Performance Improvement of Routing Protocol in MANET

[1] **Namrata Chavan,** [2] **Shilpa Verma**

[1, 2] Computer Department, TSEC, Mumbai University Bandra
Mumbai-Maharashtra, India

Abstract - A Mobile Ad-hoc Network (MANET) is a self organizing and self configuring network without any centralized base station. Congestion and the loss of energy is the most common problem in the Ad hoc network. A considerable amount of energy is consumed in wireless interfaces. On the other hand the actual available bandwidth varies due to change in contention affected by node mobility. Many of routing protocols use the shortest path route from source to destination with minimum hop count as optimal route selection. This paper analyses and evaluates the mechanism using multipath routing for performance improvement. This mechanism determines the best path selection out of the N-available shortest paths by considering congestion and energy constrains at each of the intermediate nodes. A new mechanism based on contention window provides better performance compared to AODV.

***Keywords* – Ad-hoc on Demand Distance Vector (AODV), Contention Window (CW), Distributed Co-Ordination Function (DCF), Energy Consumption, Mobile Adhoc Networks (MANET), Quality of Service (Qos).**

1. Introduction

A mobile ad hoc network (MANET) is a collection of mobile hosts which interact with each other without the need of any existing infrastructure. Hosts work as routers and interact with each other over wireless links. This particularly means that the network may work as a self-configured stand-alone network. The topology is changing constantly, since the hosts are mobile and moving arbitrarily. There are several ways to set up such a network which we refer to as routing protocols.

To have communication within the network, a routing protocol is used to discover routes between nodes. The primary goal of such ad-hoc network routing protocol is to establish correct and efficient route between a pair of nodes so that messages may be delivered in a timely manner. The two major classifications of MANET routing protocols are single path and multipath routing protocols. The single path routing protocols discover a single route between a pair of source and destination. A new route discovery is required in response to every route break this leads high overhead and latency. The multipath routing protocols discover multiple routes between a pair of source and destination in order to have load balancing to satisfy Quality of Service (QoS) requirements. This work explicates such different protocols which are being used. In wireless network there are different protocols used in estimation of end to end delay like load aware routing protocol which concern about fast transmission and accuracy, Queue aware routing for measurement of traffic have been used for minimizing delay and also try to avoid the congestion occurs in the network to improve the performance.

This work focus on finding the best path selection rather than shortest path to minimize end to end delay from source to destination using multipath routing which determines the best path selection out of N-available shortest paths by considering congestion and energy constraints at each of the intermediate nodes. Contention window along with buffer size at MAC layer affects the successful transmission of packets. Path selection is mainly based on least cost metric using contention window, queue size and remaining energy of the nodes.

This study help us to understand the concept of controlling overhead in network by using the parameters as contention window, queue size and remaining energy. The path from source to destination with less contending nodes, high queue size and higher energy are selected. Further the traffic is split using cost based factors (more load through better path) for parallel transmission.
MANET is dynamic without centralized control for Routing and downlink Power and Resource Management. Therefore the quality of the service is found to be very low at times like very high load or mobility. As mobility increases the delivery of packets decrease which results in delayed transmission that further results in more delay.

The objective is to solve this problem of High delay by suitably adopting the paths which have best cost and splitting the load or the traffic accordingly.

2. Overview of AODV

Routing protocols for ad hoc networks must deal with limitations such as high power consumption, low bandwidth, high error rates and arbitrary movements of nodes. On the basis of routing information update mechanism routing protocol for ad-hoc wireless network can be classified into three categories.
1) Table driven (proactive) routing protocol
2) On – demand (reactive) routing protocol
3) Hybrid routing protocol.

We have selected On–demand (reactive) routing protocol like AODV. In the On-demand approach, when a node desires a route to a new destination, it will have to wait until such a route can be discovered.

In AODV a route discovery is initiated when a sending source wants a route to a destination but does not already have one in its routing table. To do so a RREQ is broadcasted into the network specifying the destination for which the route is requested. When a RREQ packet is received, the node checks whether it is the destination or not. If it is not the destination, it first checks if it has a route to the destination. If so, the node will send back a RREP along the reverse path. If there is no entry for the requested destination the node keeps on broadcasting the RREQ packet. When the node is the destination it will generate a RREP packet which will also be sent back towards the source along the reverse path. Each node along the reverse path sets up a forward entry in their routing table to the node it received the RREP from. This sets up a forward path from the source to the destination. There is also routing information to gather by the intermediate nodes from the RREP packet on the way back to the source. Intermediate nodes may use that information for further routing table entries to the destination and the nodes between the destination and the gathering node. Irrespective of the node is the destination or not, when a node receives a copy of the same RREQ packet it will be dropped, without even checking it. This behavior guarantees loop free routes.

3. Proposed Scheme

With the growing demands of higher bandwidth for applications such as high-definition video streaming, network storage, and online gaming, the industry has been working to seek higher data rate (HDR) extensions to the family of IEEE 802.11 specifications.

In this work we develop a new technique of contention based multipath routing where each of the nodes participate in routing using contention mechanism. Contention window selects path with less contending nodes from source to sink. Earlier the use of single path routing increases much overhead in case of collision. So by considering this multiple path is adopted for better performance and selects the path based on the cost which is minimum cost path and minimum cost path is sorted in ascending order. After finding the paths from source to sink, traffic splitting mechanism is used based on least cost matrix and selects the best multiple path. Every node measures its contention window size, queue size and remaining energy and all the values are averaged using exponential moving average function which helps to select the recent paths.

An AdHoc network uses Distributed Co-ordination Function (DCF) as the medium access mechanism supported by IEEE 802.11 MAC layer protocol. When one or more nodes try to access the channel simultaneously collision is experienced following which contention window is set to CWmin. .The size of the contention window determines how long a node would back-off before attempting to gain access to the channel.

The use of multipath routing provides efficiency compare to single path but we also need to consider the energy factor. The consideration of the energy consumption factor is important because in wireless ad hoc networks, a mobile device has a limited battery and a considerable amount of energy is consumed in wireless interfaces. These characteristics limit the network lifetime of the wireless ad hoc networks. As more energy consume performance is decreases. Below formulae shows the energy calculation of nodes.

Remaining Energy=Queue size * Energy per packet for transmission **(1)**

3.1 Traffic Splitting

Traffic splitting helps to efficiently utilize the network resources and to achieve better packet delivery ratio and also throughput. In this we are using cost based path matrix for splitting the traffic from source over different multiple path to destination. As the nodes receives the RREQ from previous neighboring nodes it decides whether to forward the RREQ packets or not which is mainly based on parameters used in this project which is

IJCAT International Journal of Computing and Technology, Volume 1, Issue 6, July 2014
ISSN : 2348 - 6090
www.IJCAT.org

Remaining energy, queue size and contention window. As the Remaining energy which is less than the threshold value then it stops forwarding RREQ. The cost is calculated for each of the nodes and forward till reach to destination after getting RREQ packets the destination generates the RREP.

The cost of the path from source to destination is calculated using formulae

Cost=Remaining Energy + Queue size / Contention window (**2**)

The contention window (CW) size is a value chosen from the range between the minimum contention window (CWmin) and the maximum contention window (CWmax). CWmin and CWmax are PHY dependent value, e.g. in 802.11b, the CWmin and CWmax are 15 and 1023 respectively. The initial value of CW is CWmin.

When source node receiving of RREP from destination then source node wait for certain amount of time so that few other RREP may arrive. If no other path arrives then all traffic sent on one path. If other path arrives then traffic is splits which are shown below and the packet size which is of 512 bytes.

$$\text{Traffic1} = \frac{\text{Least cost 1}}{\text{Total cost}} \quad (3)$$

$$\text{Traffic2} = \frac{\text{Least cost 2}}{\text{Total cost}} \quad (4)$$

After the RREQ there is N-number of paths found with different cost and selecting the best path which consumes less energy and cost of path is minimum with the help of traffic splitting. We can select the 2 best paths and send a data packets parallel. If the current path fails because of collision of packets or the other reasons then the next best path is selected from the route cache and forwards the data. The use of route cache which stores all the possible routes in it, so when collision occurs then no need make route request again.

3.2 Retransmission of Packets

Packets are retransmitted using binary exponential back off mechanism. BEB used to schedule retransmission after collision. The retransmission is delayed by an amount of time derived from the slot time and the number of attempts to retransmit. After *c* collisions, a random number of slot times between 0 and 2^c - 1 are chosen. For the first collision, each sender will wait 0 or 1 slot times. After the second collision, the senders will wait anywhere from 0 to 3 slot times. After the third collision, the senders will wait anywhere from 0 to 7 slot times and so forth. As the number of retransmission attempts increases, the number of possibilities for delay increases exponentially. The 'truncated' simply means that after a certain number of increases, the exponentiation stops; i.e. the retransmission timeout reaches a ceiling, and thereafter does not increase any further.

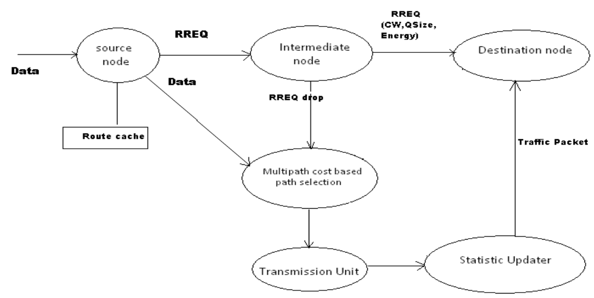

Fig. 1 Data Flow Diagram

The above figure shows data flow diagram in which each of function plays important role. Before the actual data transfer from source to destination must need to make connection this is done by using route request and route reply. The source node checks for the path to destination. Intermediate nodes used to forward the RREQ with parameters like energy, CW to the desired destination. Use of route cache is to store all the possible paths from source to destination based on least-cost then cache is updated. When there is link failure so no need of RREQ again it directly select next best path from route cache. Transmission unit used to transmit given data. Statistic updater is used to update recent paths and send to destination. To select the best path which is mainly based on cost matrix, the use of multipath this increases the resiliency.

4. Results and Discussion

4.1 Performance Matrices

We measure different performance metrics. In particular, for each source we evaluate:

Packet Delivery Ratio
It is defined by a factor of number of packets received by number of packets transmitted. As the stability of nodes

increases in the network then the packet delivery ratio increases.

Throughput

Network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

Control overhead

It is defined as number of control packets transmitted for every data packet delivered.

Latency

The latency is the amount of time that is required for a packet to travel from source to destination. The latency includes propagation delay, transmission delay and processing delay.

4.2 Simulation Environment

The simulation was carried out in OMNET 3.3 network simulator. It supports physical, data link and MAC layer models for simulating wireless ad hoc networks. We compare our proposed system Contention window multipath routing (CWM) with on demand routing protocol for different scenarios.

4.3 Simulation Parameters

Table 1: Simulation parameters

Parameters	Values
Simulation time	100 seconds
Number of nodes	20,40,60,80,100
MAC protocol	IEEE 802.11
Pause time	0-100 sec
Simulation area	500m*500m
Mobility model	Random way point
CW min	31
CW max	1023

4.4 Simulation Results and Analysis

4.4.1 No. of Nodes V/s PDR

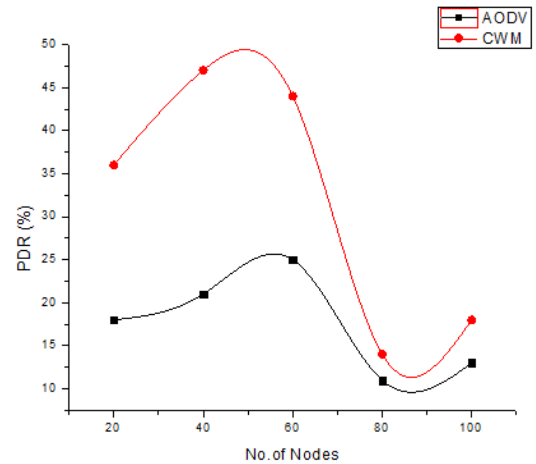

Fig 2: No. of Nodes V/s PDR

From above graph by keeping the pause time and packet rate as constant to 100 and as the number of nodes increases the delivery ratio is slightly dropping but the proposed CWM routing has better PDR than the AODV at some point the pdr of AODV is higher than proposed CWM but proposed method is better overall delivery ratio.

4.4.2 No. of Nodes V/s Throughput

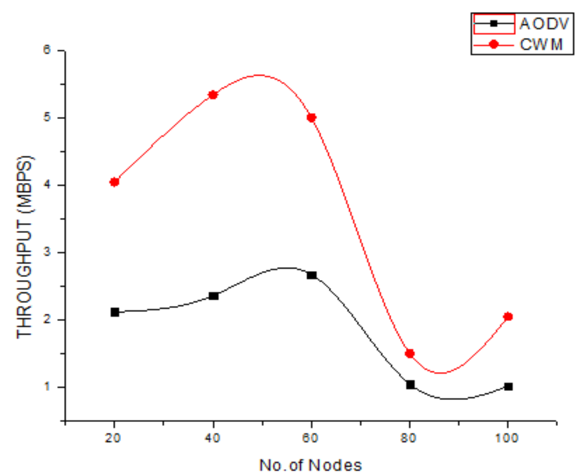

Fig 3: No. of Nodes V/s Throughput

From the above graph by keeping the pause time and packet rate as constant to 100 and increasing the number of nodes the throughput of proposed method.

4.4.3 No. of Nodes V/s Overhead

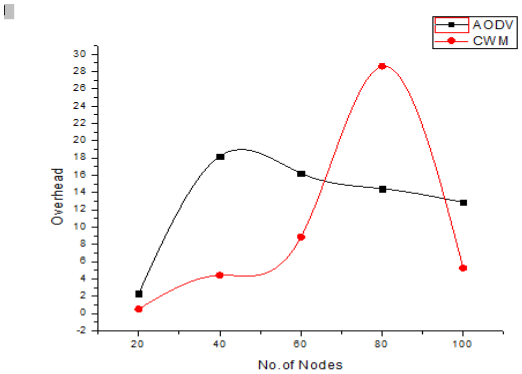

Fig 4: No. of Nodes V/s Overhead

4.4.4 No. of Nodes V/s Latency

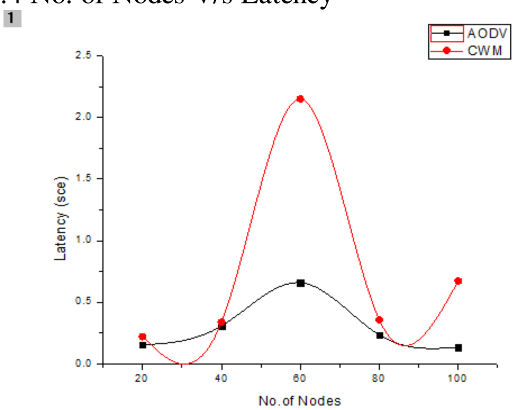

Fig 5: No. of Nodes V/s Latency

4.4.5 Pause Time V/s PDR

To achieve High packet delivery ratio in any network we need to know stability of links in the route to ensure high PDR and aslo lifetime. The stability of link is varied by using RandomWayPoint in Omnet mobility model. RandomWP is set Tpause=high,Vmax=low results in stability and Tpause=low, Vmax=high results in dynamic.

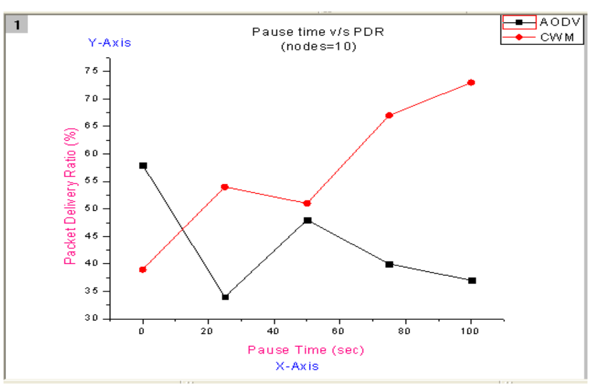

Fig 6: Pause Time V/s PDR

4.4.6 Pause Time V/s Overhead

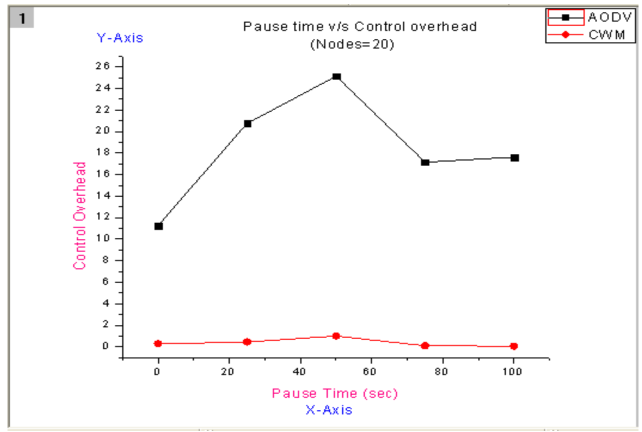

Fig 7: Pause Time V/s Overhead

The overhead in network observed due to loss of packets in network and more retransmission this leads much overhead so we use the queue buffer for storing data packet when transmission taking place when channel become idle first packet gets channel and this controls overhead in network. In fig as nodes increase the overhead is much in AODV but CWM which is having almost minimum overhead.

4.4.7 Packet Rate v/s Throughput

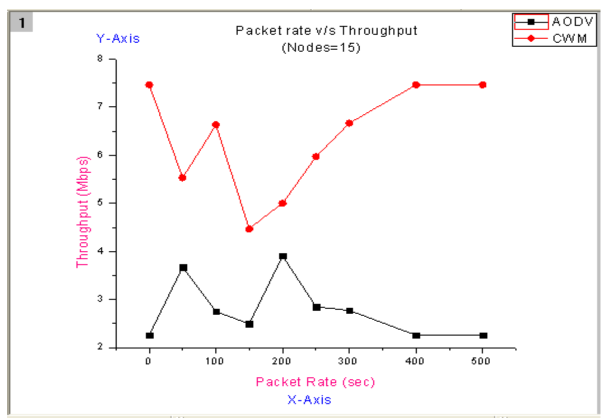

Fig 8: Packet Rate V/s Throughput

From above fig 8 throughput of proposed Contention window multipath routing is better than the AODV by increasing the packet rate the throughput also increases by keeping the pause time constant at 100sec and for 15 number of nodes.

4.4.8 Packet Rate v/s Latency

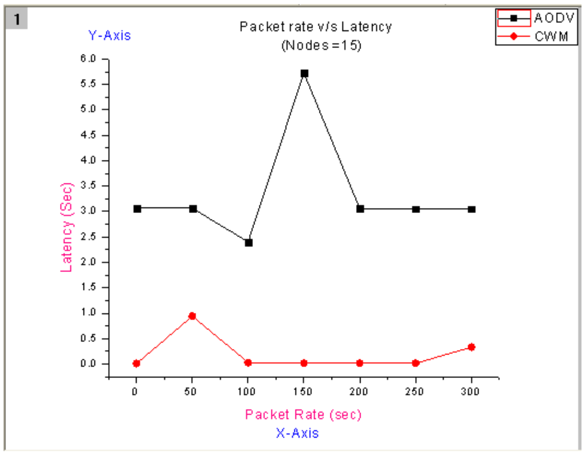

Fig 9: Packet Rate V/s Latency

From above Fig 9 the latency which is almost less in contention window multipath routing compared with AODV protocol.

6. Conclusions

In this paper, we present new approach to improve the overall performance using multipath routing in ad hoc network. As load increases in network, maintaining high packet delivery ratio and throughput is difficult. Excess control overhead is observed due to route maintenance. In order to overcome these problems, new contention based multipath routing is introduced. In proposed approach all paths are cached at the beginning only so that source select best multi-path route from source to destination based on cost matrix with maximum Contention Window.

The selected path based on less contending nodes and nodes with high energy and residual queue helps overcoming the problem of control overhead with increase of network lifetime and considering the energy consumption. The use of multipath routing is more efficient compared with single path. Traffic split method is used for parallel transmission. If there is any link failure in current path next best path is selected based on least cost. In the proposed system, routing protocols such as AODV and Contention Window based protocol compare with respect to more metrics. Protocol performances are tested in higher mobility situations. This work tries to optimize delay and overhead.

References

[1] Pravin Ghosekar, Girish Katakar, Dr.Pradip Ghorpade," Mobile Ad Hoc Networking: Imperatives and Challenges", IJCA Special Issue on "Mobile Ad-hoc Networks" MANETs, 2010.

[2] P. Periyasamy, Dr.E.Karthikeyan, "Performance Evaluation of AOMDV Protocol Based on Various Scenario and Traffic Patterns", International Journal of Computer Science, Engineering and Application (IJCSEA) Vol.1, No.6, December 2011.

[3] Salehali K.al-omari, Putra sumari, "An overview of mobile ad hoc network for existing protocol and applications.

[4] Anju Gill, Chander Diwaker," Comparative Analysis of Routing in MANET ", International Journal of Advanced Research in Computer Science and Software Engineering", Volume 2, Issue 7, July 2012.

[5] Sujatha.P. Terdal , Dr.V.D.Mytri , Dr. A.Damodaram ," A Link Quality Based Dispersity Routing Algorithm for Mobile Ad Hoc Networks "Dept. of CSE,JNTU college of Engineering,Hyderabad,India,I. J. Computer Network and Information Security, 2012, 9, pp 20-28.

[6] Humayun Bakht," Survey of Routing Protocols for Mobile Ad-hoc Network", IJICT, Vol.1 No.6, 2011.

[7] Stephen Mueller, Rose P. Tsang, and Dipak Ghosal, "Multipath Routing in Mobile Ad Hoc Networks: Issues and Challenges", Department of Computer Science, University of California, Davis,Sandia National Laboratories, Livermore.

[8] Sofiane Hamrioui , Mustapha Lalam, Houari Boumedienne,
"Improving Transport Protocol Performance in MANET by exploiting the Backoff Algorithm of MAC Protocol ",IJNCAA, Department of Computer Science, University of Mouloud Mammeri, Algeria,2011.

[9] Shao-Cheng Wang and Ahmed Helmy, "Performance Limits and Analysis of Contention-based IEEE 802.11 MAC", Department of Computer and Information Science and Engineering, University of Florida.

[10] Chintan Bhavsar, Mayur.M Vegad, Sunil.A Bakhru, "Performance Comparison of Stability Enhanced AODV and AOMDV Protocols for MANET", IJETAE, Volume 2, Issue 5, May 2012.

[11] Sanjeev Gangwar," Mobile Ad Hoc Networks: Comparasion of Multipath Routing Protocols with Unipath Routing Protocols", IJCT,Vol 5 No.3.

[12] Parul Sharma, Arvind Kalia And Jawahar Thakur," Performance Analysis of Aodv, Dsr And Dsdv Routing Protocols in Mobile Ad-Hoc Network (Manet)", Journal of Information Systems and Communication, Volume 3, Issue 1, 2012, pp.-322-326.

[13] Mehajabeen Fatima, Roopam Gupta,T.K. Bandhopadhyay," "Route Discovery by Cross Layer Approach for MANET", International Journal of Computer Applications, Volume 37– No.7, January 2012

Ms.Namrata Chavan received the B. Tech degree in Computer Science and Technology from SNDT University in 2009. Now she is doing her M. E .in Computer Engg from Thadomal Shahani College of Engineering, Bandra, Mumbai. Working as Lecturer in IT Department at K.J.Somaiya college of Engineering, Sion.

Ms.Shilpa Verma is an associate professor in the Department of Computer Science and Engineering at Thadomal Shahani College of Engineering, Bandra, Mumbai. She has more than 11 years of experience in teaching. Her current research interests areas are Neural networks, Networking, Object oriented systems.