An Enhanced Cluster-Based Multi-hop Multipath Routing Protocol for MANETs

[1]R. Shanthy, [2]J. Suji Priya
Dept. of Computer Applications, Sona College of Technology, Salem, Tamil Nadu, India

Abstract
Wireless ad-hoc networks have recently emerged as a premier research topic.To support QoS routing in MANET (Mobile Ad hoc Networks) we propose a Cluster-Based Multi-hop Multipath Routing in MANET (CBMMRP). It distributes traffic among diverse multiple paths to avoid congestion, which optimizes bandwidth using and improves the sharing rate of channel. It uses clustering's hierarchical structure diverse to decrease routing control overhead and improve the networks scalability. Here, we compare CBMMRP and a multipath algorithm named Split multi-path routing (SMR) with plane structure. And also we compare CBMMRP with unipath routing (AODV). Both of the ways are all under different mobile speeds. By implementing it on the ns2 environment, the result shows that it balances the load of the network and deals with the change effectively of the network topology, and also improves the reliability, throughput and stability of the network efficiently.

Keywords
QOS, MANETs, CBM-MRP, Split multi path, AODV, NS-2

I. Introduction

Wireless networks can generally be classified as wireless fixed networks, and wireless mobile ad-hoc networks. MANETs (mobile ad-hoc networks) are based on the idea of establishing a network without taking any support from a centralized structure. In these networks nodes also work as a router that is they also route packet for other nodes. Normal routing protocol which works well in fixed networks does not show same performance in Mobile Ad Hoc Networks. The unique feature of these protocols is their ability to trace routes in spite of a dynamic topology .There are significant differences between wireless and wired network. Wired networks have relatively high bandwidth and topology which changes infrequently. In contrast, wireless networks have limited bandwidth resource, and their nodes have high mobility. Moreover, the link breakage rate is high, which leads to high partitioning rate of the network. Therefore, classic Bellman-Ford based routing protocols incur too much overhead and take long time to converge and hence are not appropriate for ad hoc network. Messages in MANETs may be forwarded through multiple hops due to the limitation of radio transmission range in every mobile computer. Finding paths, i.e., routing, is an essential mechanism to support multiple hop radio transmissions. However, node mobility and limited communication resources make routing in MANETs very difficult. Mobility causes frequent topology changes and may break existing paths. A routing protocol should quickly adapt to the topology changes and efficiently search for new paths. On the other hand, the limited power and bandwidth resources in MANETs make quick adaptation very challenging. 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 [1,2,4] do not take fairness into account. They tend to have a heavy burden on the hosts along the shortest path from a source to a destination. As a result, heavily loaded hosts may deplete power energy quickly, which will lead to networks partitions and failure of application sessions. The multipath routing is proposed as an alternative to single shortest path routing to distribute load and alleviate congestion in the network. In multipath routing, traffic bound to a destination is split across multiple paths to that destination. In other words, multipath routing uses multiple "good" paths instead of a single "best" path for routing. Multipath routing aims to establish multiple paths between source-destination pairs and thus requires more hosts to be responsible for the routing tasks. Although the research on multi-path analysis have been covered quite thoroughly in wired networks[1-5, 16-18], research on multi-path routing for wireless networks is still in the early age. The advantage of multipath is not obvious in MANET because of the traffic along different feature of radio transmission. Some protocols in MANET such as the Dynamic Source Algorithm (DSR) [13], and Temporally Ordered Routing Algorithm (TORA) [15], use multiple paths. However, the Multipaths are utilized as a backup of auxiliary method in these protocols. In order to explore the benefits of multipath routing in MANET, how to efficiently search for multiple paths, how to choose proper multiple paths, and how to use them deserve further study. Here we AODV,SMR introduced and compared their novel concepts or optimizations in our routing protocols presented and we have discussed some of the clustering based routing protocols.

II. Related Work: Existing Clustering Techniques for Ad Hoc on-Demand Routing

Recently, there have been some works on multipath routing in ad hoc networks.

A. Densed Cluster Gateway Based Routing (DCG)

DCG is a technique used to determine clusters for ad hoc mobile networks using the k-tree core approach. Connectivity between nodes are determined by the wireless range of broadcast signal. First, a distributed spanning tree, which is the sub graph of the network topology is constructed and the root is selected towards the centre of the network as possible. During the construction, the edges of the trees are monitored and tracked. These edges are categorized by colors- yellow edges and green edges. The use of color attribute in DCG determines the role of the edge on the tree formed. Cluster heads and gateways are used as special nodes which have added responsibilities over the ordinary participating nodes in the network. A cluster head keeps track of all the members (nodes) in a cluster, and the routing information needed. The gateways are the nodes at the border or edge of a cluster and communicate with the gateways of neighboring clusters.

B. Associativity Based Clustering (ABC)

Associativity Based Clustering (ABC) is a strategy proposed using the ABR protocol as its base to support location based routing protocol. ABC presents framework for dynamically organizing mobile nodes and electing a dominating set in a highly spontaneous large scale mobile ad hoc networks. A node is selected as the cluster head based on nodes having associativity states that imply periods of spatial, temporal and stability. The results of simulation show that it is more dynamic, distributed and adaptive. A cluster head as elected based on spatial associativeness and based on the notion of virtual clusters. The location information maybe then obtained using Global Positioning Systems (GPS) or other self positioning algorithms. Existing solutions to this problem are based on the heuristic (mostly greedy) approaches and none attempts to retain topology of the network [12].

Multipath-DSR (M-DSR) [6] is a simple multipath extension of the popular DSR, in which alternate routes are maintained so that they can be utilized when the primary one fails. Instead of replying only to the first received RREQ as DSR, the destination node sends an additional RREP for a RREQ which carries a link disjoint route compared with the routes already replied. However, M-DSR can't compute link disjoint paths in many cases because the intermediate nodes drop every duplicate RREQ that may comprise another link disjoint path. In AODV-BR [7], an extension of AODV multiple routes are maintained and utilized only when the primary route fails. However, traffic is not distributed to more than one path. Multiple Source Routing protocol (MSR) [8] proposes a weighted round-robin heuristic-based scheduling strategy among multiple paths in order to distribute load, but provides no analytical modeling of its performance. In [9], the positive effect of alternate path routing (APR) on load balancing and end-to-end delay in mobile ad hoc networks has been explored. Split multi-path routing (SMR), proposed in [10], focuses on building and maintaining maximally disjoint paths, however, the load is distributed in two routes per session. In an interesting application [14], multi-path path transport (MPT) is combined with multi-description coding in order to send video and image information in multi-hop mobile radio network. However, these protocols distribute traffic on one connection at a time for each source-destination pair. In other words, traffic is not diversified into multiple routes at the same time but focused on primary route. When this route is broken, other alternate routes are used for transmission. From the literature survey for multi-path routing strategy, there are still many issues in applying multi-path routing techniques into mobile ad hoc networks that are to be covered. On the one hand, in most of the routing protocols, the traffic is distributed mainly on the primary route. It is only when this route is broken that the traffic is diverted to alternate routes. Clearly, load-balancing is not achieved by using these routing mechanisms. Although there are some routing protocols which distribute traffic simultaneously on multiple paths, there has not been a routing protocol which could dynamically cope with the changes of topology in ad hoc network. On the other hand, all the routing don't takes into consideration that the routing control overhead will increase quickly when the number of the networks node increases, due to the attribute of bandwidth constrains and power limitation in MANET with the plane structure. These lead to scalability problem and reliability problem. As a result, there is a demand for a multi-path routing strategy that can not only balance efficiently the load on the network but also can cope with the dynamics of the network.

III. Cluster Based Multi-Hop Multipath Routing Protocol

A. Overview

The structure of MANET is plane. In other words, all the nodes in the networks are equity, and functions as terminal as well router. There is difference in performance instead of function. The main advantage of the structure is that there are multiple paths between source-destination pairs. So it can distribute traffic into multiple paths, decrease congestion and eliminate possible "bottleneck". But MANET with the plane structure will increase routing control overhead, the scalability problem is likely to happen. Utilizing clustering algorithm to construct hierarchical topology may be a good method to solve these problems. An adaptive mobile cluster algorithm can sustains the mobility perfectly and maintains the stability and robustness of network architecture. To support the multihop and mobile characteristics of wireless ad hoc network, the rapid deployment of network and dynamic reconstruction after topology changes are effectively implemented by clustering management. Clustering management has five outstanding advantages over other protocols. First, it uses multiple channels effectively and improves system capacity. Second, it reduces the exchange overhead of control messages and strengthens node management Third, it is very easy to implement the local synchronization of network. Fourth, it provides quality of service (QoS) routing for multimedia services efficiently Finally, it can support the wireless networks with a large number of nodes.
Therefore, combining the multipath of the MANET with cluster hierarchical topology, we propose a new protocol named Cluster-based Multihop Multipath Routing (CBMMRP). It's described as follows.

B. Cluster structure and cluster forming

We classify all the nodes in the network into cluster head node and cluster member node. The cluster head is one hop away from the other cluster member. Every cluster member belongs to exactly one cluster head and records the IP address of its cluster head into its routing table. A cluster head records all the IP address of its cluster member in its routing table. Cluster head keeps a neighbor table that records all the IP address of its neighbor cluster head.
Nodes exchange information using the distributed push approach, i.e., every node should broadcast a HELLO message regularly. A cluster member adds its IP address into its HELLO message and a cluster head adds the IP address of its cluster member into its HELLO message as well. To facilitate the cluster head discovery process, cluster member keep the IP addresses of other cluster head that can hear. When the former cluster head moves away or a cluster member does not receive three HELLO packets continuously from its cluster head, it considers that the wireless link between them is broken (or the cluster head has moved away). Thus, a cluster member chooses the latest refresh cluster head in its routing table as its new cluster head, which is one hop from it, or becomes itself a cluster head if it cannot hear any existing cluster head. After broadcasting its HELLO right next packet, the selected cluster head is informed that a new cluster member has joined its group. The cluster member will obtain the confirmation of its new cluster head when it receives the HELLO packet that carries its IP address.

(a) CLUSTER HEAD

Message type	length	Reserved word
IP		
IP (cluster member)		
IP (neighbor cluster heads)		

(b) CLUSTER MEMBER

Message type	length	Reserved word
IP		
IP (cluster head)		
IP (cluster heads can be heard)		

Fig 1 : HELLO Message Format

C. Virtual Route Directory

A computer network is modeled as a graph G=(V,E),where V is set of nodes and E is set of edges(links).Let S be the source node and D be the destination node. A cluster is denoted by Ci={N_{ij}},where N_{ij} is the member of cluster i. Let CHi be the cluster head of C_i. CBMMRP defines the successor set of node N_{ij} in cluster Ci as S_{ij} and the predecessor set as D_{ij}

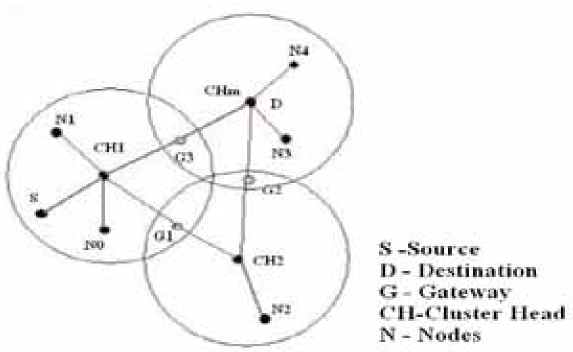

Fig. 2. Cluster structure for MANET

When a source node S (S∈C_1) seeks to set up a connection to destination D, S sends a route request message (RREQ) to its cluster head CH_1.The RREQ message includes the following fields

Source address S
Destination address D
Session ID
P_{lower}
QoS request
Virtual Route VR

Fig. 3. RREQ

If D is a member of cluster C_1 as well and hears the request message, then

1) It sets up multiple paths from source node S to next hop nodes D(N_{ij})={C_i-N_{ij}, i=1,N_{ij}=S};
2) Then sets up multiple path from the source nodes S(N_{ij})={C_i-N_{ij},i=1,N_{ij}=D} to destination node D.
3) It selects all the reliable link disjoint paths from S to D($P \geq P_{lower}$, where P is reliability and P_{lower} is lowest reliability).
4) If all paths have been established, then it chooses the maximal disjoint and loop-freedom reliable paths that satisfies above conditions.

If destination node D is not in the same cluster as source node S, then

1) Source node S sends a route request message(RREQ)to its cluster head CH_1.CH_1 looks for which cluster the destination node D belongs to, then searches for a stable route as a directional guideline { S,C_2,…, C_{m-1}, D }.At the same time, it sets up multiple links from source node S to the destination nodes set D(N_{ij})={C_i-S,i=1}, nodes set D(N_{ij})={C_i-ΣijN-ΣijNdenoted as nodes set between source node S and $N_{ij,}$i=1} as next hop address, the hop of the links is likely more than one.
2) Cluster head CH_1 sends the RREQ message to its downstream cluster CH_2. Once CH_2 receives this message, it will send the RREQ to next cluster and report the IP addresses of its cluster members to CH_1 at one time.
3) Then, it sets up disjoint links: {N_{1j}→N_{2j}}, (N_{1j}∈ C_1, N_{2j} ∈ C_2);
4) C_{i-1} passes the RREQ messages to C_i. Once CH1 receives the message, CH_i reports the addresses of its cluster members to C_{i-1}, and passes the RREQ to $C_{i+1;}$
5) Then, it sets up multiple disjoint links: {N_{i-1j}→N_{ij} }, (N_{i-1}∈C_{i-1}, N_{ij}∈ C_i);
6) It sets up links from the members of C_i Si={}(as source nodes) to the members of cluster Ci except the NijN$_{ij}$ {C_i-N_{ij}} (as destination nodes), {C_i-} as next hop addresses, and chooses the links that satisfies the reliability request (P≥PΣ−1ijN$_{lower}$), the hop of the links is likely more than one;
7) When the cluster head CH_m where the destination locates recieves the path request message, cluster Cm will set up disjoint multiple links from S_m={ C_i-D } (as source nodes) , D(N_{ij})={C_i-} as next hop address, to destination node D, and choose the links that satisfies the reliability request (P≥PΣ−1ijN$_{lower}$);
8) Finally, when all complete paths to destination node have been established, it will choose all maximal disjoint, loop-freedom reliable paths that satisfy above conditions based on hop number and bandwidth.

The above paths just are possible routes, we call them virtual routes

D. Reverse Link Labelling

The reverse link labeling algorithm tries to find as many as possible real routes that are along the virtual path with loop-freedom and satisfy the QoS requirement for this particular session as well. The destination D generates a one-hop broadcast, sending the reverse labeling message. The reverse labeling message includes the following fields:

Source Address
Labeling Source Address L
Session ID
QoS Requirements
Virtual Route VR
Hop H
Accumulated Delay AD

Fig. 4 : RREP

The Delay Requirement and Accumulated Delay fields are only for applications that have delay requirements. Before starting the reverse-link labeling phase, D sets L as its IP address, H as 0 and AD as 0 while other fields are the same with those in the route request message. Every node that receives the reverse labeling message checks whether it meets the following conditions in order to broadcast the packet again after:

- increasing H by 1;
- adding its delay to AD;
- recording L, H and AD into its routing table;
- replacing L with its IP address, L must meet the following requirement:

It belongs to a cluster head that is in the virtual route VR.
It has enough bandwidth.
The accumulated delay AD does not exceed the delay requirement in QoS.
The hop number H does not exceed the maximum hop (H_{max}).
It is neither a leaf node nor the source node S.
The intermediate nodes also record the labeling information from other labeling source address L with a bigger H (not 2 hops bigger than the maximum hop number) but do not broadcast it.

Thus, more than one route will be discovered between S and D that comprise of links labeled by session ID.

E. Route strategy and traffic distribute

After source node receives the RREP messages, it sets up multiple paths from source node to destination node. These paths are real paths. According the hop number (h), accumulated delay (AD) and bandwidth (b) included in the paths messages received by source, we classify these paths into optimal path, shortest path and so on.

For some particular requirement application, we classify all data packets (or users) into different service levels, such as the shortest path service level, widest bandwidth service level and so on. For bandwidth sensitive applications, we define widest bandwidth service level for the applications. For delay constraint applications, we define shortest path service level for them. Source node selects the proper path for the different service level applications.

For the generally applications, algorithm will do:

1) calculating the path weight value w=b/ln(dh) according the hop number (h), accumulated delay (AD) and bandwidth (b) included in the paths messages;
2) utilizing M-for-N [12] diversity coding technique to solve the inherent unreliability of the network by adding extra information overhead to each packet. The data packet is fragmented into smaller blocks.
3) according to the weight value of the path, distribute the blocks over the available paths. The larger the weight value of the path is, the more the blocks is distributed over the path. The data load is distributed over multiple paths in order to minimize packet drop rate, achieve load balancing, and improve end-to-end delay

IV. Simulation

In our simulation, 50 mobile nodes move in a 1500 meter x 500 meter rectangular region for 900 seconds simulation time. Initial locations of the nodes are obtained using a uniform distribution. We assume each node moves independently with the same average speed. All nodes have the same transmission range of 250 meters. The mobility model is the random waypoint model. In this mobility model, a node 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 from 0 seconds to 900 seconds to investigate the performance influence of different mobility. A pause time of 0 seconds presents continuous motion, and a pause time of 900 seconds corresponds to no motion. We change node number from 50 to 500 to investigate the performance influence of node number increase

The simulated traffic is Constant Bit Rate (CBR). 15 source nodes and 15 destination nodes were chosen randomly with uniform probabilities. The interval time to send packets is 250ms. The size of all data packets is set to 512 bytes. A packet is dropped when no acknowledgement is received after several retransmissions or there is no buffer to hold the packet. All traffic is generated and the statistical data are collected after a warm-up time of 30 seconds in order to give the nodes sufficient time to finish the initialization process. For each scenario, ten runs with different random seeds were conducted and the results were averaged

A. Performance Metrices

We use two different ways to study CBMMRP . In one method, we compare CBMMRP and a multipath algorithm named Split multi-path routing (SMR) with plane structure and two paths. The other method is to compare CBMMRP and unipath routing (AODV). Both of the ways are all under different mobile speeds. 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.

Bandwidth cost for data: The bandwidth cost for data is defined as the total number of data packets transmitted at all mobile hosts 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.

Load balancing: We use a graph G=(V, E) to denote the network, where V is the node set and E is the link set. We define a state function f: V → I where I is the set of positive integers. f(v) represents the number of data packets forwarded at node v. Let CoV (f) = standard variance of f / mean of f. We use CoV (f) as a metric to evaluate the load balancing. The smaller the CoV (f) is, the better the load balancing

B. Results

In this experiment, the maximal number of multiple paths is 4. Fig. 5 shows the result of total number of routing discovery phases versus the mobility. The frequency of routing discovery for multipath routing (CBMMRP and SMR) is less than that for the unipath routing approach. This result is coincident with the theoretical analysis in [6]. The frequency of routing discovery for multipath routing CBMMRP and SMR is almost the same since the number of routing discovery mainly depends on the link breakage of the selected multiple paths instead of the method of using multiple paths.

However, Fig. 6 and 7 shows that the control overhead for unipath routing is less than multipath routing. This is because searching for diverse multiple paths in our method could be more costly than searching for a single path using on-demand routing approaches. The control overhead of CBMMRP is lower than that of SMR, especially when the node number increases large enough. This is because searching for multiple paths with hierarchical structure management could be lower costly than searching for multiple paths at large network using general approaches. The bigger the size of the network is, the lower the cost of CBMMRP is relative to SMR.

Fig. 8 shows the results of average end-to-end delay. The end-to-end delay includes the queue delay in every host and the propagation delay from the source to the destination. Multipath routing will reduce the queue delay because the traffic is distributed along different paths. On the other hand, it will increase the propagation delay since some data packets may be forwarded along the sub-optimal paths. From Fig. 8, the unipath routing has slightly higher average end-to-end delay compared to multipath routing and the average end-to-end delay of CBMMRP is slightly higher than that of SMR. This demonstrates that the multipath routing could distribute the traffic and improve the end-to-end delay, the smaller the number of the paths, the higher the average end-end delay, but the improvement is limited below pause time of 300 seconds. With the decrease of pause time, the average end-to-end delay for both multipath routing and unipath routing increases, because the network topology changes more frequently at smaller pause time. More route discoveries will be promoted and thus the queuing delay of the data packets in the source nodes increases, which leads to the increase of the average end-to-end delay.

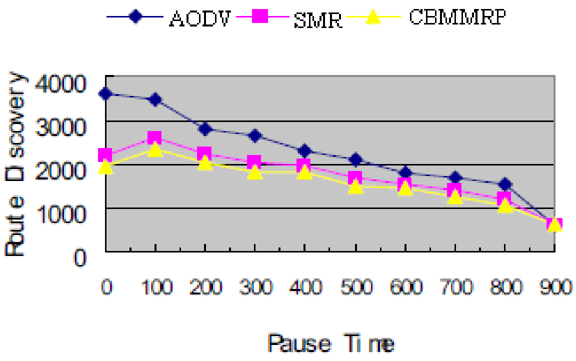

Fig. 5 : The number of route discovery with varying speed

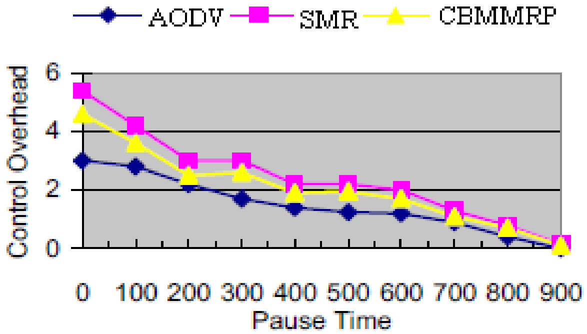

Fig. 6 : The control overhead with varying speed

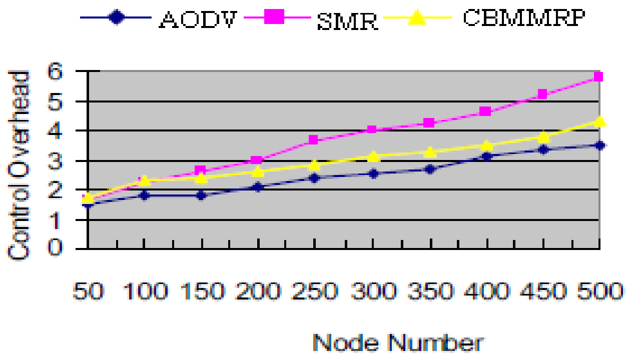

Fig. 7 : The control overhead with varying network nodes

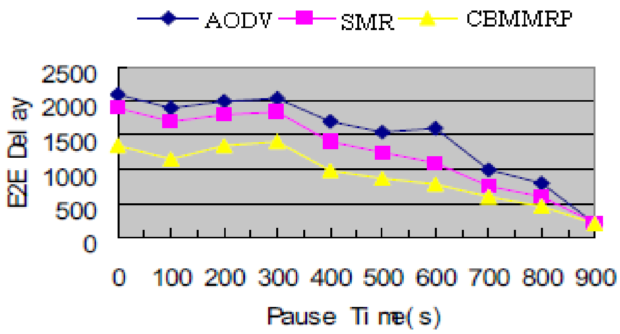

Fig. 8 : The average end-to-end delay with varying speed

V. Conclusions and Future Work

CBMMRP distributes traffic among diverse multiple paths to avoid congestion, optimize bandwidth using and improve the sharing rate of channel. It uses clustering's hierarchical structure diverse to decrease routing control overhead and improve the networks scalability. It can balance the network load, dynamically deal with the changes of network topology and improve reliability. These benefits make it appear to be an ideal routing approach for MANETs. However, these benefits are not easily explored because the data packet that is fragmented into smaller blocks must be reassembled at the destination node, it maybe lead to error and increase control overhead. In the future, we will do some work on the dynamically distribute traffic into multiple paths algorithm and error correction packet segmentation algorithm to improve the performance of CBMMRP.

References

[1] Liang, B., Haas, Z.J. "Hybrid Routing in Ad Hoc Networks with a Dynamic Virtual Backbone", IEEE Transactions on Wireless Communications, Vol. 5, No.6 2006.

[2] Lei Wang, Lianfang Zhang, "Yantai Shu, "Miao Dong Multipath Source Routing in Wireless Ad hoc Networks", IEEE Transaction 2009

[3] Aristotelis Tsirigos, Zygmunt J. Haas, "Analysis of Multipath Routing, The Effect on he Packet Delivery Ratio", IEEE Transactions on Wireless communication, vol 3 No. 1, 2004.

[4] Liang, B., Haas, Z.J. "Hybrid Routing in Ad Hoc Networks, IEEE Transactions on Wireless Communications, vol. 5, NO. 6, 2006

[5] S. V. Nageswara, S. G. Batsell, "Algorithm for Minimum End – to - End Delay Paths", IEEE Communication letters, Vol.1, No.5, Sept, 1997

[6] A. Nasipuri, S.R. Das, "On-Demand Multi path Routing for Mobile Ad Hoc Networks", IEEE ICCCN'99, pp. 64-70.

[7] S.J. Lee, M. Gerla, "AODV -BR: Backup Routing in Ad Hoc Network", IEEE WCNC 2000, pp. 1311-16, 2000

[8] L. Wang et al, "Multipath Source Routing in Wireless Ad Hoc Networks", Canadia Conf. Elec. Comp. Eng., Vol. 1, 2000 pp. 479-83.

[9] M. R. Pearlman et al, "On the Impact of Alternate Path Routing for Load Balancing in Obile Ad Hoc Network works", MobilHOC, 2000 pp.150.

[10] S. J. Lee, M. Gerla, "Spli t Multi-path Routing with Maximally Disjoint Paths in Ad Hoc Networks", ICC'01.

[11] N. Gogate et al, "Supporting Video / Image Applications in a Mobile Multihop Radio Environment Using Route Diversity IEEE ICC'99, 1999.

[12] "Protocols in mobile Ad hoc Networks- A simulation Study", Journal of Computer Science, JCS Vol.1 No.1,pp 83-88, 2005

[13] J. Broch, D. Johnson, D. Maltz. "The Dynamic Source Routing Protocol For Mobile Ad hoc Networks" [Online] Available : http://www.ietf.org/internet-draf/draft-ietf-manet - dsr-01.txt, Nov., IETF Internet Draft.

[14] Yixin Dong, Tingzhou Yang, Dimitrios Makrakis, Ioannis Lambadaris, "Supernode – based Reverse Labeling Algorithm: QoS Support in Mobile Ad hoc Wireless Networks", CCECE'02, Winnipeg, Canada, May, vol. 3, 2002 pp. 1368-1373 .

[15] V.D.Park, M.S. Conson, "A Highly Adaptive distributed Routing Algorithm for Mobile Wireless Networks", Proceeding of IEEE INFOCOM'97 Conf, 1997.

[16] Bai, F. Narayanan Sadagopan, Helmy, "A framework to systematically analyze the Impact of Mobility on Performance of Routing Protocols for Adhoc Networks INFOCOM 2003. Twenty-Second Annual Joint Conference of the IEEE Computer and Communications Societies, 2003.

[17] Geogrgtsos, P, Grifin, D, "A Management System for Load Balancing Through Adaptive Routing in Multiservice AT Networks", Proceeding of IEEE INFOCOM, 1996

[18] Maxemchuk. N, F, "Dispersity Routing in High – speed Networks", Computer Networks and ISDN system, 1993, pp 645-661.

ISSN : 2229-4333(Print) | ISSN : 0976-8491(Online)

Shanthy. R received her Masters degree in Computer Application from Anna University, Chennai, India, in 2005. She is a P.h.D scholar in Anna University, Coimbatore. She is currently working as a Lecturer in the Department of Computer Applications, Sona College of Technology, Salem, India. She has many publications in National/International Conference proceedings and published a paper in an international journal. Her research interests include mobile Ad hoc networks, wireless data networks, high speed networks, routing protocols QOS, energy efficiency and performance analysis for wireless networks and also design algorithm for ad hoc networks.

Suji Priya. J received the MCA degree from IGNOU Delhi in 2003. She has received her M.Phil degree from Periyar University, Salem India in 2007. She is a P.h.D scholar in Bharathiyar University, Coimbatore, India. She is life time member of ISTE. At present she is working as a Lecturer in the Department of Computer Applications, Sona College of Technology, Salem, India. Her research interests includes routing protocols, MAC, network security, clustering, QOS and performance analysis for both wired and wireless networks.