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# ADAPTIVE ROUTING PROTOCOL IN MANET

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***Abstract:*** *Wireless networks have become very popular along with the increasing demand of mobile devices, which has given birth to the need of Mobile Ad hoc Network (MANET). MANET is a collection of wireless mobile nodes which communicate and exchange data with each other without any central administration or wired infrastructure. Due to mobile nodes and the frequently changing network topology the overhead in the network increases, also the use of broadcasting technique affects the network overhead. Thus in the proposed protocol we use the uncovered neighbor set generation mechanism to restrict the broadcasting limit, which helps in reducing the network overhead. Due to limited processing power, energy, routing table size and different mobility of the nodes, it is hard to maintain a stable path between the communicating nodes. Thus the proposed protocol makes use of average state calculation technique to increase the route stability and efficiency. In this way we can achieve improved performance of the routing protocol in MANET.*

***Keywords:*** *MANET, Routing, Rebroadcasting, Uncovered Neighbor Set.*

## 1. INTRODUCTION

Mobile Ad-hoc Network (MANET) is a collection of wireless mobile nodes which communicate and exchange data with each other without any wired infrastructure. Mobile Ad hoc Network varies from other networks on the basis of its limited power, limited processing and limited memory resources and also frequently changing topology. Thus the main goal of ad-hoc routing protocols are to provide consistent communication and to guarantee load balancing as well as to improve other requirements in MANETs. Mobile Ad hoc Network performs the task of self-creating, self-organizing and self-administrating wireless network, with mobile nodes and continuously altering network topologies. In MANET routing is defined as the process of finding path from a source to every destination in the network. There are several routing protocols designed for Mobile ad hoc networks. The routing protocols are classified into three categories such as table-driven/proactive, on-demand/reactive and hybrid [1][2][24].

In proactive routing protocols, the routes to all the destination nodes are maintained by each node in its routing table and also periodically routes are updated if any changes occur in the network. This routing type consists of Destination-Sequenced Distance-Vector (DSDV) [6], Optimized link state routing (OLSR) [7], Cluster-head gateway switch routing (CGSR) [8], Wireless routing protocol (WRP) [10], Global state routing (GSR) [11] protocols. In reactive routing protocols, the routes to all destination nodes are not maintained but determined when requested by using the route discovery process. This routing type consists of Ad hoc on-demand distance vector (AODV) [9], Dynamic Source Routing (DSR) [21], Associativity-based routing (ABR) [14], Source routing with local recovery (SLR) [15], Neighbor Coverage-based Probabilistic Routing (NCPR) [3], Load Balanced Routing (LBR) [4], Greedy-based Backup Routing (GBR) [5] protocols. Hybrid routing protocols are the combination of proactive and reactive routing with number of different routing strategies. This routing type consists of Zone routing protocol (ZRP) [16], Fish-eye state routing (FSR) [17], Landmark ad hoc routing (LANMAR) [19], Relative distance micro-discovery ad hoc routing (RDMAR) [20] protocols.

## 2. LITERATURE SURVEY

Several parts of key literature in the area of Mobile Ad-hoc Network routing protocols are identified which focus on existing protocols as well as the current thinking within the area and the directions in which the researchers are moving in the future.

Perkins, E. Belding-Royer, S. Das[9] proposed Ad-hoc On-demand Distance Vector (AODV) Protocol. Which is an on-demand, single path routing protocol. AODV uses the concept of both DSR[21] and DSDV[6] routing protocol. This protocol inherits the on-demand mechanism of route discovery and route maintenance from DSR protocol and the use of sequence number and periodic beacons from DSDV protocol. Drawback of this protocol is use of periodic beacons that leads to unnecessary bandwidth consumption [18].

Wenjing Yang, Xinyu Yang, Shusen Yang, Dongxu Yang [4] proposed load balancing (LBR) protocol. LBR protocol uses the Pham and Perreau’s simple analytical model [12] that helps to determine load distribution in ad-hoc network. In LBR (Load Balanced Routing), for reactive routing protocol, consider AODV in which, with route discovery mechanism the load balancing mechanism can be applied. For proactive routing protocols, consider OLSR (Optimized Link State Routing) Protocol [7], using lowest number of MPR(multi-point relay) selector to reach to the destination with less loaded route is found.

Xin Ming Zhang, Membe, En Bo Wang, Jing Jing Xia, and Dan Keun Sung [3], proposed the NCPR (Neighbor Coverage-based Probabilistic Rebroadcasting) Protocol for reducing the routing overhead in the mobile ad-hoc network. It has proposed a rebroadcast delay mechanism to keep track of neighbor coverage and to define rebroadcasting order. A rebroadcasting probability mechanism is also used to reduce the number of retransmissions so as to reduce the overhead.

J. Kim, Q. Zhang, and D.P. Agrawal [22], said that, Previously Gossiping Based Routing [13] method of rebroadcasting was used in which a certain gossiping probability was set to forward the messages, but this method fails when the network is densely populated and where the traffic load is very high. In probabilistic broadcasting based on coverage area and neighbor confirmation [22] approach the mechanism of probability based and area based techniques are combined. This rebroadcasting technique helps to reduce the number of transmissions and also reduces collisions in the network.

Neighbor Knowledge Scheme Name SBA (Scalable Broadcast Algorithm) [23] is made to keep the main objective that if a node broadcasts a packet and all the neighbor nodes are covered then it should not rebroadcast that packet again. For this, node keep track of local topologies of neighbor information and the duplicate packet receiving.

## 3. PROPOSED WORK

In the proposed Protocol, we use the uncovered neighbor set calculation scheme to avoid the overhead generated in the network while broadcasting and the State calculation using the mobility and routing table size of the node to define an efficient and stable routing path between the two communicating nodes. The proposed mechanism goes as follows:

**At the source node:** When a source node ‘s’ generates the Route Request (RREQ) packet it first checks its state using the routing table size and mobility as the parameters to calculate the average state value. An average state ST calculated is then added to the broadcasting RREQ packet. The source node also adds the neighbor list N(s) to the RREQ packet before broadcasting. These fields added to the broadcasting packet are then used by the receiving nodes to restrict the imbalance in the network generated while broadcasting.

**At the intermediate node:** when the node accepts the RREQ it first calculates the uncovered neighbor set (UCN) using the source nodes neighbor list and its own neighbor list by intersecting these two lists and eliminating the common neighbors between them. The node computes its State using its own mobility and routing table size parameter. Then the node calculates the average state using the previous nodes average state value. The node sets an acceptance timer to accept the duplicate RREQ packets from the neighbors and after the timer expires it compares the different average States of the different RREQ packets it accepted and selects the maximum average State value to set as its rebroadcasting value. Then the node adds the selected maximum average state value and the neighbor list to the RREQ packet and rebroadcasts the RREQ packet to the calculated UCN set.

**At the destination node:** when the node receives different RREQ packets from different nodes it selects the RREQ whose average state value is maximum, then generates the Route Reply RREP packet. Then, the node uses that RREQs path to send generated RREP packet to the source node to set the communication path.

## A. PROPOSED ALGORITHM:

- Initialization: RREQ: Route Request Packet.

  N(u): neighbor list of node u.

  U(u, x): uncovered neighbor set UCN of node 'u' with RREQ id 'x'

  ATimer: acceptance timer for each node.

- At Source node 's': s generates the RREQ packet, adds the neighbor list N(s) information to the packet.
- Calculates its state as,

  Mobility of node 's', $M_s = \text{Mobility of the source node}$

  Table Size of node 's', $Tb_s = \text{Routing Table Size of the source}$.

  State of node 's', $ST(s) = ST(1) = \frac{M_s + Tb_s}{2}$

- Add State information 'ST(1)' to the RREQ packet. Broadcasts the packet to the neighbors.
- At intermediate nodes $n_i$: Node '$n_i$'accepts the RREQ packet.
- Checks if it's a destination node if not then, Computes the UCN set as,

  U($n_i$, $Rs_{id}$) = N($n_i$) – [N($n_i$)∩N(s)] – {s}.

- Checks the Acceptance Timer, if not expired;

  It will accept Duplicate RREQs with the same sequence number from other neighbors till the timer expires.

- If UCN set is not null then, The node will calculate its state as ST($n_{i+1}$) and then the average State ST($i+1$) by adding its own state with the Source node's state information, now the number of previous nodes in considered path is i (i.e. hop count) then the average state will be calculated as,

  $$ST(i+1) = \frac{i}{i+1} ST(i) + \frac{1}{i+1} ST(n_{i+1})$$

- Then the node will compare the states of the different duplicate RREQs received then,

  Set the max state value as the nodes average state value ST(i), adds the neighbor set and maximum average state to the RREQ packet and rebroadcasts the packet.

- At Destination node 'd', when it receives different RREQ packet from possible paths to source node 's', then, Node 'd' selects the route with maximum average State value to reply. Then generates the RREP packet to reply back to the source node's'.

## 4. PERFORMANCE EVALUATION

In this section the verification of the proposed algorithm with respect to previous work done is compared. The parameters considered are the different number of nodes, queue Length, Transmission Range, Mobility of the node, number of connections, Simulation Time and Simulation area. We evaluated the proposed system using the Network Simulator. A Simulation area considered is 1000*1000m in which N= {10, 20, 50, and 100} nodes are moving around. Simulation Time is 100s.

In the following results two scenario evaluation are compared with AODV, NCPR, ENCPR and our proposed work with varying delay, overhead and Packet delivery ratio with respect to the queue length as 20, number of connections 3 and mobility of the nodes 5-10m/s.

## 5. RESULTS

### First Scenario:

*Table1: Packet Delivery Ratio*

| | PDR varying with different node density | | | | |
|---|---|---|---|---|---|
| | **RP** | **10 NODE** | **20 NODE** | **50 NODE** | **100 NODE** |
| **Mobility 5m/s** | **AODV** | 97.5236 | 95.9098 | 94.8586 | 99.0505 |
| | **NCPR** | 98.288 | 96.9724 | 97.7775 | 97.1756 |
| | **ENCPR** | 98.8751 | 98.0571 | 97.7287 | 98.6172 |
| | **ABR** | 98.8454 | 98.7479 | 99.1214 | 98.8972 |

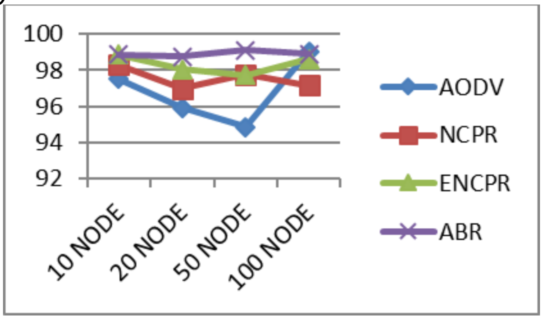



*Table2: Normalized Routing Overhead*

| | Normalized Overhead varying with different node density | | | | |
|---|---|---|---|---|---|
| | **RP** | **10 NODE** | **20 NODE** | **50 NODE** | **100 NODE** |
| **Mobility 5m/s** | **AODV** | 0.0659512 | 0.239546 | 1.16063 | 0.883008 |
| | **NCPR** | 0.0556891 | 0.106673 | 0.271487 | 0.852919 |
| | **ENCPR** | 0.0535287 | 0.247474 | 0.516007 | 1.04226 |
| | **ABR** | 0.0688313 | 0.111858 | 0.281071 | 0.387718 |

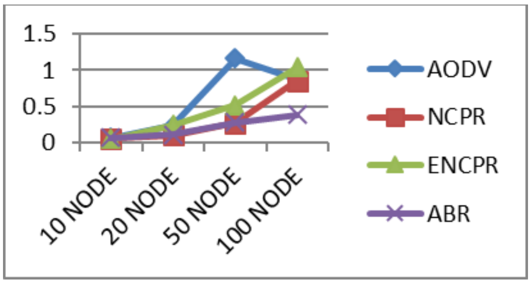
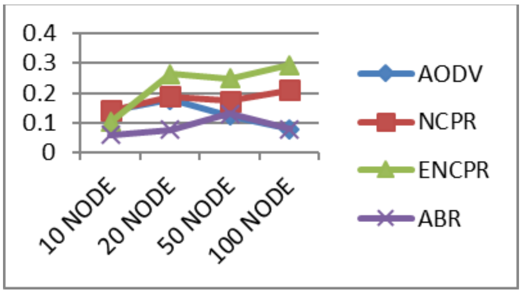



*Table3: End to End Delay*

| | End To End Delay varying with different node density | | | | |
|---|---|---|---|---|---|
| | **RP** | **10 NODE** | **20 NODE** | **50 NODE** | **100 NODE** |
| **Mobility 5m/s** | **AODV** | 0.138739 | 0.178284 | 0.124226 | 0.0785815 |
| | **NCPR** | 0.140954 | 0.187886 | 0.173497 | 0.210449 |
| | **ENCPR** | 0.102348 | 0.262666 | 0.248463 | 0.293087 |
| | **ABR** | 0.0588585 | 0.075777 | 0.130327 | 0.077467 |




### Second Scenario:

*Table4: Packet Delivery Ratio*



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| | PDR varying with different node density | | | | |
|---|---|---|---|---|---|
| | **RP** | **10 NODE** | **20 NODE** | **50 NODE** | **100 NODE** |
| **Mobility 10m/s** | **AODV** | 97.5509 | 96.1248 | 96.4146 | 96.9785 |
| | **NCPR** | 97.182 | 97.963 | 98.3342 | 98.4837 |
| | **ENCPR** | 97.8494 | 98.1916 | 98.1142 | 97.1096 |
| | **ABR** | 98.759 | 98.7148 | 98.8214 | 98.6556 |

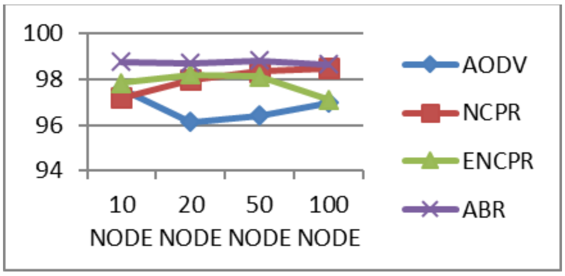



*Table5: Normalized Routing Overhead*

| | Normalized Overhead varying with different node density | | | | |
|---|---|---|---|---|---|
| | **RP** | **10 NODE** | **20 NODE** | **50 NODE** | **100 NODE** |
| **Mobility 10m/s** | **AODV** | 0.0655043 | 0.255261 | 0.351365 | 0.960155 |
| | **NCPR** | 1.31704 | 0.103615 | 0.29874 | 0.609467 |
| | **ENCPR** | 0.105194 | 0.456116 | 0.463058 | 1.19044 |
| | **ABR** | 0.056625 | 0.106995 | 0.169173 | 0.291208 |

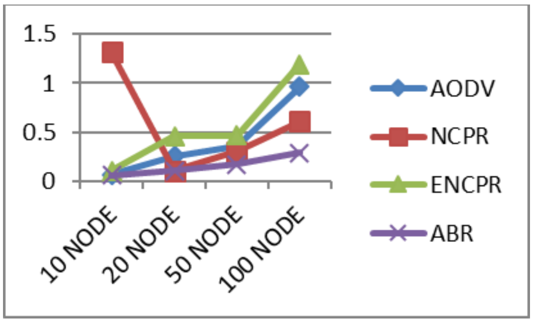
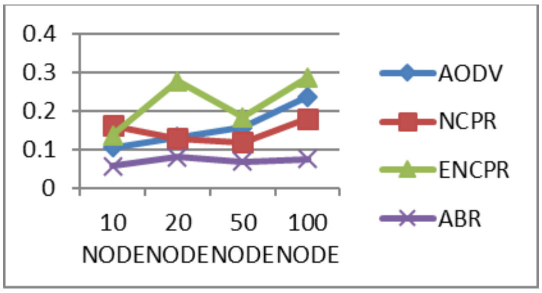



*Table6: End to End Delay*

| | End To End Delay varying with different node density | | | | |
|---|---|---|---|---|---|
| | **RP** | **10 NODE** | **20 NODE** | **50 NODE** | **100 NODE** |
| **Mobility 10m/s** | **AODV** | 0.105513 | 0.132715 | 0.1564 | 0.237247 |
| | **NCPR** | 0.162342 | 0.127785 | 0.118854 | 0.180557 |
| | **ENCPR** | 0.136521 | 0.27755 | 0.184551 | 0.28686 |
| | **ABR** | 0.0568872 | 0.079373 | 0.0682675 | 0.0744205 |




The observed results shows that the proposed protocol helps to reduce the end to end delay, reduces normalized routing overhead and improves packet delivery ratio of the network and improves the overall performance.

## 6. CONCLUSION AND FUTURE SCOPE

Routing is a necessary component of communicating protocols in mobile ad hoc networks. The protocols are driven by specific objectives and requirements based on particular rules about the network properties or application. The use of uncovered neighbor list generation mechanism in the proposed protocol helps in reducing overhead in the network and the State calculation helps in selecting the most stable and efficient routing path for setting the effective communication between nodes in the mobile ad-hoc network. In future we can use Q-learning to improve the stability of the route formed by the protocols.

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## REFERENCES

*[1] Dr Sunilkumar S. Manvi and Mahabaleshwar S. Kakksageri, Feb 2010, "Wireless and Mobile Networks-Concepts and Protocols", New Delhi, Wiley Publishing, 293-312 Pages.*

*[2] Carlos de Morais Cordeiro and Dharma P. Agrawal, Feb 2011, "Ad-hoc and Sensor Networks- Theory and Applications", World Scientific Publishing, 587-620 pages.*

*[3] Xin Ming Zhang, Membe, En Bo Wang, Jing Jing Xia, and Dan Keun Sung, Senior Member, 2013, "A Neighbor Coverage-Based Probabilistic Rebroadcast for Reducing Routing Overhead in Mobile Ad Hoc Networks", IEEE Transactions on Networking, vol. 12, issue no. 3, pg. 424-433.*

*[4] Oussama Souihli, Mounir Frikha, Mahmoud Ben Hamouda, 2009, "Load-balancing in MANET shortest-path routing protocols", Elsevier Transactions on Ad Hoc Networks (2009) vol. 7, issue no. 14, pg. 431-442.*

*[5] Wenjing Yang, Xinyu Yang, Shusen Yang, Dongxu Yang, 2011, "A greedy-based stable multi-path routing protocol in mobile ad hoc networks", Elsevier Transactions on Ad Hoc Networks, vol. 9, issue no.4, pg. 662-674.*

*[6] C. E. Perkins and P. Bhagwat, 2000, "Highly dynamic destination-sequenced distance vector routing (DSDV) for mobile computers", Proceedings of ACM SIGCOMM, vol.4 issue no.9 pg. 234-244.*

*[7] T. Clausen and P. Jacquet, 2003, "Optimized Link State Routing Protocol (OLSR)", IETF Mobile Ad Hoc Networking Working Group INTERNET DRAFT, vol. 2 issue no. 7.*

*[8] W.L.C. Chiang, H. Wu and M. Gerla, 1997, "Routing in clustered multihop, mobile wireless networks", Proceedings of IEEE SICON, April 1997 vol. issue no. pg. 197–211.*

*[9] IETF, 2003, RFC 3561: C. Perkins, E. Belding-Royer, S. Das, Ad hoc On-Demand Distance Vector (AODV) Routing, Available at: <www.ietf.org/rfc/rfc3561.txt>, [Accessed 4 December 2013].*

*[10] S. Murthy, J.J. Garcia-Luna-Aceves, 1996, "An efficient routing protocol for wireless networks", MONET Transaction, vol.1, issue no.2, pg. 183–197L.*

*[11] T.-W. Chen, M. Gerla, 1998, "Global state routing: a new routing scheme for ad-hoc wireless networks", Proceedings of IEEE ICC, vol. 1, pg. 171–175.*

*[12] P.Pham, S. Perreau, 2003, "Performance analysis of reactive shortest path and multi-path routing mechanisms with load balance", IEEE Conference on Computer Communications (INFOCOM), vol.4 issue no. 6.*

*[13] Z. Haas, J.Y. Halpern, and L. Li, 2002, "Gossip-Based Ad Hoc Routing," Proc. IEEE INFOCOM, vol. 21, pg. 1707-1716.*

*[14] C.-K. Toh, 1997, "Associativity-based routing for ad-hoc mobile networks", Wireless Personal Communications Journal, vol.4, issue no. 2, pg. 103–139.*

*[15] C. Sengul, R. Kravets, 2006, "Bypass routing: an on-demand local recovery protocol for ad hoc networks", Ad Hoc Networks, vol. 4, issue no. 3, pg. 380–397.*

*[16] P. Samar, M. Pearlman, S. Haas, 2004, "Independent zone routing: an adaptive hybrid routing framework for ad hoc wireless networks", IEEE/ACM Transaction on Networking, vol. 12, issue no. 4.*

*[17] G. Pei, M. Gerla, T.-W. Chen, 2000, "Fisheye state routing in mobile ad hoc networks", Proceedings of IEEE ICDCS Workshop on Wireless Networks and Mobile Computing, pg. D71– D78.*

*[18] B. Williams and T. Camp, 2002, "Comparison of Broadcasting Techniques for Mobile Ad Hoc Networks", Proc. ACM MobiHoc, vol.3, pg. 194-205.*

*[19] G. Pei, M Gerla, X. Hong, 2000, "LANMAR: Landmark routing for large scale wireless ad hoc networks with group mobility", Proceedings of ACM MobiHoc, vol. 5, pg. 11–18.*

*[20] G.N. Aggelou, R. Tafazolli, 2000, "RDMAR: A bandwidth-efficient routing protocol for mobile ad hoc networks", Proceedings of ACM WOWMOM, vol. 2 pg. 26–33.*

*[21] D. Johnson, Y. Hu, and D. Maltz, 2007, "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR) for IPv4", IETF RFC 4728, vol. 15, pg. 153-181.*

*[22] J. Kim, Q. Zhang, and D.P. Agrawal, 2004, "Probabilistic Broadcasting Based on Coverage Area and Neighbor Confirmation in Mobile Ad Hoc Networks," Proc. IEEE GlobeCom, vol.8, issue no. 4.*

*[23] W. Lou and J. Wu, 2002, "On reducing broadcast redundancy in ad hoc wireless networks," IEEE Transactions on Mobile Computing, vol. 1, issue no. 2, pg. 111–123.*

*[24] Azzedine Boukerche, Begumhan Turgut , Nevin Aydin , Mohammad Z. Ahmad, Ladislau Bölöni , Damla Turgut, 2011, "Routing protocols in ad hoc networks: A survey", Elsevier Transactions on Computer Networks, vol.3, issue no. 55, pg.3032-3080.*