ISSN No. 0976-5697
Volume 3, No. 2, March-April 2012
International Journal of Advanced Research in Computer Science
RESEARCH PAPER
Available Online at www.ijarcs.info

Routing Protocols in MANETs: An Enhanced Multipath Routing Protocol (AODLB) using Load Balancing Approach

Jayant Vats* and Sachin Khurana
Dept. of Management Studies & Applications
Amritsar College of Engineering & Technology,
Amritsar, INDIA,
jayantvasu@gmail.com
sachin331@gmail.com

Tanu Preet Singh and Shivani Sharma
Dept. of Computer Science & Engineering
Amritsar College of Engineering & Technology,
Amritsar, INDIA,
tanupreet.singh@gmail.com
er.sharma04@gmail.com

Abstract-In Recent Years, on demand Multipath routing protocols have been key research area in mobile Adhoc networks. An Adhoc network is comprised of mobile host without any wired infrastructure support. Multiple Adhoc routing allows the establishment of multiple paths between a source and destination. The multipath routing protocol with load balancing provides a solution for the congestion network and increases its capacity. Various multipath routing protocols have been proposed. In this paper we discuss the wireless routing protocols for adhoc networks like DSR, AODV, LBAODV, AOMDV, and LBAOMDV & AODLB. Simulation result shows the performance of AODLB protocol is much better than any other protocol in terms of PDR End to End Delays, ABS, and TOH.

Keywords-Mobile Adhoc Networks, AODV: Ad-Hoc on Demand Vector, AOMDV: Adhoc on Demand Multipath Vector, LBAOMDV: Load Balancing Adhoc on Demand Multipath Vector

I. INTRODUCTION

A Mobile Ad Hoc Network is a Collection of Wireless Mobile nodes dynamically forming a temporary network without the use of fixed network infrastructure of centralized administration and operating on limited amount of battery energy consumed mostly in transmission and reception. MANET has known a great success. They are opening up to various applications of Quality of service, such as delay, throughput packet loss and network lifetime.

The mobility of nodes and the error prone nature of the wireless medium pose many challenges, including frequent route changes and packet losses, in the way of meeting the requirements of QoS. Such Challenges increases packet delay, decreases throughput and reduce network failure. The network performance degradation gets worse as traffic load increases. Despite there are large amount of effort invested in routing protocols, improving TCP performance and medium access control (MAC) for MANET [1]. MANET is one of the most important technologies that have gained interest due to recent advantages in both hardware and software techniques. MANET technology allows a set of mobile uses equipped with radio interfaces (Mobile nodes) to discover each other and dynamically form a communication network [2]. MANET provisioning of real time multimedia services such as voice and video over ad-hoc networks is problematic since wireless links are unreliable and are of limited bandwidth [3].MANET incorporates routing functionality into mobile nodes so that they become capable of forwarding packets on behalf of other nodes and thus effectively become the infrastructure. Providing multiple routing paths between any source-destination pair of nodes has proved to be very useful in the context of wired networks.

The general understanding is that dividing the flow among number of paths in a better balancing of load throughout the network [2].The multipath routing appears an efficient solution for the ad hoc networks. It can provide load balancing and route failure protection by distributing traffic among a set of diverse paths. But this repartition is more efficient if we use load balancing mechanism allowing distribution the traffic through the less congested route. The multipath routing appears an efficient solution for the ad hoc networks. It can provide load balancing and route failure protection by distribution traffic among a set of diverse paths. Load balancing mechanism allowing the traffic through the less congestion route [4]. Multipath routing allows the establishment of multiple paths between a single source and single destination node [5]. Multipath routing protocols are useful for finding more than one possible route between source and the destination [3]. A formula used by routers to determine the appropriate path onto which data should be forwarded. The routing protocol also specifies how routers report changes and share information with the other routers in the network so that they can reach. A routing protocol allows the network to dynamically adjust to changing conditions, otherwise all routing decisions to be predetermined and remain static [6]

II. CATEGORIZATION OF ROUTING PROTOCOLS USED IN MOBILE ADHOC NETWORKS

In general, ad hoc routing protocols are categorized into three categories: proactive (table-driven) protocols, reactive (on-demand) protocols and hybrid protocols [7].

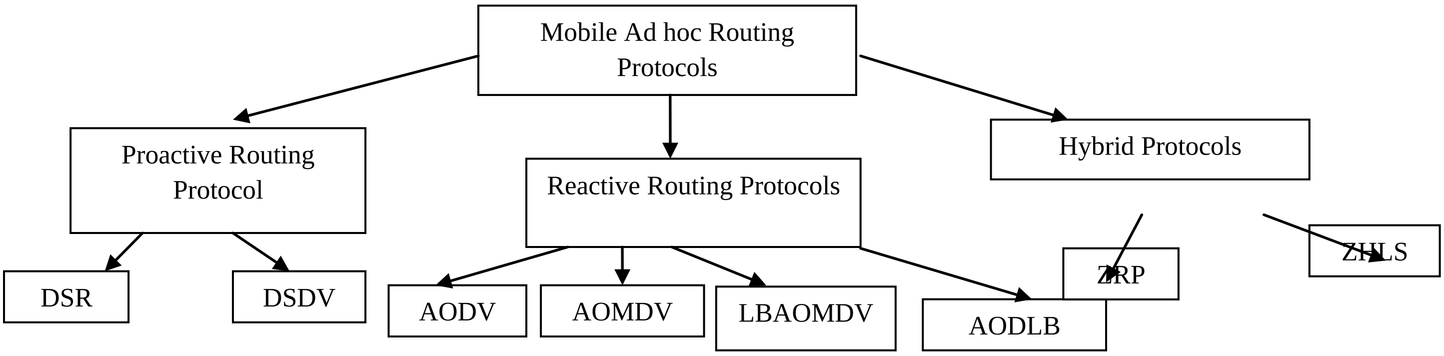

Figure 1 Categorization of Routing Protocols

A. Proactive Routing Protocol:

These protocols are fixed wired networks. Proactive Protocols are also called as table driven. In these Protocols each node consists of a table which maintain at each other node and periodically exchanging each information with each node and maintain a consistent network. In proactive protocols the power, bandwidth consumption of adhoc networks are increased due to topology table exchange among nodes after each changing in nodes location

B. Reactive Routing Protocol:

Reactive routing techniques, also called on-demand routing, take different approach for routing than proactive protocols. Routes to the destination are discovered only when actually needed. When source node needs to send packet to some destination, it checks it routing table to determine whether it has a route. If no route exists, source node performs route discovery procedure to find a path to the destination.

C. Hybrid Routing Protocols:

Hybrid protocols inherit the advantage of high-speed routing form proactive and less overhead control messages from reactive protocols. The characteristics of proactive and reactive routing protocols can be integrated to achieve hybrid routing technique. Hybrid routing protocols may exhibit proactive or reactive behaviour depending on the circumstance, hence allow flexibility based on the wireless network

a. Dynamic Source Routing (DSR) Protocol [5] [8]:

DSR is a reactive routing protocol which is able to manage a MANET without using periodic table-update messages like table-driven routing protocols do. DSR was specifically designed for use in multi-hop wireless ad hoc networks. Ad-hoc protocol allows the network to be completely self-organizing and self-configuring which means that there is no need for an existing network infrastructure or administration. For restricting the bandwidth, the process to find a path is only executed when a path is required by a node (On-Demand Routing). In DSR the sender (source, initiator) determines the whole path from the source to the destination node (Source-Routing) and deposits the addresses of the intermediate nodes of the route in the packets. Compared to other reactive routing protocols like ABR or SSA, DSR is beacon-less which means that there are no hello-messages used between the nodes to notify their neighbors about her presence. DSR was developed for MANETs with a small diameter between 5 and 10 hops and the nodes should only move around at a moderate speed. It is based on the theory of source-based routing. It is source-initiated rather than hop-by-hop. This protocol is divided into two essential parts:-

a) Route Discovery (find the path.)
b) Route Maintenance (Maintain the path)

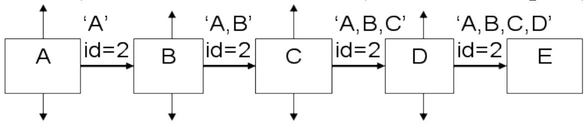

Figure 2: Mechanism of route Discovery in DSR Protocol

If node A has in his Route Cache a route to the destination E, this route is immediately used. If not, the Route Discovery protocol is started:

Node A (initiator) sends a Route Request packet by flooding the network

If node B has recently seen another Route Request from the same target or if the address of node B is already listed in the Route Record, Then node B discards the request!

If node B is the target of the Route Discovery, it returns a Route Reply to the initiator. The Route Reply contains a list of the "best" path from the initiator to the target. When the initiator receives this Route Reply, it caches this route in its Route Cache for use in sending subsequent packets to this destination.

Otherwise node B isn't the target and it forwards the Route Request to his neighbors (except to the initiator).

a) Route Maintenance:

In DSR every node is responsible for confirming that the next hop in the Source Route receives the packet. Also each packet is only forwarded once by a node (hop-by-hop routing). If a packet can't be received by a node, it is retransmitted up to some maximum number of times until a confirmation is received from the next hop. Only if retransmission results then in a failure, a Route Error message is sent to the initiator,that can remove that Source Route from its Route Cache. So the initiator can check his Route Cache for another route to the target. If there is no route in the cache, a Route Request packet is broadcasted.

i. If node C does not receive an acknowledgement from node D after some number of requests, it returns a Route Error to the initiator A.
ii. As soon as node receives the Route Error message, it deletes the broken-link-route from its cache. If A has another route to E, it sends the packet immediately using this new route.
iii. Otherwise the initiator A is starting the Route Discovery process again.

b. Ad Hoc On Demand Distance Vector Routing (AODV) [4] [9]:

The AODV routing protocol is an on-demand routing protocol. If a node receives a RREQ with a new request id it stores the hop count of this request in the Num Hop Count variable, appends its address to the Route Record of RREQ, increases the hop count of RREQ and rebroadcast it. This process is initiated by creating a RREQ message, including the hop count to the destination, the IP address of the source and the destination, the sequence numbers of both of them, as well as the broadcast ID of the RREQ. All nodes which receive the RREQ first checked by comparing the identifier of the message with identifiers of messages already received. If it is not the first time the node sees the message, it discards silently the

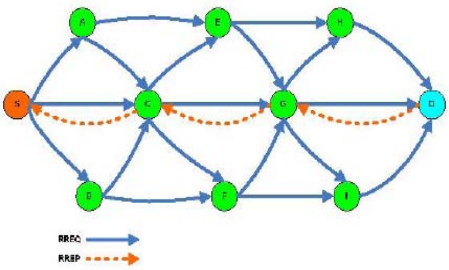

Figure 3: Mechanism of AODV Routing Protocol

Message. If this is not the case the node processes the RREQ by updating its routing table with the reverse route. If a node is the destination node or has already an active route to the destination in its routing table with sequence number of the destination host which is higher than the one in the RREQ, it creates a RREP message and uncast it to the source node. Otherwise it increments the RREQ's hop count and then rebroadcasts the message to its neighbors. When the source node receives no RREP as a response on its RREQ a new request is initialized with a higher TTL, wait value and a new ID. It retries to send a RREQ for a fixed number of times after which, when not receiving a response, it declares that the destination host is unreachable.

c. Load Balancing Ad Hoc On-Demand Distance Vector Routing Protocol (LBAODV) [9][10]:

LBAODV is an on-demand routing protocol that consists of three main phases:

a) Path Discovery Process:

When a node has data to send the data without the route information, it starts process of discovering path by sending RREQ to its neighbors identifiers the target ie the host for which route is requested.. Each RREQ packet also contains a unique request id, set by the initiator. To prevent the possibility of forming routing loops, each intermediate node that receives RREQ, propagates it if their address is not already included in RREQ's Route Record filed and appends its address to the RREQ's Route Record before rebroadcasting it. If a node receives a RREQ with a new request id it stores the hop count of this request in the Num Hop Count variable, appends its address to the Route Record of RREQ, increases the hop count of RREQ and rebroadcast it. To prevent flooding network with too many RREQs, nodes only rebroadcast it if the hop count of received RREQs is less (or equal to) than Num Hop Count Rebroadcasting the RREQs is continued until they reach to the destination. By using this method for propagation the RREQs, many RREQs from different routes will be received to the destination.

b) Sending Data:

When the source receives RREPs, it can transmit data packets through the discovered routes. Our protocol uses hop-by-hop method for forwarding data. Each node that receives data packets sends them to the next hops according to their Count Reply values. Each next hop that has greater Count Reply receives more data than the next hops that have less Count Reply. This process causes that all of the discovered routes is used and data packets distributed across all of the paths simultaneously.

c) Route Maintenance:

If a route is not used for some period of time, a node cannot be sure whether the route is still valid; consequently, the node removes the route from its routing table. If data is flowing and a link break is detected, a Route Error (RERR) packet is sent to the source of the data in a hop-by-hop fashion. As the RERR propagates towards the source, each intermediate node decrements Count Reply by 1 which means one of the routes from this next hop to the destination is broken. When Count Reply of each next hop in Route Table reaches to 0 this next hop is deleted from route table. If no entry for a destination exists in Route Table of source, it invalidates the route and reinitiates route discovery process if necessary.

d. Adhoc On Demand Multipath Distance Vector Protocol (AOMDV) [4] [11]:

AOMDV is an extension to the AODV protocol for computing multiple loop-free and link-disjoint paths

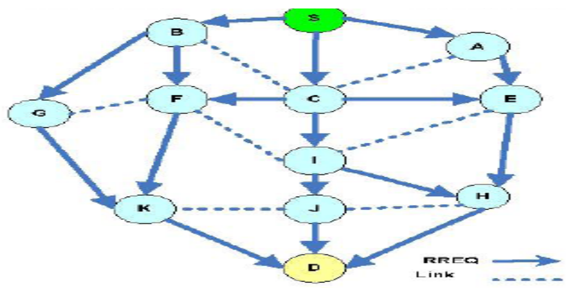

Figure 4: Propagation REEQs

To keep track of multiple routes, the routing entries for each destination contain a list of the next-hops along with the corresponding hop counts. For each destination, a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths. AOMDV can be used to find node-disjoint or link-disjoint routes To reduce interruption of communications in ad hoc network, the discover procedure of routes must be efficient especially with the continuous mobility of the nodes and also the frequent change of network topology, many routing protocols are proposed such as AOMDV: the multipath routing protocol that extends the single path AODV protocol to compute multiple path routing

Routing Definition

The main idea in AOMDV is to compute multiple paths during route discovery procedure for contending link failure. In fact, the main goal to concept this protocol is to search multiple routes during the same route discovery procedure, but only the best path based on some metric (number of hop) is chosen and is used for data transmission between source and destination. The other paths are used only when the primary path fails. AOMDV use the information available in AODV, but to compute multiple paths it adds additional number of control packet "overhead". AOMDV is based on two essential mechanisms:

a) A route update to establish and maintain multiple loop-free paths at each node.
b) A distributed protocol to find link-disjoint paths.

e. Multipath route construction without loop-free:

AOMDV is based on the advertised hop count. The advertised hopcount of a node i for a destination d represents the maximum hopcount of the multiple paths for d available at i. The protocol only accepts alternate routes with hopcount lower than the advertised hopcount, alternate routes with higher or the same hopcount are discarded. This condition is necessary to guarantee loop-freedom. Fig 7 shows the structure of the routing table entries for AODV and AOMDV

Destination
Sequence_number
Advetised_Hopcount
Route_list {(nexthop1, hopcount1) ,(next hop2,hopcount2), …}
Expiration_timeout

Destination
Sequence_number
Hopcount
Next_hop
Expiration_ timeout

Routing Table for AOMDV
Routing Table for AODV

Figure 5 Structure of routing table entries for AOMDV and AODV

a) In AOMDV, advertised_hopcount replaces hopcount in AODV.
b) A route list replaces nexthop and essentially defines multiple next hops with respective hopcounts

f. Computing Multiple Loopfree Paths:

AOMDV allow building multiple link disjoint paths. It ensures multiple paths without common link between routes from source to destination. Additional modifications are made in the route discovery process to allow formation of node-disjoint paths from intermediate nodes to the source and destination.

g. AOMDV problems:

In such protocols a link failure in the primary path, through which data transmission is actually taking place, causes the source to switch to an alternate path instead of initiating another route discovery. A new route discovery occurs only when all pre-computed paths break.

e. Load Balancing Adhoc on Demand Multipath Distance Vector Protocol (LBAOMDV) [4]:

To overcome the problem of AOMDV protocol the new protocol LB-AOMDV was introduced. In the LB-AOMDV protocol the structure of RREP packet by adding a new field called buffer size which take into account the traffic load on the route. This traffic load is expressed as the sum of buffer size of intermediate nodes for each route between source and destination. The new structure of routing table entries for LB-AOMDV is shown in Fig 7. The additional field buffer size in the route list.

Destination
Sequence_number
Advertised_hopcount
Route_list {(nexthop1,hopcount1,buffer_size), (next hop2,hopcount2,buffer_size), …}
Expiration_timeout

Figure 6: Structure of routing entries for LB-AOMDV

The LB-AOMDV protocol establishes three paths between source and destination nodes. The packets sent by source node are scheduled according to Round-Robin (RR) algorithm.

III. SYSTEM MODEL & DESIGN

The network model consists of k number of hops from source to destination. Therefore, the number of relaying nodes between source and destination will be k-1 [6][1]. Let de be the end to end distance between source and the destination. If di is the distance between the relaying nodes then the value of di is given as: αide where 0 < αi < 1. Note that for k number of hops the summation of≥αi1. This determines that it is not necessary that all the nodes are not always in the straight line [12]. The characteristics and the requirements of the nodes are: (1) Has a common power amplifier characteristics, (2) experiences the same propagation environment, (3) transmission is independent of each other that is from node to node, (4) requires energy Ep [J] to process a received symbol

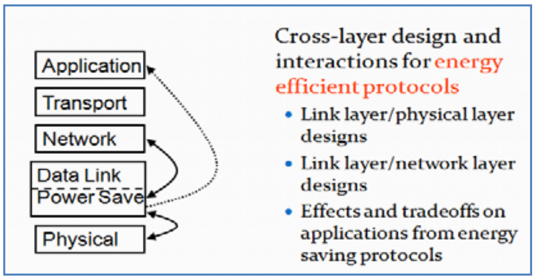

Figure 7

The factors to be considered for the system model are Ep as already defined is the receiver's processing energy, the power amplifier characteristics is described by two functions fc and fo [13]. As assumed in [13] Pin denote the input power to power amplifier, Pdc the consumed power to drive the power amplifier to generate the desired output and Pout the desired output power of the power amplifier [14].Now the characteristics can be given as:

$$P_{out} = f_o (P_{in})$$

$$P_{dc}= f_c(P_{in}) \ldots\ldots\ldots\ldots\ldots\ldots[14]$$

Both the above function are strictly increasing function of Pin and the difference between the consumed power to drive the power amplifier and the desired output power of the power amplifier is equal to the heat loss in the power from the power amplifier of the transmitter on each node i.e. Ph= Pdc - Pout.. Here Ph is considered to be constant [14]. Also the simplifier power amplifier is considered with the following expressions:

$$f_o (P_{in}) = \rho P_{in}, 0 < P_{in} < P_1$$
$$P_{SAT}, P_1 < P_{in} \leq P_{max}$$
$$f_c (P_{in}) = f_o(P_{in}) + P_h \text{ ....[14]}$$

where ρ and P_h are constants. Also it is considered that $P_{max} = P_1$. The values for the constant are ρ=50(17) dB, P_1=1.5 mW,

IV. LOAD BALANCING USING CROSS LAYER

A. Cross Layer:

Cross layer is the technique of using the parameter of one layer on the other layer and then using that parameter to optimize the working of routing protocols. In our technique, we are using the technique of load balancing at cross layer. In this, we have generated the values of transmission at physical layer and this value is then transferred to network layer where this is used for efficient routing. This is termed as cross layer implementation. Fig. 8 shows the clear implementation of cross layer between the physical and the network layer. The cross layer allows multiple decision support during routing which optimizes the performance of routing which was earlier carried without any dynamic routing decisions.

B. Load Balancing:

The load balancing is the term of managing the traffic in transmission process efficiently such that the network structure do not enter in the dead state i.e. state of no transmission or delayed transmission. For load balancing consider the Figure. 9.

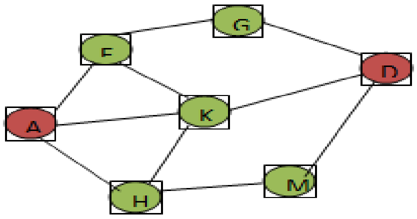

Figure 8

Figure.2 shows the nodal arrangement for ad hoc network. The path is shown to depict the clear joining between the various nodes. Now consider, that data is to be transferred from node A to node D. suppose, that the path chosen for transmission is via K. Since this is the most efficient path, this will traversed more number of times until the whole data is transferred. But there is danger that the node K undergoes excessive data burden and thus might get into dead state as its energy might lowers due to excessive load. Thus to manage this, load balancing has to be implemented which is easily carried out using load sharing with ratio 1:1. Thus, the simultaneous paths such as A-F-G-D or A-H-M-D can also be used to allow proper load balancing in ad hoc network.

C. Combining Load Balancing and Cross Layer (AODLB Protocol)

The two important techniques of load balancing and cross layer is integrated to design a new routing protocol AODLB i.e. Ad hoc on demand load balancing routing Protocol. This protocol manages the working of routing protocol in such manner that performance of the network is optimized to great extent. This protocol as works on cross layer thus, delays are also eradicated. The formula used for delay and efficiency calculation is explained below:

$$B_{k, CR} = {}_{i=1}\Sigma^{k} (d_i / d_{max})^{\eta \leq} \quad k$$
$$\gamma = E_{tx} d_e^{-\eta} / N_o$$
$$\gamma_c = (E_p + P_h Ts) d_e^{-\eta} / N_o$$
$$\mathbf{E_{eff} = R_{eff} / \text{ʍ} (B_{k, CR} . \gamma / k + \gamma_c)}$$

Where k is the number of hops, γ is the signal to noise ratio, γ_c is the efficiency constant, N_o is the noise power spectral density that depends upon the type of physical transmission, E_{tx} is the transmitter energy, E_p is the receiver processor energy, Reff is the effective energy rate i.e. bandwidth, is mobility and E_{eff} is the modified energy efficiency.

$$\mathbf{Delay = 1 / (link\ speed)((Np - N_t) + (D_I - 1))N}$$

Where link speed is the actual bandwidth for transmission between the receiver and the transmitter and N is the number of nodes and the N_t is the number of retransmissions, Np is the packet size and D_I is the average delay that is measured taking into account the ideal conditions for transmissions and its value is computed to be 6 bms.

V. MULTIPATH ROUTING PROTOCOL COMPARISON WITH RESPECT OF LOAD BALANCING

In this section each of the protocols described in section 2 will be compared with that list of properties.

a) The routing protocol must provide multiple complete paths to destinations.
b) The routing protocol must provide loop-free paths to destinations.
c) The routing protocol should preferably provide node-disjoint paths to destinations.
d) The multiple paths need to be used simultaneously for data transport.
e) Routes need to be completely known at the source.
f) For each route the QoS metrics must be known (Delay).
g) Basic implementation of the protocol needs to be available

Table 1: Comparison of Routing Protocols on various parameters

	DSR	**AODV**	**LBAODV**	**AOMDV**	**LBAOMDV**	**AODLB**
Multiple Complete Path	YES	YES	YES	YES	YES	YES
Loop Free Path	YES	YES	YES	YES	YES	YES
Node Disjoint Paths	YES	YES	YES	POSSIBLE	YES	YES
Complete Route Known	YES	NO	NO	NO	NO	YES
Delay Known	NO	NO	NO	NO	YES	YES
Path Used Simultaneously	NO	YES	YES	YES	YES	YES
Implementation	DSR	AODV	AODV	AODV	AODV	AODV

a. Protocols provide multiple complete paths from source to destination:

All the Protocols are provided Multiple Complete path from source to destination. As Shown In Table 1.

b. Protocol should preferably provide loop-free paths:

All described protocols provide loop-free paths from sources to destinations. The source routing protocols, DSR, all have the complete routes included in the packet headers, so it is easy to detect and remove loops. In the case of AOMDV and AODV, it is done differently. AODV uses sequence numbers to avoid loops, while AOMDV uses the notion of advertised hopcount to avoid loops.. It use directed a-cyclic graphs to establish loop-free routes. In LBAOMDV & AODLB Protocol a new field is added i.e. Buffer Size for Loop Free Paths.

c. The protocol must provide node-disjoint paths:

AOMDV do not always provide multiple node-disjoint paths. With AOMDV the paths could be node-disjoint, but only link-disjointness is guaranteed. A modification at the destination is needed to ensure node-disjointness in the paths.

d. The complete path information is known at the source:

The only protocols where complete route information is known at the source are the source routing protocols, DSR.With AODV, AOMDV, LBAODV, LBAOMDV & AODLB which are both distance vector protocols, only the next hop to the destination is known.

e. The delay of each path is known:

LBAODV and LBAOMDV are the protocols that use the delay of each path in some way. It uses the delay of each path to distribute traffic along these paths. This is done in such a way that paths with smaller delay will get more traffic.

f. The multiple paths are used simultaneously:

AOMDV, LBAODV, LBAOMDV and AODLB are the protocols that provide multiple complete paths from a source to a destination. In AOMDV and TORA there is only one route (mostly the shortest route) used for data transport, the others function as backups for when the primary route fails.DSR is only one protocol in which only the primary path is known from source to destination. There is no secondary path for transferring the data.

g. A basic implementation must be available:

It is required that a basic implementation of the routing protocol exists. Fortunately this is the case for all described protocols. The AOMDV, LBAODV, LBAOMDV and AODLB protocols are based on AODV.

VI. SIMULATION RESULTS AND ANALYSIS

With the aim to evaluate the routing protocol such as AODV, LB-AOMDV & AODLB. The variation effect on the following metrics:

a) Packet Delivery Ratio (PDR)
b) Average end to end Packet Delay (APD).
c) Average Buffer Size (ABS).
d) Traffic Over Head (TOH).

e) Parameters for Evaluation:

In this I will take same parameters which can be taken in table. Simulations and the validation of the system the following parameters have been chosen by NS 2 Simulator.

Table 2: Simulation Parameters

Parameter	Value
Dimensions	1000X1000 sq. m.
Number of Nodes	30
Simulation Time	300 s
Source Type	CBR
Number of Connections	10
Packet Size	512 bytes
Mac Layer	IEEE 802.11 b
Buffer Size	50 packets
Propagation Radio Model	Two Ray Ground
Physique layer	Band width as 2 Mb/s
Maximal Speed	10 m/s
Pause Time	10 s
Interval Time To send	2 packets /s

A. Performance Metrics Result:

Table 3.Our Simulator results

Parameters	**Improvement**
Transmitter Energy	45%
Receiver Processing Energy	45%
Energy Efficiency	50%
Bandwidth Efficiency	50%
Delays	Reduced By 70%
Working Efficiency	85%
Link Reliability	65%
Network Reliability	Adaptive

B. Graphical Analysis:

The graphical analysis is carried out by comparing the trace file of the newly designed and previous version of protocol. The comparison is carried out by use of files present in the x graph of NS-2. The graphs taken by us are as follows:

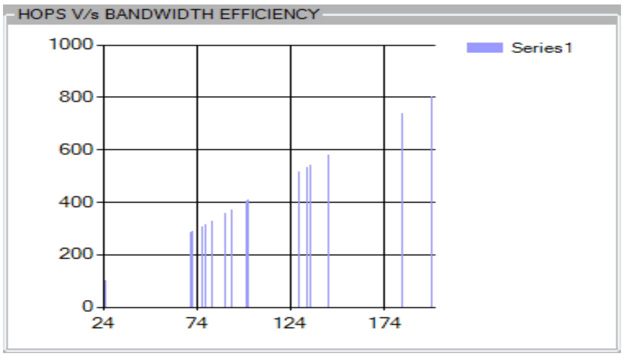

Figure 9 Relation between the bandwidth efficiency and hops

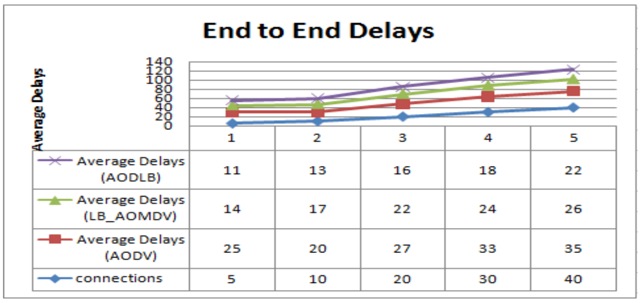

Figure 10 is the relation between the bandwidth efficiency and hops of AODLB routing protocol.

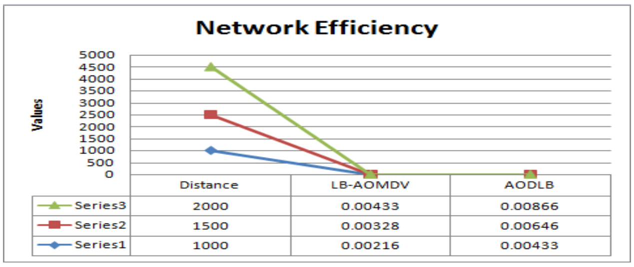

Figure 11 Network efficiency comparisons between AODV, LBAOMDV & AODLB

Fig11 shows the network efficiency comparison between the AODV before use of AODLB and after user of AODLB. There has tremendous improvement in the life time of the network on use of our proposed algorithm

C. Traffic overhead versus the network load:

Fig 16 shows the overall improvement in efficiencies of AODLB routing protocol as compared to LB-AOMDV and AODV protocol as network overheads decreases tremendously in AODLB.

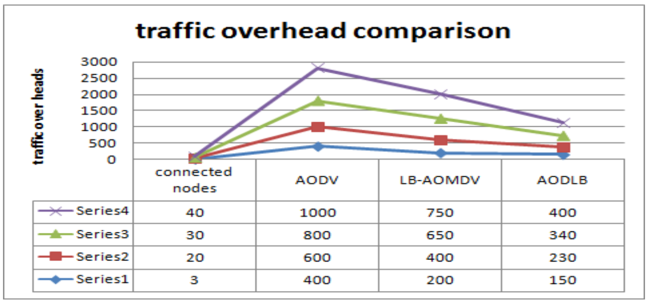

Figure 12 Traffic overhead versus the network load

D. Success packet delivery ratio versus the network load:

Fig17 shows the comparison analysis of the AODLB protocol with the AODV and LB-AOMDV routing protocol. There has been improvement of more than 15% in case of packet delivery ratio.

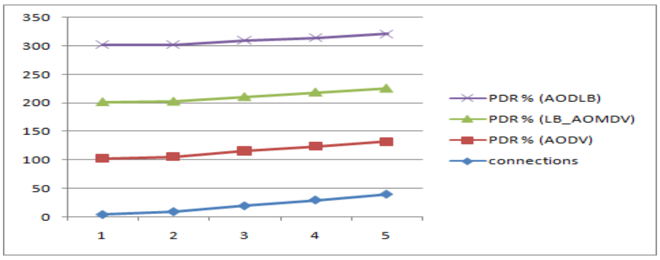

Figure 13 Packet delivery ratio versus the network load

E. Average end-to-end delay versus the network load:

Fig 18 shows the comparison of the average end to end delays that shows the improvement of 5 percent for AODLB as compared to LB-AOMDV.

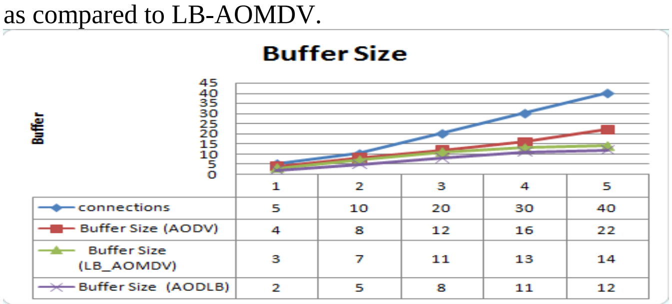

Figure 14 Average end-to-end delays versus the network load

F. Traffic overhead versus the network load:

Figure 19 shows the improvement of 5 % for buffer size in case of AODLB as compared to LB-AOMDV.

The above result shows that the multipath routing protocol AODLB is better than other multipath routing protocols. i.e. AODV & LBAOMDV in terms of capacity and congestion level.

VII. CONCLUSIONS

On-demand multipath routing protocols achieve lower end-to-end delay, routing overheads and higher goodput under certain scenarios when compared to traditional single-path routing protocols. An ad hoc network is comprised of mobile hosts without any wired infrastructure support. Multipath routing allows the establishment of multiple paths between a source and a destination. it distributes traffic among multiple paths instead of routing all the traffics along a single path. in this paper, authors propose multipath routing protocols that uses all discovered paths simultaneously for transmitting data, by using this approach data packets are balanced over discovered paths and energy consumption is distributed across many nodes through network. The multipath routing protocol with load balancing provides a solution for the congestion network and increases its capacity. To consider that the use of multiple paths simultaneously for transmission data allows improving the network performance, In this Paper AODLB Protocol achieve better load balancing mechanism in terms of PDR, End to End Delays, ABS & TOH than AODV & LBAOMDV.

VIII. REFERENCES

[1]. Networks",IEEE Communications Magazine , August 2009, pp 78-84

[2]. Maysam Hedayati, Hamid reza hoseiny, Seyed Hossein Kamali, Reza Shakerian, " Traffic Load Estimation and Load Balancing in Multiple Routing Mobile Ad Hoc Networks", 2010 International Conference on Mechanical and Electrical Technology(ICMET 2010), 2010 IEEE, pp 117-121

[3]. Amir Darehshoorzadeh , Nastooh Taheri Javan, Mehdi Dehgan, Mohammad Khalili, " A New Load Balancing Multipath Routing Algorithm for Mobile Ad Hoc Networks", Proceedings of IEEE 2008 6th National Conference on Telecommunications and IEEE 2008 2nd Malaysia Conference on Photonics, 26-27 August 2008, Putrayaja, Malaysia, pp 344-349

[4]. Mohamed Tekaya,Nabil Tabbane, Sami Tabbane, " Multiple Routing Mechanism with Load Balancing in Ad Hoc Networks",2010 IEEE, pp 67-72

[5]. Shouyi YIN, Xiaokang LIN , " MALB: MANET Adaptive Load Balancing', 2004 IEEE, pp 2843-2847

[6]. Aakanksha , Punam Bedi, " Load Balancing on Dynamic Network Using Mobile Process Groups", 15th International Conferences on Advance

Computing and Communications, 2007 IEEE, pp 553-558

[7]. www.monarch.cs.cmu.ed

[8]. Sunil Taneja, Ashwani Kush,"A Survey Of Routing Protocols in Mobile Ad Hoc Networks "International Journal Of Innovation, Management and Technology, Vol. 1,No. 3,August 2010 ISSN:2010-0248

[9]. Zhang XiangBo, Ki Il Kim, " Load Aware Metric for Efficient Balancing on Multipath DSR Protocol in Mobile Ad Hoc Networks", 2008 International Conference on Advance Technologies for Communications, 2008 IEEE, pp 395-398

[10]. Mehdi EffatParvar, MohammadReza EffatParvar, Amir Darehshoorzedeh, Mehdi Zarei, "Load Balancing and Route Stability in Mobile Ad Hoc Networks base on AODV Protocol", 2010 International Conference on Electronic Devices, System and Applications(ICEDSA2010), 2010 IEEE, pp 258-263

[11]. Mohamad Tekaya, Nabil Tabbane, Sami Tabbane,"Multipath Routing with Load Balancing and Qos in Ad hoc Network" ,IJCSNS international Journal of computer science and network security, Vol 10 no 8, August 2010,pp 280-285

[12]. Chai Keong Toh, Anh Ngoc, You Ze Cho, " Load Balanced Routing protocols for Ad Hoc Mobile Wireless , 2009

[13]. Networksimulator-2 www.isi.edu

[14]. http://www. csi.uoregon.edu.

