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Performance Analysis of DSR in MANET using Optimized Branch and Bound Algorithm

P.Ponmuthuramalingam, S.Sasikala

Abstract: ***Mobile Adhoc NETwork (MANET) is a compilation of autonomous and arbitrarily located movable nodes forms an shemaless network. Nodes in MANET are dynamically changing in nature. MANET has different kinds of routing protocols. In this work MANET's reactive Dynamic Source Routing (DSR) protocol is developed with the Branch and Bound (BB) algorithm to obtain a possible feasible elucidation with greater optimality. Branch and Bound Algorithm is mainly applicable for obtaining the optimal solution. In this paper, DSR protocol is evaluated with the proposed approaches namely, DSR with BB in MANET and DSR with Modified Branch and Bound (DSRMBB) is analyzed. Simulation metrics namely End to End delay, Packet Delivery Ratio (PDR), Routing Overhead, Throughput, Network Lifetime and Nodes energy were compared to evaluate their performances. From the observation, proposed work DSRMBB performs well. Performance metrics like Network lifetime, Nodes Energy and throughput has increased in considerable amount when comparedto the traditional DSR protocol.***

Keywords: MANET, Modified Branch and Bound, Optimization, State space search, DSR protocol.

I. INTRODUCTION

MANET is a recline of transportable nodes that are fixed via wireless channel which further extended for the interchange of information. Transmission acts upon a channel that is supervised by the central station [1]. Random displacement of node may result in loss of connection and variation in transmission [2]. Deployment of MANET is a effortless process that can extend to applications likely in armed forces, transmission medium in battleground, and calamitie rescue. The protocols in MANET are segregated into:

(i) Proactive or Table driven routing protocols [3]

(ii) Reactive or On demand routing protocols[3].

DSR protocol is one of the examples of Reactive or on-demand protocol in MANET.

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* Correspondence Author
Dr.P.Ponmuthuramalingam*, Principal, L.R.G. Government Arts College for Women, TIRUPUR-641 604 Tamilnadu.
Mrs.S.Sasikala , Assistant Professor, PG & Research Department of Computer Science**,** Hindusthan college of arts and science, Coimbatore.

Over a decade, MANETS had shown a enormous growth in popularity and having the capability to offer instant wireless networking solution where no pre-deployed schema exists as MANET is a infrastructure less environment. Cellular phones and laptos act as a nodes in the MANET which are clustered together and frame a network. In the situation of network grouping services like exchange of resource, files and messages are established. The key purpose of MANET is establishing speedy as well as efficient unicast or multicast channel across the nodes which enable consistent communication. Routing scheme may leads to shortening of battery life. Proficient routing enables Though, MANET faces numerous confronts [4]. The topology of the network suffers from vibrant variation while transmitting the data. Dynamic environment may lead the node connect or run off from the network randomly. The situation is unpredictable due to the movement nature of the nodes.In MANET, consistent and proficient service cannot be make sured all the time. The formulation of efficient protocol may ends in a resource maintenance and assuring consistent network channel. The increasing handheld devices and the needs of efficient network led the establish of ad hoc network. Protocols can establish the communication through best route by considering certain parameters of transmission channel. Single cannot take up the incharge of administration due to energy constraint. Thus, routing is considered to be a tedious task in MANET. Formost routing approach in ad hoc networks is the on-demand routing method. In the on-demand proactive protocol, they exchange periodical messages for route maintaining as protocol's routingtable is full of topology. It develop routes along the nodes which are placed in the transmission channel. Oberhead is minimized and the information in the routing table is utilized properly [5,6,7].

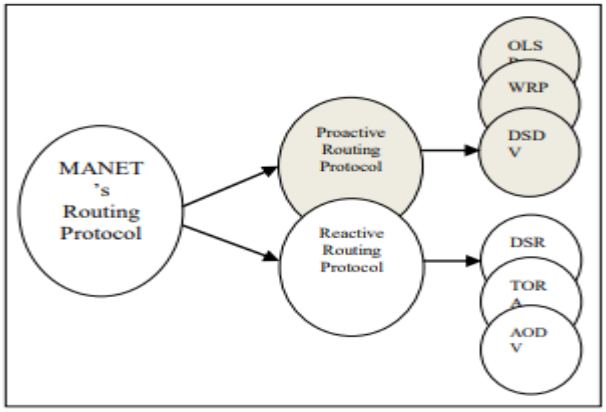

Figure 1. Types of MANET protocols

Every transmission session utilises single path for the data exchange. The bandwidth of the network communication pairs, their response to blocking, burst traffic,

and delivery consistency are maintained [5,6].

In order to attain Quality of Service in routing along networks, multipath routing has been developed widely in the society [7, 8]. Multipath routing incorporates table-driven algorithms to estimate various routes in the deployed network. Studies shows that DSR perform poorly in MANET because of disproportionate routing overhead in them when compared to reactive protocols [9, 10].

II. BRANCH AND BOUND ALGORITHM

The searching process can be improved and solved analytically which is called as BB algorithm. In BB approach all the candidate solutions are enumerated in order to eliminate the obviously impossible solutions. BB algorithm focuses on the problems with possible and finite number of solutions that are represented as sequence of options. BB is similar to backtracking approach and uses the state space tree for solving the problem.BB algorithm is mainly used for solving the optimization problems. Optimization is a technique used for obtaining definite solution for optimal problem which is used for obtaining maximum or minimum solution for the defined set of problem. In the BB algorithm, only minimizes the problem solution [11]. BB is not suitable for the maximization problems and to use the same for maximization problem, maximization problem can be converted to minimization problem.BB algorithm is comprised of two stages, first one is branching and requires several choices to be done to branch out in to them to solution space. By performing, the solution space is arranged as a treelike structure [12 and 13]. The construction of tree is based on the method of breadth first search. The solution space may be too vast to traverse in those cases the problems were handled using the method Bounding. Bounds set the quality value for the solution that is it set the route length for the solution. Bounding is considers as one of the essential concept of the algorithm BB. Job sequencing problem is discussed with three possible branching methods they are,

- FIFO-BB (Queue based First Come First Served)
- LIFO-BB (Stack Based Last In First Out)
- LC-BB (Least Cost BB)

In the back tracking strategy it considers only the next level of the tree that is the child node but in BB it also considers the next parents for the exploration of the solution space in the tree. The search of the tree is based on the technique of the Breadth first search for the exploration of the solution space for the problem.

To find the optimum solution for the job sequencing problem the above mentioned methods were used for the exploration of the solution space. The following figure 1 shows the construction steps for state space tree with different methods.

Example: Job Sequencing Job: {w1, w2, w3, w4}

Suppose job one and job four is done, then the solution for the search space S is represented as S= {w1, w4}. This solution space is the subset of the job sequence. This is said as a variable size solution. In this type the number of solution may vary. In case job one is done, two and three is not done, four is done then the solution for the search space is represented as S= {1, 0, 0, 1}. This is called fixed size solution. But, in this number solution obtained is fixed in number. This method follows the strategy of representing zeros and ones.

Construction of State Space Tree

In this type of tree construction traverse starts at first job then in backtracking it considers next job levels but here in BB second job is also considered and the traverse will move on to the next jobs. After completing the level one jobs search will goes to the next levels for searching the solution.

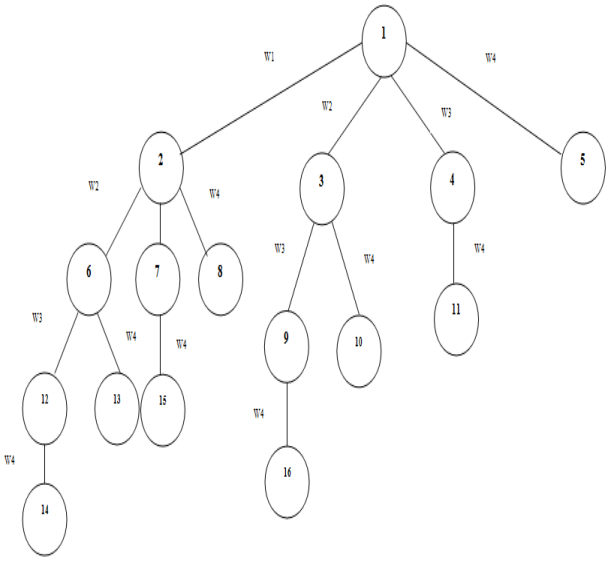

Figure 2: Job sequencing using BB

This is the state space search tree for the solution S = {w1, w4}. It is like breadth first search. It considers all the next levels of job to traverse. From the first solution w1 it is found that it has the possibility of w1, w2, w3. Again branching is extended from this solution to reach the optimal solution of expectation.

III. DSR PROTOCOL

The DSR protocol is called as Reactive protocol which is a uncomplicated and proficient routing protocol in MANET. This is mainly deployed in the multi-hop wireless MANET which is organized and configured by its own. It does not require any kind of administrator to look over this to monitor them. As it is proactive it is used to send the packets. DSR uses source routing that the source must know the complete hop sequence that is from source to the destination [13, 14, 15, 16, and 17].Each node preserves path cache information where all paths that DSR knows are accumulated that is previously routed route is accumulated in the path cache information. Discovery process of the route is commenced only if the preferred path information will not be located in the path cache information. Initially, node processes the route request to check whether the route is already routed via the same or any route history is available in it or not, to limit the number of route requests propagated throughout the network. DSR is completely based on the source routing mechanism, as mentioned earlier in this section. Routing overhead has to be carried by every packet, it is known to be a negative consequence of this method of routing. However, one main benefit is that intermediary nodes can learn routes from the source routes in the packets they receive.

Nodes carry the information along with itself [18,19,20].

DSR is composed of two mechanisms they are;

- Route Discovery
- Route Maintenance

All the aspects of the protocol works completely based on "on demand". It allows the routing packet overhead to scale automatically and react to changes in the routes that are currently in use, only the times of necessity.

IV. PROPOSED ALGORITHM

DSRMBB Algorithm:

DSR in MANET having the ablity to cope in the active network without any periodic table that is implicated to update the messages whereas table-driven routing protocols establish the same. Multihop wireless MANET is efficiently handled by the distinctively designed DSR protocol. DSR doesn't require any pre-designed infrastructure or administration in the network. DSR protocol is used to improve the routing discovery path in the MANET.

A BB algorithm is an optimization technique to acquire an optimal solution for the problems with possible solutions. In this work, Improved BB algorithm is used with DSR protocol. BB algorithm is used for exploring the routing path using the maximum energy value. Improved BB algorithm is finds the steering path with the maximum and minimum energy value to attain efficient throughput, pdr, network lifetime, delay, overhead.

Procedure for DSR Protocol with Modified Branch Bound in Algorithm:

Node generation

Generate the variables and initialize them in MANET. Hence, calculate the performance of MANET by considering the idle energy consumption during the bounding. Sequence of tree nodeswith the size of n (n+1)/2 is generated which is represented as S and all the involved jobs with the size of n.

x = value of x node

y = value of y node

src = source node

dst = destination node

source node destination node distance calculation

$$Src_{distane} = \sqrt{((x - So\,(x))^2 + ((y - So\,(y))^2} Dst_{distane} = \sqrt{((x - Des\,(x))^2 + ((y - Des\,(y))^2}$$

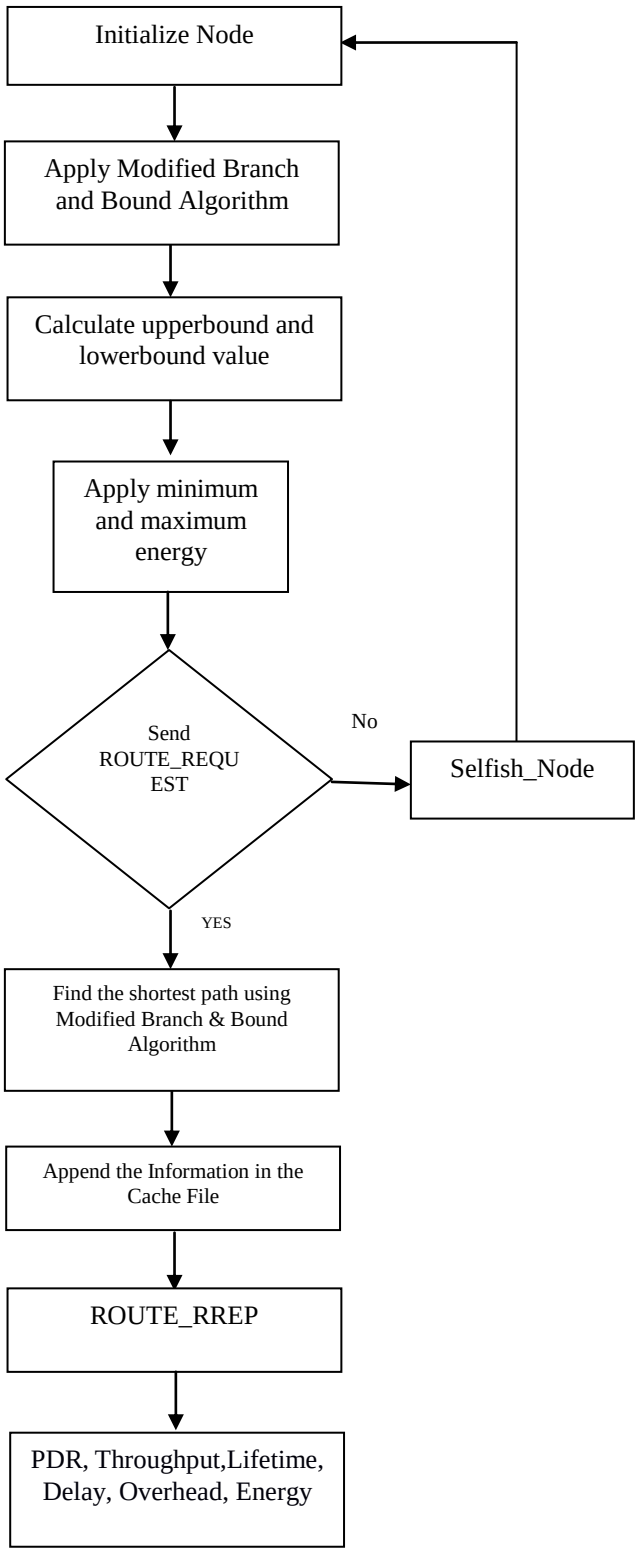

Figure 3: Flowchart for the algorithm DSR with Modified BB in MANET

Tree generation

Calculate the lower bound value for all the nodes in S by calling the relevant bounding procedure and arrange them in a non decreasing order. Traverse the all the new nodes. If the lower bound of current new node is smaller than global upper bound then it is ignored.

$CT_{current} = Erg$: {Current node energy value}
$Ttl_{total} = \sum N_i \; i \in \{0, \ldots, N\}$ N- No of nodes: {Total node energy value}
For loop $CT_{current} < Ttl_{total}$
Store the current nodes value
End loop
$CT_{Hcurrent}$ = Max: {current node highest energy value}
$Past_{Hcurrent}$ = Max: {Past node highest energy value}
$CT_{Lcurrent}$ = Max: {current node lowest energy value}
$Past_{Lcurrent}$ = Max: {Past node lowest energy value}

Bounding

The lower bound value of the current node is calculated to find the attacker node or selfish node. Maximum energy value is assigned to the upper bound node which is larger than lower bound. If the energy value of lower bound is higher than the upper bound thenreplace the upper bound value with the lower bound of the current node to obtain an optimum solution.Flag value is meant to find the attacker node.

$Fg_{flag} = min$: {Set flag Value}
If
$CT_{Hcurrent} == Past_{Hcurrent}$ &&
$CT_{Lcurrent} == Past_{Lcurrent}$&&$Fg_{flag} == min$
Break the path so change the branch
Else
Choose optimal path to send the packets

Terminating

Branching procedures are initiated to find the optimal route. After the process completion termination is processed to end up the routing.

VI. SIMULATION ANALYSIS

In order to predict the simulation behaviour of the Network Simulation software is used which is called as Network simulator (NS). These are used in identifying the network behaviours by considering the performance metrics of the protocol [21, 22, 23]. In this section some of the performance metrics were compared with the newly designed DSR with Modified BB in MANET. Performance metrics used for comparison are,

- Average End to End Delay
- PDR
- Network Lifetime
- Nodes Energy
- Routing Overhead
- Throughput

Simulation Parameters

Table 1. Simulation parameters

Property	Value
Coverage area	1000 x 1000 m
Number of nodes	60
Simulation Time	1000sec
Traffic Type	UDP – CBR
Pause Time	0,5,10…
Number of nodes	50, 100, 150…
Transmission range	200 m

Average end-to-end Delay:

Time taken to deliver the packet from source to destination and the packet get delayed to transmit over network is called routing delay.

$$EndtoEndDelay_{kpac}=starttime_{kpac}-endtime_{kpac}$$

Where kpac is the start time when sending the packet pack at node k and end-time kpac, is the time when packet pac is send by node k is received successfully at destination node.

PDR:

Packet Deliver Ratio is the ratio of the data packets delivered correctly to the destinations. PDR is useful for calculating the packet loss.

$$Packet\ Delay\ Ratio = \Sigma\ Receive\ Packet / \Sigma\ Sent\ Packet$$

Nodes Energy:

Energy symbolizes the capacity to alive over the network in a period of time. During ebvery transmission node loses its energy.

$$Nodes\ energy = Current\_Erg - Initial\_Erg$$

Network Lifetime:

The capability of the nodes to observe the concerned phenonmena over a period of time.

$$Lifetime = 100 - \Sigma Ai$$

$$\Sigma Ai \text{ - Average of energy}$$

Routing Overhead:

The ratio of the total number of the data packets transmitted from the source to destination while routing is increased which results in data traffic. This situation is called routing overhead.

Routing Overhead = rtpkt – rcpkt===(Routing packets Count)

rtpkt - received routing data in the transmission

rcpkt - received data in the transmission

Throughput:

Throughput is the number of received packets successfully at the recipients side in a precise and it is represented in bps of unit.

Average throughput= Sum of packets successfully delivered-Total number of packets/Transmission time

a).Average Delay

Table 2. Average End to end Delay vs Pause Time

Pause Time	DSR	DSR With BB	DSR With MBB
50	9.8456	9.7847	9.684
100	9.8012	9.7668	9.6665
150	9.7354	9.7648	9.3659
200	9.3204	9.2464	9.235

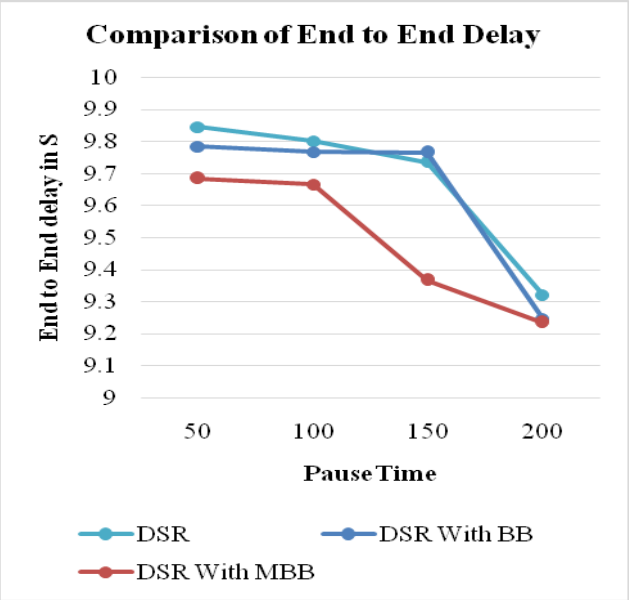

Figure 4. Pause Time Vs End to End Delay

Above figure shows that the delay time for DSR with modified BB is lower than the other protocols it shows that the transmission delay among the node is reduced considerably. In the graph at the initial stage all the nodes are at inactive state when the transmission initiated node start's to transmit the data to the neighboring nodes transmission delay is reduced for every node with the help of the improved algorithm.

b). PDR

Table 3. PDR vs Pause Time

Pause Time	DSR	DSR With BB	DSR With MBB
50	9.4045	9.5609	9.6261
100	9.4784	9.5783	9.6435
150	9.4871	9.5803	9.6515
200	9.8471	9.9646	9.976

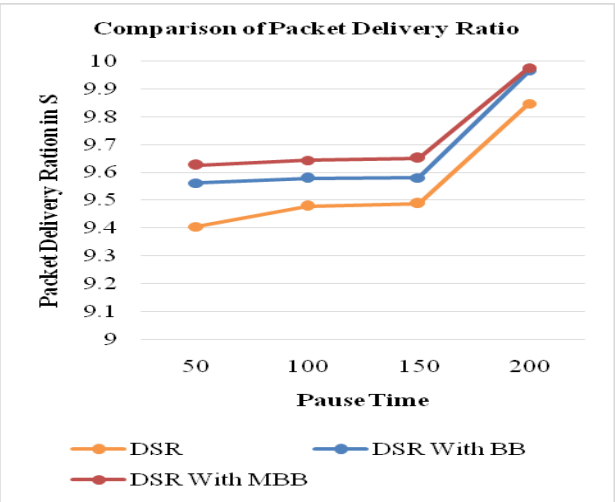

Figure 5. Pause Time Vs PDR

The above figure shows that the PDR for DSR with modified BB is higher than the other protocols which show the flawless data transmission. In the graph at the initial stage all the nodes are at inactive state when the transmission initiated, node transmits the data to the neighboring nodes. Transmission of data occurs among the nodes and the packet drop is also reduced in the transmission network.

c). Network Lifetime

Table 4. Network Lifetime vs Pause Time

Pause Time	DSR	DSR With BB	DSR With MBB
50	9.5314	9.4861	9.5762
100	9.6541	9.5034	9.5936
150	9.6784	9.5053	9.6015
200	9.9845	9.9646	9.976

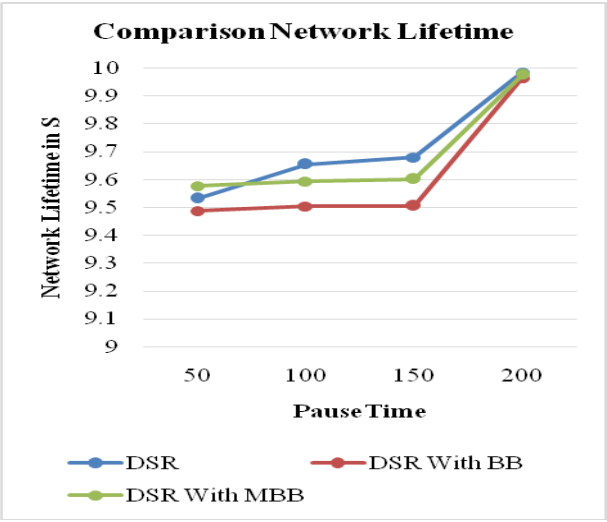

Figure 6. Pause Time Vs Network Life Time

The above figure shows that the Network Lifetime for DSR with modified BB is increased when compared to the other protocols that are the longevity of network life. In the graph at the initial stage all the nodes are at inactive state when the transmission initiated node start's to transmit the data to the neighboring nodes. The lifetime of the node is increased in the proposed approach called DSR with MBB.

d). Nodes Energy

Table 5. Nodes Energy vs Pause Time

Pause Time	DSR	DSR With BB	DSR With MBB
50	9.8124	9.7746	9.674
100	9.8031	9.7568	9.6565
150	9.7864	9.7548	9.3562
200	9.3521	9.2454	9.235

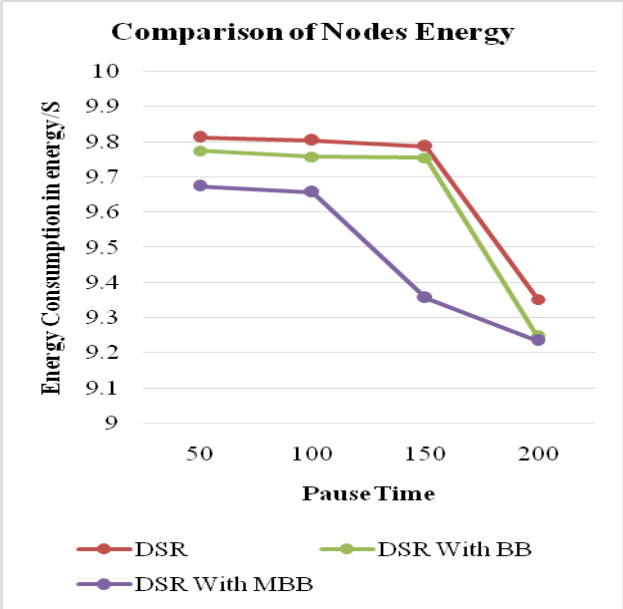

Figure 7. Pause Time Vs Nodes Energy

The above figure shows that DSR with modified BB performs well than the other protocols that are loss of nodes energy during data transmission is reduced. In the graph at the initial stage all the nodes are at inactive state when the transmission initiated node transmits the data to the neighboring nodes. During the data transmission the energy loss occurs in every node and energy loss is reduced in the proposed approach DSR with MBB.

e). Routing Overhead

Table 6. Routing Overgheadvs Pause Time

Pause Time	DSR	DSR With BB	DSR With MBB
50	9.8784	9.7646	9.6639
100	9.8541	9.7468	9.6465
150	9.8021	9.7448	9.3465
200	9.2012	9.2444	9.235

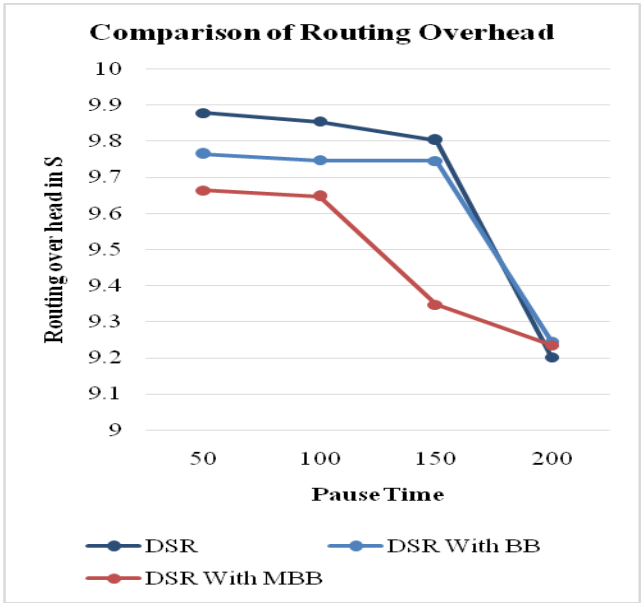

Figure 8. Pause Time Vs Routing Overhead

Above figure shows that the Routing Overhead for DSR with modified BB is decreased when compared to the other protocol that isLower range of Routing Overhead incurs the efficient performance.In the graph at the initial stage all the nodes are at inactive state when the transmission initiated node start's to transmit the data to the neighboring nodes and the routing overhead is reduced in the entire transmission state.

f). Throughput

Table 7. PDR vs Pause Time

Pause Time	DSR	DSR With BB	DSR With MBB
50	9.4561	9.5958	9.676
100	9.5143	9.6133	9.6935
150	9.3451	9.6153	9.7015
200	9.8132	9.9646	9.976

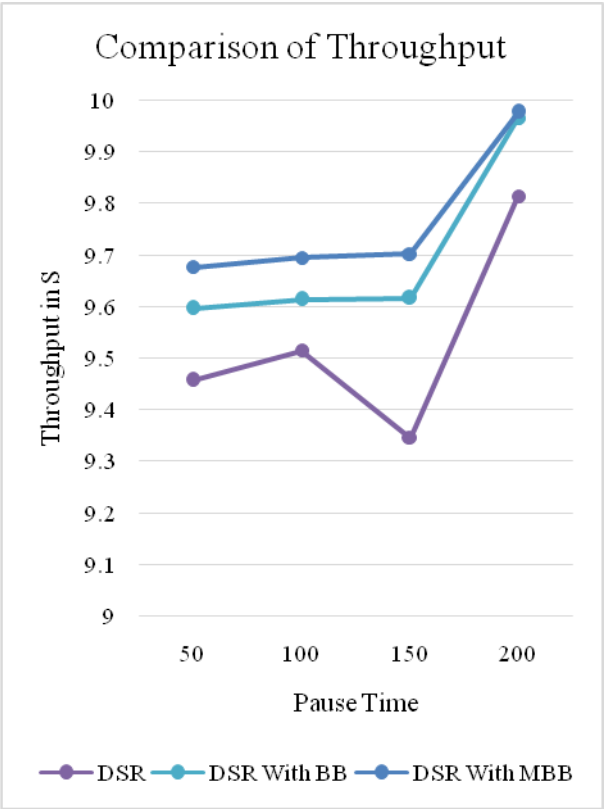

Figure 9. Pause Time Vs Throughput

Above figure shows that the throughput for DSR with modified BB is increased when compared to other protocols. In any network higher throughput is most essential factor for best performance. In the graph at the initial stage all the nodes are at inactive state when the transmission initiated node start's to transmit the data to the neighboring nodes and for every transmission the data from one node to the other rate of throughput is increased in newly designed algorithm when compared to the existing approaches.

VII. CONCLUSION

In this paper proposed a new method called DSR with Modified BB algorithm for MANET. It is a newly designed algorithm for routing the packets along the network. In order to meet the factors like fault tolerance, Quality of Service and low energy consumption. Performance metrics of DSRMBB were compared with the existing algorithm. From the observation of comparison, it is observed that the DSRMBB algorithm executes better. The performance metrics like, PDR and Throughput values increased. This states that the loss of packets during the transmission is reduced in a good amount. The performance metrics like Delay time and routing overhead values reduced this represents that the propagation path is optimal. From this experimental study, it is found that DSRMBB algorithm works better for MANET. The performance of DSR protocol is improved with the help of optimized BB algorithm.

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AUTHORS PROFILE

P.Ponmuthuramalingam received his Master Degree in Computer Science from Alagappa University, Karaikudi in 1988 and the Ph.D. in Computer Science from Bharathiar University, Coimbatore in 2010. He worked as Associate Professor and Head in Department of Computer Science, Government Arts College (Autonomous), Coimbatore. Now he is working as a Principal in LRG Government Arts College, Tirupur. His research interest includes Text mining, Semantic Web, Network Security, and Image Processing.

S.Sasikala received her Master Degree in Msc (Cs) from Maharaja College of Arts and Science in 2004 and Received her Master of Philosophy in Computer Science under Bharathiar university in 2008 Presently Pursuing her PhD in Computer science, L.R.G. College Tirupur. She had published various journals in the area of Mobile Adhoc Networks under UGC Journal list. She focuses her research on Mobile Adhoc Network and its applications.