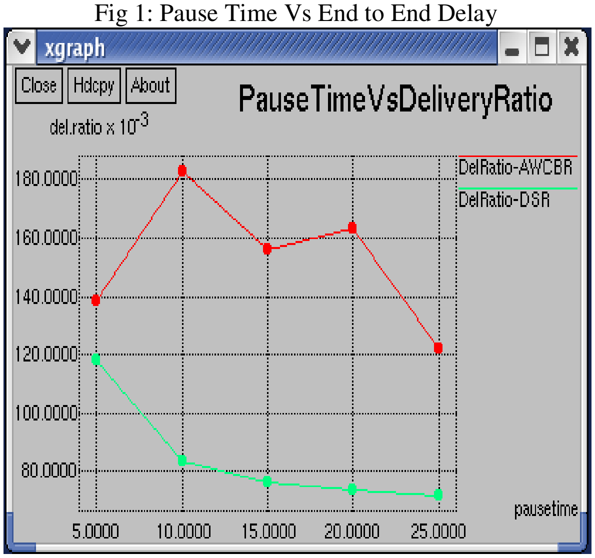

Fig 2: Pause Time Vs Delivery Ratio

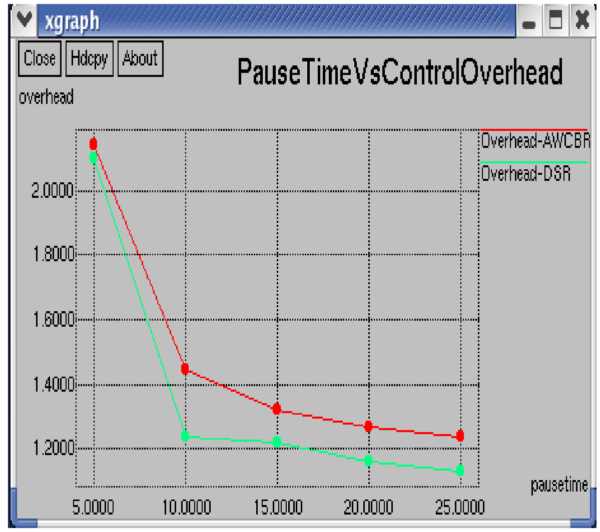

Fig 3: Pause Time Vs Control Overhead

From Fig1, we can see that, the end to end delay of AWCBR is considerably less when compared with DSR, when the pause time is increased as 5, 10, 15,…

Fig2 shows that the packet delivery ratio of AWCBR is high when compared to DSR, when the pausetime is increased.

We can see from Fig3, the control overhead of our routing protocol AWCBR is more when compared to DSR. This due to the fact that, in the cluster formation process, lots of control packets are be exchanged.

5 Conclusion

We have proposed an adaptive weighted cluster based routing (AWCBR) protocol for MANETs. AWCBR mainly focuses on reducing frequent topology changes and link breakages. It rapidly adjusts to the topology changes and efficiently searches for new paths with minimal power consumption.

In our proposed approach, the cluster head selection is performed by assigning a weight value based on the factors Energy Level, Connectivity and Stability. The structure of the network can be stabilized and every cluster head can enlarge the number of its members. Our simulation study shows that our protocol achieved significant performance promotion with relatively low computational costs, when compared to existing routing protocols.

Our future work involves improving the performance of the protocol by further reducing the delay and reducing the control overhead.

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