Maximum Minimal Bandwidth Aware Multipath Routing protocol (BWA-AOMDV) in MANET.

T.Sivaraman, Dr. E. Karthikeyan.
Research scholar, Manonmaniam Sundaranar University, Government Arts College, Udumalpet, Tamilnadu, INDIA.

Abstract— A mobile Ad-hoc network is a wireless communication network. The multipath routing protocols establish multiple routes between sources to destination. Mobile ad-hoc networks (MANET) are having limited battery life and band width. So, the bandwidth is the important one in design of mobile ad-hoc network. The limited band width of wireless network is the important parameter in mobile Ad-hoc network. The main objective of this paper is to develop efficient bandwidth aware routing protocol for mobile Ad-hoc networks. The source selects the primary route for data forwarding on the basis of minimal residual and available bandwidth for on demand multiple disjoint paths. The simulation result show that the performance of AOMDV and BWA-AOMDV using Ns2.34. It reduces the consumption, bandwidth aware, average end-to-end delay, routing overhead and normalized routing overhead. it also improves packet delivery ratio and throughput..

Index Terms— Mobile Ad-hoc networks, multipath, efficient, bandwidth, AOMDV, BWA-AOMDV.

1. Introduction:

The Routing protocols are used to provide multiple paths from source to destination. A mobile Ad-hoc networks[MANET] is providing multi hop communications without using much physical network infrastructure such as routers, servers, access points and cables. Each mobile node is acting as a router as well as node. The MANET provide multipath routes between source to destination for transmit the data. In case of route break, an alternative route can be used to send the packets towards the destination. The MANET provide limited battery life, minimum bandwidth and maintaining the route. The QOS (Quality of service) is important one MANET. QOS means not only to find a route from source to destination but in a quality route depending upon residual and bandwidth.

2. Related work:

A. The Ad-hoc On-Demand multipath distance vector routing protocol (AOMDV) is an enhanced version of a prominent and well-defined on-demand multi path routing protocol . AOMDV eliminates the occurrence of frequent link failures and route breaks due to node mobility, node failures, congestion in traffic, packet collisions, and so on. In highly dynamic Ad hoc networks by adding some extra fields in routing tables and control packets in order to compute loop-free and link-disjoint multiple routes between the source and destination.

B. In multiple routes, the destination contains list of the next-hops along with the corresponding hop counts in routing table entries. If all the next hops have the same sequence number, the advertised hop count

ISSN 2229-5518

is defined as the maximum hop count for all the paths. Route advertisement effectively sends to destination by using this hop count value. If any duplicate route advertisement received by a node then it forwards the packet through alternate path to the destination. The loop freedom is ensured by selecting the alternate path for a destination on the basis of the hop count value if it is less than the advertised hop count for that destination. The destination node sorts out all the paths by maximum hop count value. The best path is selected and data forwarded through this path. In AOMDV, RREQ (route request) propagates from the source node to the destination to establish multiple reverse paths both at intermediate nodes as well as the destination. The corresponding multiple RREP (route reply) generates and traverses these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes. The major thing in AOMDV is to provide alternate path for intermediate nodes also and it is useful for reducing route discovery frequency. It is classified into node-disjoint or link-disjoint route. In node-disjoint routes, duplicate RREQs cannot be immediately rejected, because the reason is RREQ and RREP pair arriving through different neighbor of the source node in a node-disjoint path.

3. Proposed routing protocol: BWA-AOMDV

3.1 Route Discovery

we propose an extension of AOMDV protocol, in which the channel bandwidth is utilizes in order to improve the network performance. AOMDV allows finding many routes between source and destination during the same route discovery procedure .The table entry structure of AOMDV is modified for one field is added which gives the information about the minimal residual bandwidth.

The AOMDV protocol is finding many routers between source and destination in discovery process loop freedom and disjoints alternative Path. The channel bandwidth is utilized in order to improve the network. The power saving during route discovery and power control during data transmission are major classification for wireless ad-hoc network. The total consumption is reduced in power saving technique in idle listening mode [11, 12] by putting the nodes in to periodical step in power control technique. Liang et al., designed an multipath routing for wireless network. This algorithm considers the remaining battery capacity. Yumei liu at al.,[20] proposed Maximum Minimal nodal residual

ISSN 2229-5518

bandwidth [BWA-AOMDV] in to the existing AOMDV in each route discovery phase.

(i) Finding minimal nodal residual bandwidth and hop count of each route between any source and destination pair in the route discovery process.

(ii) Sorting the multiple routes by descending nodal residual bandwidth and ascending hop count and then elect the route based on the route priority algorithm to forward data packets.

3.2 Route discovery algorithm

Several changes made in the route discovery phase of AOMDV to find the minimal nodal residual bandwidth of each route between any source and destination pair. Each RREQ and RREP now carries an additional field called min_re_bandwidth in order to have the route's minimal residual energy. Structure of Routing Table Entries of AOMDV and BWA-AOMDV routing protocols are several changes made in the route discovery phase of AOMDV to find the minimal nodal residual bandwidth of each route between any source and destination pair. Each RREQ and RREP now carries an additional field called min_re_bandwidth. The Structure of Routing Table Entries of AOMDV and BWA-AOMDV routing protocols are described.

Algorithm 1: Update the Route Rule of BWA-AOMDV:

1. **if** ($seqnum_i^d$ < $seqnum^d_j$) **then**
2. $seqnum_i^d$:= $seqnum^d_j$;
3. **if** (*i≠d*) **then**
4. **if** (*re_bandwidth*$_i$ < *min_re_bandwidth*^d_j) **then**
5. *min_re_bandwidth*^d_j:= *re_bandwidth*$_i$;
6. *advertised_hopcount*$_i^d$:=∞;
7. **else**
8. *advertised _hopcount*^d_i:= 0;
9. **end if**
10. *route _list*$_i^d$= *NULL;*
11. **insert** (*j* , *advertised_hopcount*^d_j +1, *min_re_bandwidth*^d_j) **into** route _list^i_d ;
12. **else if** (*seqnum*$_i^d$=*seqnum*^d_j) **and** ((*advertised_hopcount*$_i^d$,i)>
13. (*advertised_hopcount*$_j^d$,j)) **then**
14. **if** (*re_bandwidth*$_i$< *min_re_bandwidth*^d_j)
15. *min_re_bandwidth*^d_j:= *re_bandwidth*$_i$;
16. **insert** (*j* , *advertised_hopcount*^d_j +1, *min_re_bandwidth*^d_j) **into** route _list^i

Route Update Rules of BWA-AOMDV Routing Protocol :

In route discovery process to find the minimal residual band width of each route between source and destination node. Each RREQ and RREP carry an additional field called min_re_bandwidth which gives the information about the band width of multipath stored in route list.

The RREQ and RREP packets consist of existing information of available bandwidth of forwarding in it. The source is able to identify the bandwidth of the multipath during the discovery process by using maximum minimum approach. The path with the greatest available bandwidth as its primary path for transfer data. The source node will change its path from current primary path to alternative path if the available bandwidth is higher than the predefined to wait for its primary path break.

3.3 Hello packets

In AOMDV the hello packets used to keep the address of the node .We modify the Hello packet for the new solution by adding the bandwidth information of the node sending the hello packet and neighbors of the node with their bandwidth information. Each node broadcast this hello packet periodically and update its neighbors depend up on its bandwidth.

4. Simulation Result:

4.1 Simulation Environment

The performance of Efficient Bandwidth aware AOMDV (BWA-AOMDV) and AOMDV routing protocols are evaluated by using NS 2.34 [21,22] illustrate the simulation model and simulation parameters respectively.

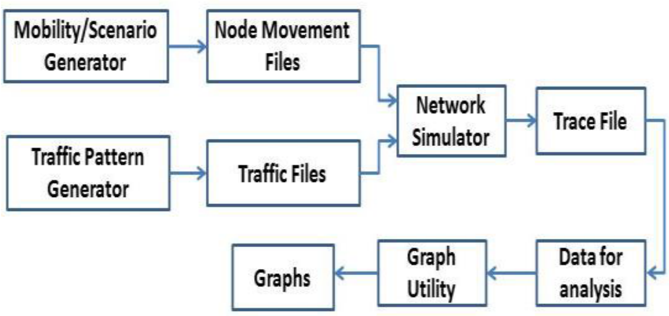

***Fig*:1 Simulation model**

The simulation experiment is carried out by using LINUX. Table shows the simulation parameters .The simulations are run for with the speed of 5,10,15,20 and 25 m/s. The initial energy is 100 joules.

Table:1 Simulation parameters

Parameters	**Values**
Simulator	Ns 2.34
Traffic Type	CBR
Number of Nodes	100
Simulation time	100 seconds
Pause Time	50,100,150,200,250,300
Network load	4 packets/sec
Packet size	512 byte
Mobility Model	Random way point model
Routing protocols	BWA-AOMDV,AOMDV
Antenna Model	Omni
Radio propagation Model	Two Ray Ground
Dimension	1000m*1000m
Speed	5,10,15,20,25
Channel Type	Wireless Channel
MAC Type	802.11
Initial	100 Joules

ISSN 2229-5518

4.2 performance Metrics

The performance of new protocol BWA-AOMDV is evaluated using following metrics to compare the performance with the existing protocol of AOMDV. We evaluate the following metrics.

I) packet delivery fraction:-The ratio of data packets delivered to the destination generated by the sources.

II) Throughput:-The amount of data packets received by the destination per unit time.

III) Normalized routing overhead:-the number of routing packets transmitted per data packet towards the destination.

IV) End-to-end Delay:-The average time of data packet to be sent transmitted from source to destination includes buffering, latency and interface queue etc.

V) Total consumed:-The summation of bandwidth consumed by all nodes during the simulation.

Table2: Routing Overhead of AOMDV and BWA-AOMDV

Max.Speed	AOMDV	BW-AOMDV
5	69	65
10	72	65
15	60	57
20	68	65
25	68	63

Fig:2 Routing overhead of AOMDV and BWA-AOMDV

Table 2 fig 2 represent the Routing overhead of AOMDV and BWA-AOMDV protocols. The BWA-AOMDV protocol reduces the bandwidth and hop count routing packets.

Table3: Packet delivery Ratio (%) of AOMDV and BWA-AOMDV

Max.Speed	AOMDV	BW-AOMDV
5	80.386	80.213
10	74.666	72.179
15	64.831	65.280
20	62.117	62.090
25	50.081	49.970

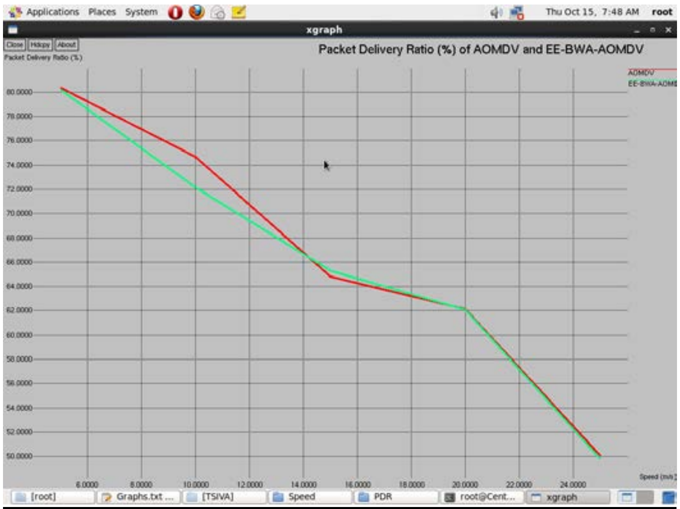

Fig:3 : Packet delivery Ratio(%) of AOMDV and BWA-AOMDV

Table 3 fig 3 represents the Packet delivery Ratio (%) of AOMDV and BWA-AOMDV protocols. The BWA-AOMDV protocol given the better packet delivery ratio compare to AOMDV.

Table 4: Normalized Routing Overhead(%) of AOMDV and BWA-AOMDV

Max.Speed	AOMDV	BW-AOMDV
5	3.162	3.170
10	3.715	3.846
15	4.549	4.647
20	5.108	5.056
25	7.265	7.281

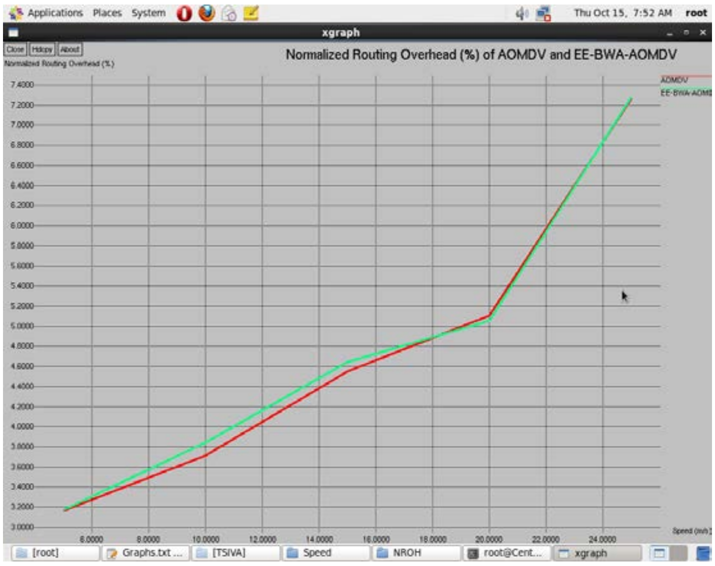

Fig 4: Normalized Routing Overhead (%) of AOMDV and BWA-AOMDV

The figure 4 represent the Normalized Routing load of AOMDV and proposed routing protocol of BWA-AOMDV .The new protocol given less normalized routing load.

Table:5 Total energy Consumed(in joules) of AOMDV and BWA-AOMDV

Max.Speed	AOMDV	BW-AOMDV
5	3893.9910	3631.6410
10	3670.6015	3413.3515
15	3420.2020	3065.5820
20	3162.6225	3028.2725
25	2851.333	2672.6300

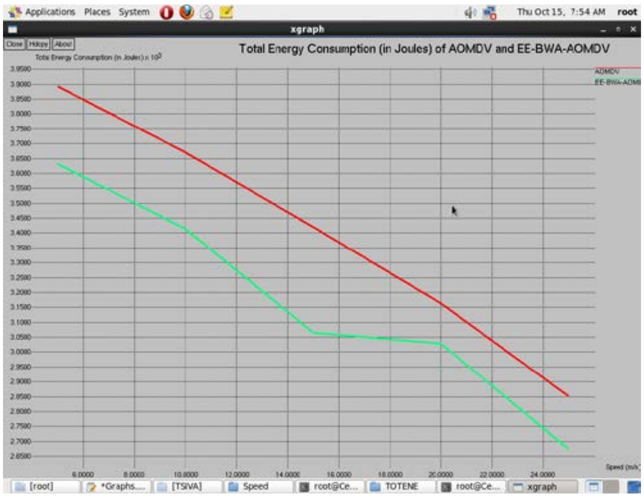

Fig :5 Total Consumed(in joules) of AOMDV and BWA-AOMDV

The graph represent total consumption of BWA-AOMDV PROTOCOL is very less compare it with the AOMDV protocol as shown in fig 5.

Table:6 Average End-to-end delay of AOMDV and BWA-AOMDV

Max.Speed	AOMDV	BW-AOMDV
5	2.820	2.872
10	3.170	3.425
15	3.289	3.134
20	3.531	4.018
25	5.752	4.752

Fig:6 Average End-to-end delay of AOMDV and BWA-AOMDV

The table 6 and fig 6 represent the Average End-to-end delay of AOMDV and BWA-AOMDV routing protocols. The BWA-AOMDV is reducing the end to end delay whenever the speed of node is increased.

Table: 7 Throughputs of AOMDV and BWA-AOMDV

Max.Speed	AOMDV	BW-AOMDV
5	202.675	202.688
10	187.860	181.660
15	163.849	164.542
20	156.868	155.911
25	126.612	125.721

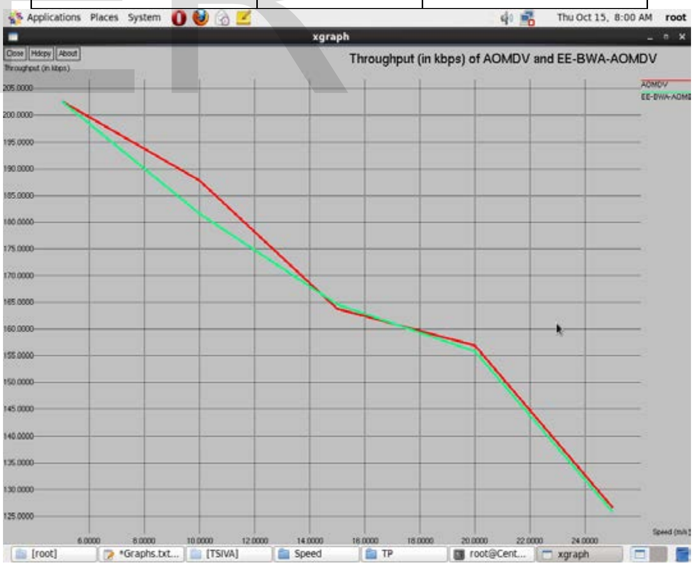

Fig 7: Throughput of AOMDV and BWA-AOMDV

The BWA-AOMDV gives the better throughput compare to AOMDV protocols as shown in the figure 7.

Conclusion:

In this paper, we proposed a BWA-AOMDV protocol to reduce the consumption, routing overhead, minimum bandwidth and average-end-to-end delay. It also improves the packet delivery ratio and throughput by using random way point model. The simulation result of BWA-AOMDV routing protocol is very better than AOMDV. In future research will focus on to improve overall performance of the new metrics associated with the network.

REFERENCES

[1] Elizabeth M. Royer, C-K Toh, A Review of Current Routing Protocols for Ad-Hoc Mobile Wireless Networks, IEEE Personal Communications, pp.46-55, , April 1999.

[2] Mehran Abolhasan, Tadeusz Wysocki, and Eryk Dutkiewicz , A review of routing protocols for mobile ad hoc networks, Ad Hoc Networks, pp.1-22, June 2004.

[3] S. Corson and J. Macker, Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations, IETF WG Charter, http://www.ietf.org/html.charters/manet-charter.html, January 1999.

[4] Ankita Sharma, Sumit Vashistha, Improving the QOS in MANET by Enhancing the Routing Technique of AOMDV Protocol, ICT and Critical Infrastructure: Proceedings of the 48th Annual Convention of Computer Society of India- Vol I Advances in Intelligent Systems and Computing Volume 248, pp. 381-392, 2014.

[5] P.J.B. King, A. Etorban, and I.S. Ibrahim, A DSDV-based multipath routing protocol for mobile ad-hoc networks. In Proceedings of the 8th Annual Post Graduate Symposium on The Convergence of Telecommunications, Networking and Broadcasting, The School of Computing and Mathematical Sciences, Liverpool John Moores University, United Kingdom, pp. 93–98, 2007.

[6] Jiazi Yi, Asmaa Adnanea, Sylvain Davida and Benoît Parrein, Multipath Optimized Link State Routing for Mobile ad hoc Networks, Elsevier Ad Hoc Networks Journal, Vol. 9, No.1, pp. 28-47, Jan. 2011.

[7] Marina, M. K., and Das, S.R. (2006) "Ad hoc on-demand multipath distance vector routing", Wireless Communications and Mobile Computing, vol. 6, no. 7, pp 969–988,.

[8] Perkins, C.E., Royer, E. (1999) "Ad-hoc On Demand Distance Vector Routing", IEEE Workshop on Mobile Computing Systems and Applications (WMCSA'99), pp 90-100,.

[9] Chakrabarti, S., Mishra, A. (2001) "QoS issues in Ad Hoc Wireless Networks", IEEE Communication Magazine, feb, pp 142-148,

[10] Lohier, S. et.al. (2003) "A reactive QoS Routing Protocol for Ad Hoc Networks", European Symposium on Ambient Intelligence (EUSAI'2003), LNCS, Nov, Springer Verlag, Netherlands, 875, pp 27-41.

[11]Brown, T.X, Doshi, S., Zhang, Q., Optimal power aware routing in a wireless ad hoc network, IEEE LANMAN Workshop Proceedings, pp. 102–105, 2001.

[12]B. Chen, K. Jamieson, H. Balakrishnan and R. Morris, SPAN: An energy-efficient coordination

algorithm for topology maintenance in ad hoc wireless networks. ACM Wireless Networks Journal 8(5), pp. 481–494, 2002.

[13] Medhi, D. (2002) "Quality of Service (QoS) Routing Computation with Path Caching: A Framework and Network Performance", IEEE Communications Magazine, vol. 40, no. 12, pp 106–113.

[14] Cerd`a, L., et. al. (2005) "A Reservation Scheme Satisfying Bandwidth QoS Constraints for Multirate Ad-hoc Networks", Eurasip.org, conference proceedings, IST, jun.

[15] Chen, L. and Heinzelman, W. B. (2005) "QoS-Aware Routing Based on Bandwidth Estimation for Mobile Ad Hoc Networks", IEEE Journal On Selected Areas In Communications, vol. 23, no. 3, pp 561-572.

[16] Geng , R. and Li, Z. (2006) "QoS-Aware Routing Based on Local Information for Mobile Ad Hoc Networks", S. Madria et al. (Eds.): ICDCIT, LNCS 4317 © Springer-Verlag Berlin Heidelberg, pp 159 – 167.

[17] Shin, D., et. al. (2009) "A2OMDV : An Adaptive Ad Hoc On-Demand Multipath Distance Vector Routing Protocol Using Dynamic Route Switching", Journal of Engineering Science and Technology, vol. 4, no. 2, pp 171 – 183.

[18] Chen, L. and Heinzelman, W. B. (2007) "A Survey of Routing Protocols that Support QoS in Mobile Ad Hoc Networks", IEEE Network, vol. 21, no. 6, pp 30-38.

[19] Raju, J. and Garcia-Luna-Aceves, J. (1999) "A new approach to on-demand loop-free multipath routing", Proceedings of IEEE International Conference on Computer Communications and Networks, pp 522 – 527.

[20]Yumei Liu, Lili Guo, Huizhu Ma, Tao Jiang, Energy efficient on demand multipath routing protocol for multi-hop ad hoc networks, ISSSTA-08, IEEE 10th International symposium on Spread spectrum and applications. Bologna, Italy, August 25-27, pp-592-597, 2008.