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# An Energy Compaction using Optimized DSR and Branch and Bound Algorithm in MANET

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***Abstract:***
Mobile Ad-hoc Network (MANET) is used for wireless communication, in that mobile nodes forms a communication without infrastructure. In the wireless communication, Routing has been the most decisive area of research in ad hoc network. The prominent type of MANET protocol is DSR protocol. Dynamic Source Routing (DSR) is used for the effective route discovery. The DSR protocol is incorporated with Branch and Bound algorithm for the optimal route discovery. The proposed algorithm, Modify DSR with Modify Branch and Bound aims at increasing the energy utilizing level in Discover Routing, Packet forwarding and Collision avoidance. It helps to progress the efficiency of the energy level in MANET. One of the chief impact of this research work is to ensure Packet forwarding with efficient utilization of Energy attributes in MANET. Performance metrics like End to end Delay, Packet Delivery Ratio (PDR), Nodes Energy, Network Life time, Routing Overhead and Throughput has used for the evaluation of performance of the proposed algorithm.

***Keywords:*** *Dynamic Source Routing protocol, Congestion Control, Energy utilization, Branch and Bound algorithm, MANET.*

## I. INTRODUCTION

MANET is a wireless networks and the construction of the network changes recurrently as the nodes that the node forms network are not fixed. In order to route packets in MANET, a great number of protocol designs have been developed. Major concern that needs the most consideration is security concerns in MANET. There are a variety of MANET applications in various areas such as vehicular control, law enforcement operations, and disaster management which requires secure transmission of data. Better security is achieved by deploying intrusion detection systems with each node forming the network. There are many successful intrusion detection techniques that are all used in MANET. It is a self-directed collection of various mobile users. As the nodes are roaming and the scheme of the topology vary accordingly [1]. MANETs find various applications like social networks, intelligent transportation systems, emergency deployment, military applications, etc. In a MANET, nodes move freely around while transmitting the information with each other [2].

Even though it has lot of positive views, the security issues in MANET are the primary risk to concern and rectify. MANET's are more susceptible to various attacks than wired network [3]. The significant advantages of MANETs are multi hop, infrastructure less data transmission framework etc., makes it as a best medium of networks for data transmission [4]. Generally, there are many attacks occurred among nodes in MANETs.

In the reactive type of routing node desires to send the data from one node to another. The establishment of connection is attained to transmit the data in a effective way [5, 6]. The two significant processes carried in on-demand routing are,

*Route Discovery:* The route cache is maintained by every transmission and it is checked for further transmission. The spotting of desired route is achieved by broadcasting the data to all the nodes and the relevant path is spotted from the discovery process [7].

*Route Maintenance:* The breakage of links and the failure of data transmission are occurring during the routing. The breakdown of the link is rectified by the proper maintenance of routes along the network [8].

Some of the other prominent aspects of DSR protocol are,

*Fault tolerance:* The transmission network is exposed to varied kinds of failures likely failure of nodes internally and the interfering of nodes that may result the huge loss of information. The loss of data is minimized by the effective protocol design.

*Energy Consumption:* The nodes resided in the transmission area are instilled with needed energy and the process of renewal of energy is not possible when the energy is exhausted [9,10]. Insufficient power supply to the nodes may result with poor network performance. The exhaust of power is minimized by the effective protocol design.

*Congestion Control:* It refers to the technique to control the congestion and keep the load below the limited capacity to transmission. The flooding of packet across the data channel is stated as congestion. The state of congestion is happened sue to the limited capacity of the network. Congestion control is an artefact that avoids the situation of data overflow or flooding and hence the situation congestion is avoided. The occurrence of congestion is avoided by the effective protocol design. So, efficient congestion control technique was implemented in order to prevent congestion in the transmission [11].

## II. Dynamic Source Routing Protocol

The DSR protocol permits sources to find out paths to any destination throughout the network. Before arriving at desired destination node, all the data packets of the source include an entire list of nodes which the packets must go through. Therefore, all nodes that advanced or listen in these packets may collect routing info for further use which reduces the delay. DSR protocol provides asymmetric links which assists the rapid network topology transforms. Furthermore, like AODV, DSR has a route finding process if a route is not set up it finds its path by itself. Source flood RREQ in the network and destination on receiving the first RREQ packet sends a RREP towards the source node. DSR provides on demand route conservation; hence no regular update packets are required for topology changes. Upon link failures, merely nodes that advanced packets through failed links must have accurate advertisements for routing [12, 13, 14].

Furthermore, DSR permits sources to obtain and reserve more than one path to a specific destination in a cache. When a link failure is informed midway nodes have the chance to choose another cached route [15, 16].

## III. Branch and Bound Algorithm

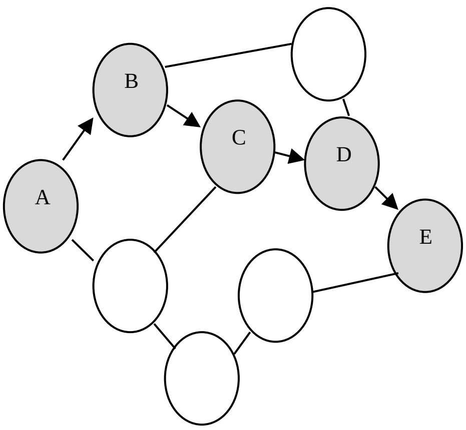
The progression is improved and can easily solve rationally. The tragedy of problem solving is called as Branch and Bound (BB) algorithm. In this approach all the candidate solutions are enumerated as a tree structure in order to eliminate the obviously impossible solutions in that tree. This algorithm focuses on the problems with possible number or finite number of solutions. They are represented as sequence of options and similar to backtracking approach. It uses the state space tree for solving the problem and finding the optimal solution. Branch and Bound algorithm is mainly used for solving the optimization problems. Optimization is a problem solving technique which is used for obtaining maximum or minimum solution for the defined set of problem. In the Branch and Bound algorithm, it only minimizes the problem solution space [17]. It is not suitable for the maximization problems. In order to use the same for maximization problem; maximization problem can be converted to minimization problem to solve.

Branch and bound is a renowned generic method for computing an optimal solution of single objective problems. Based on the idea of divide and conquer, it is viewed as a structure of search called tree search. Branch and Bound algorithm is comprised of two stages, first one is branching and it requires several choices to be done to branch out in to solution space. By performing this, the solution space is arranged as a tree like structure [18 and 19].

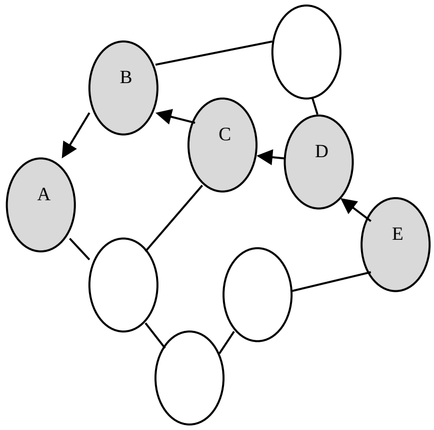
## IV. Proposed Algorithm

### Modify DSR Protocol and Modify Branch and Bound:

Dynamic Source Routing is used for route discovery. Branch and Bound algorithm is incorporated in to the DSR protocol to get an optimal route. In this work DSR and BB is modified to achieve the optimal route discovery. DSR avoids routing table maintenance and implements source routing. Incorporation of flow_ identification uses route maintenance and discovery process that uses hob by hop transmission. Route Reply is initiated at the situation of message has arrived at the reputed destination node. In the event of critical transmission, the maintenance of the transmission area phase is initiated whereby some of the Route Error packets are generated at a node. Flawless hops only are routed. If any flaw or error occurs, hop will be removed from the node's route cache. Again, the Route Discovery Phase is begun in order to determine the most viable route.




a).Route Request (RREQ)




b).Route Reply Propagation (RREP)

Figure 1. Data transmission in DSR

**Data Transmission Initiation:** Initially, source node transmits the data to the neighbour node. If a source node holds more than one neighbour then it will prioritize the route based on the acknowledgment received by the recipient node.

a = value of a node
b = value of b node
src_nd = source_node
dst_nd = destination_node
Distance estimation among the nodes

$$b - So_{nd}(b)\ ^{2}$$
$$b - Des_{nd}(b)\ ^{2}$$
$$a - Des_{nd}(a)\ ^{2} + a - So_{nd}(a)\ ^{2} + Src_{nd_{distane}}$$

### Branching Scheme

The exploration of the nodes starts at the node with null value that is root node which states the original problem that progress with 0 and initiates a new cycle. The progression searching is initiated at layer 0 with the node 0. Expansion of nodes are initiated from the layer 1 and assigned with the labels 1,2,...n+1. Every node in the tree constructs its own child. The progression of searching tree holds n+1 layers and f is the generated nodes.

Tree_gen_fun, g_f: $f^{*}$□$2^{f}$

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**Bounding Scheme**

Estimation of the lower bound is uncomplicated and easy process. The process of branch and the bounding procedures is initiated with simple procedure. Once the feasible solution found upper bound of the node updated.

$$obj_{fun(f1....fk)} = \begin{cases} d(c1 \ldots \ldots ckc1) \\ \infty \end{cases}$$

Where d is the distance among the generated node and the objective function is developed for the node generation.

**Termination Criteria**

All branching procedures are completed to find optimal solution. Then terminating process initiated to terminate the process.

## V. PERFORMANCE ANALYSIS

In this section analysis of various performance measures of the proposed work is discussed. An object based simulation tool NS2 [1] is used for performing the transmission of data.

### i). Simulation Attributes

**Table 1. Simulation parameters**

| Property | Value |
|---|---|
| Simulation Tool | NS2 |
| MAC Protocol | IEEE 802.11 |
| Routing Protocol | DSR |
| Coverage area | 1000 x 1000 m |
| Number of nodes | 60 |
| Simulation Time | 1000s |
| Traffic Type | UDP – CBR |
| Pause Time | 50, 100, 150… |
| Transmission range | 200 m |

### ii). Performance Attributes

Several performance metric were compared with the existing algorithm. These are some of the attributes that are used for comparison [21, 22, 23]. Pause time is a time that varies between 50 to 200 sec in the simulation environment. During the pause time nodes in the network remains motionless and the current performance status of every node in the simulation environment is considered for the comparison. All the simulation is carried using the DSR protocol with the varied pause time. Performance of data transmission across the node is retrieved for varied time intervals that are used in the evaluation.

- Average End to End Delay
- Packet Delivery Ratio
- Network Lifetime
- Nodes Energy
- Routing Overhead
- Throughput

### a. Average End to End Delay:

The average time utilized by the packet in the transmission state to attain its destination and the delay in that kind of data transmission is delay time.

$$End\_to\_End\_Delay_i = start\_time_i - endtime_i$$

Where $start\_time_i$ is the time when sending of packet pack at node k starts, end_timei, is the time when packet pac is send by node k is received successfully at destination node.

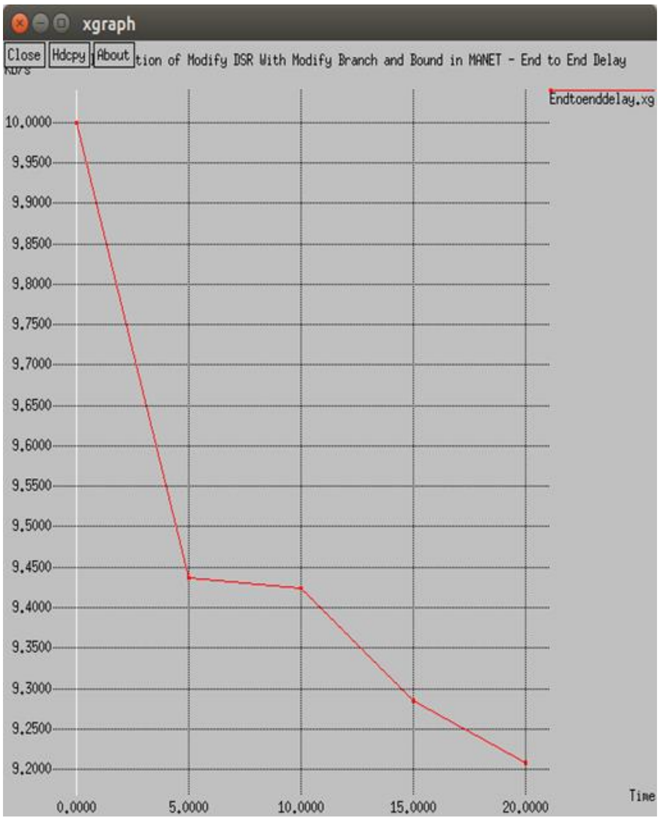

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Table 2: Pause Time VS End to End Delay

| Pause Time (Sec) | DSRBB | DSR MBB | MDSRBB | MDSRMBB |
|---|---|---|---|---|
| 50 | 9.7847 | 9.684 | 9.5841 | 9.43669 |
| 100 | 9.7668 | 9.6665 | 9.5664 | 9.42365 |
| 150 | 9.7648 | 9.3659 | 9.3158 | 9.2847 |
| 200 | 9.2464 | 9.235 | 9.2236 | 9.20778 |

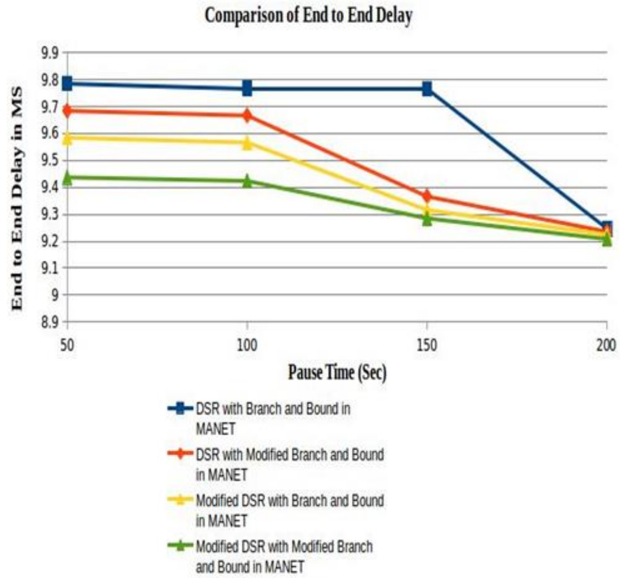


Figure 2: Pause Time Vs End to End Delay

Figure 3: Graph for End to End Delay

**b. Packet Delivery Ratio:**

PDR signifies the entire count of the data that is delivered to the destination. Missing rate of packet in the entire transmission is estimated using the PDR value. Measure of PDR value tests the correctness of the routing. The best transmission achieves highest PDR value.

*PDR = Σ Received count of the packet / Σ sent count of the packet*

**Table 3: Pause Time VS Packet Delivery Ratio**

| Pause Time (Sec) | DSRBB | DSR MBB | MDSRBB | MDSRMBB |
|---|---|---|---|---|
| 50 | 9.5609 | 9.6261 | 9.7257 | 9.82527 |
| 100 | 9.5783 | 9.6435 | 9.7435 | 9.84337 |
| 150 | 9.5803 | 9.6515 | 9.7459 | 9.90554 |
| 200 | 9.9646 | 9.976 | 9.9837 | 10.003 |

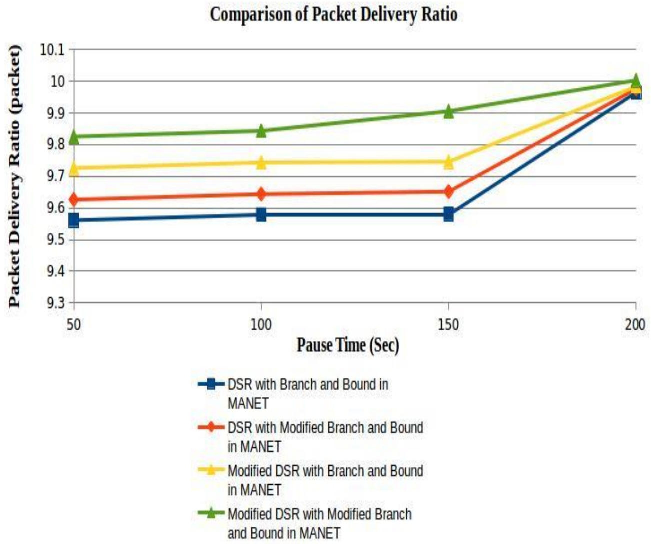


Figure 4: Pause Time Vs Packet Delivery Ratio

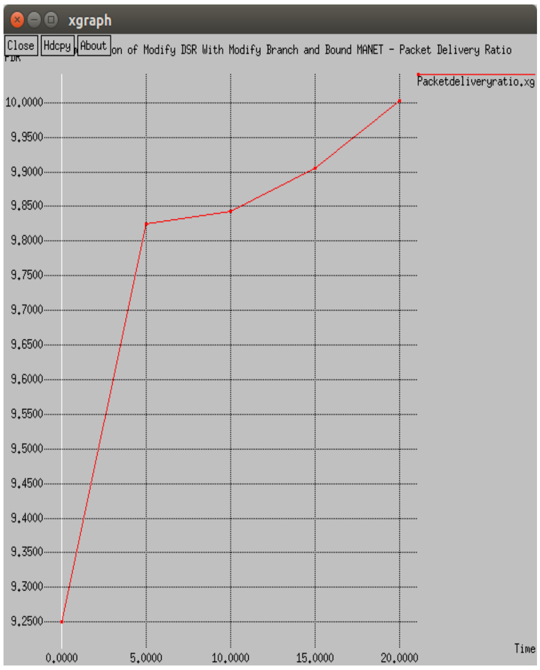


Figure 5: Graph for Packet Delivery Ratio

**c. Nodes Energy**

Every node in the network instilled with specific amount of energy and the energy exhausted at every transmission. The energy at the end of the transmission is estimated as nodes energy. Nodes energy estimation is carried by the values of current and initial energy levels.

*Nodes energy= Cur_Energy-Init_Energy*

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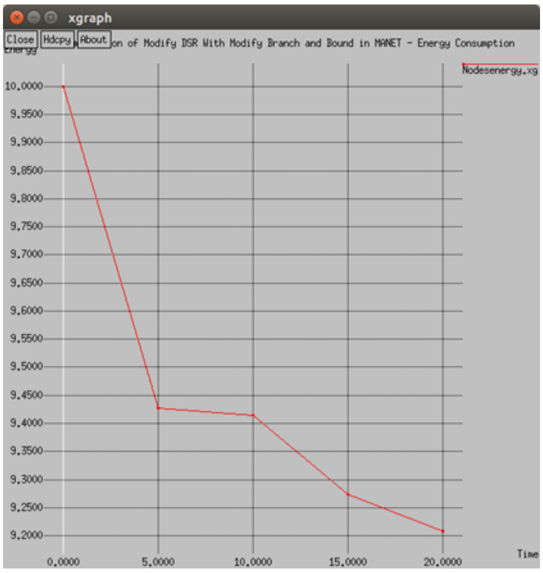


**Table 4: Pause Time VS Nodes Energy**

| Pause Time (Sec) | DSRBB | DSR MBB | MDSRBB | MDSRMBB |
|---|---|---|---|---|
| 50 | 9.7746 | 9.674 | 9.574 | 9.42672 |
| 100 | 9.7568 | 9.6565 | 9.5564 | 9.41366 |
| 150 | 9.7548 | 9.3562 | 9.3058 | 9.27441 |
| 200 | 9.2454 | 9.235 | 9.2236 | 9.20778 |

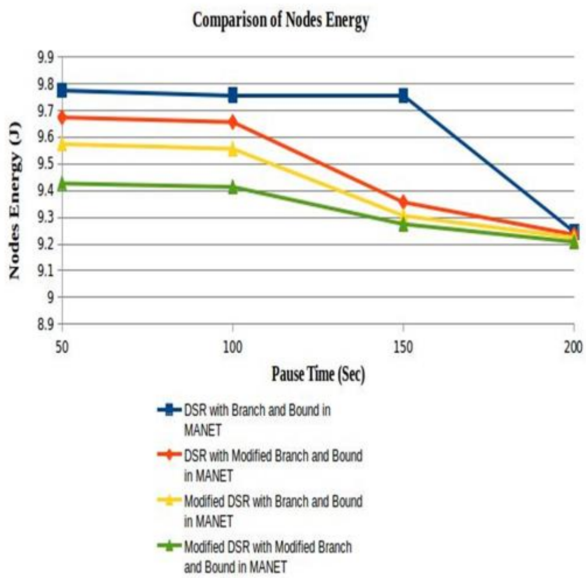


Figure 6: Pause Time Vs Nodes Energy

Figure 7: Graph for Nodes Energy

## d. Network Lifetime

The potential level of observing the state of node with utmost duration is network lifetime. The estimation of network lifetime is attained by the below formula,

$$t_{ed} = E_o/P_{ed}$$

**Table 5: Pause Time VS Network lifetime**

| Pause Time (Sec) | DSRBB | DSR MBB | MDSRBB | MDSRMBB |
|---|---|---|---|---|
| 50 | 9.4861 | 9.5762 | 9.6758 | 9.7754 |
| 100 | 9.5034 | 9.5936 | 9.6935 | 9.7934 |
| 150 | 9.5053 | 9.6015 | 9.6959 | 9.84554 |
| 200 | 9.9646 | 9.976 | 9.9837 | 10.003 |

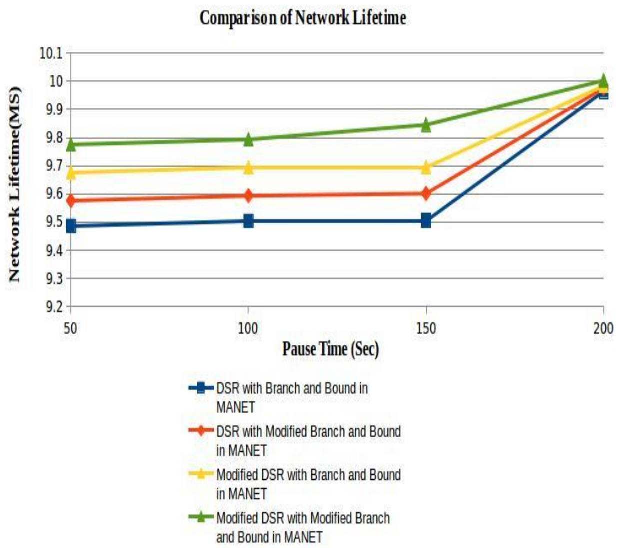


Figure 8: Pause Time Vs Network Lifetime

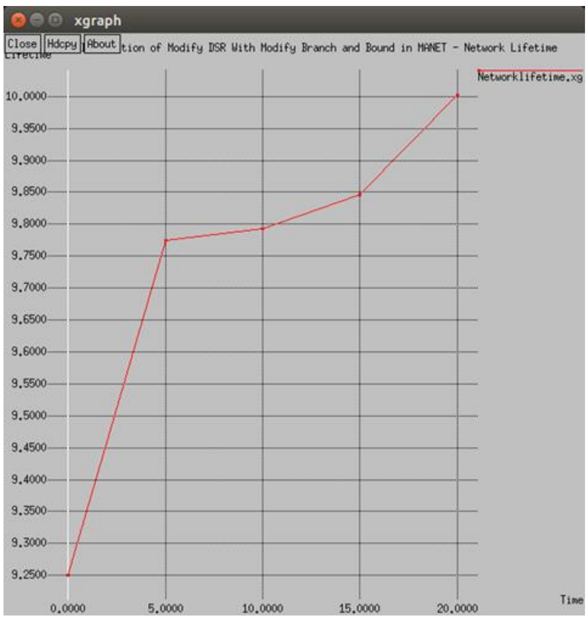


**Figure 9: Graph for Network Lifetime**

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**e. Routing Overhead**

The number of routing packets required for network communication is exceeded at the time of traffic or flooding is called as Routing Overhead.

*Routing Overhead = routing_pkt_rc – data_pkt_rc (Routing packets Count)*

*routing_pkt – count of received routing packets*
*data_pkt_rc –count of received data packets*

**Table 6: Pause Time VS Routing Overhead**

| Pause Time (Sec) | DSRBB | DSR MBB | MDSRBB | MDSRMBB |
|---|---|---|---|---|
| 50 | 9.7646 | 9.6639 | 9.564 | 9.41674 |
| 100 | 9.7468 | 9.6465 | 9.5464 | 9.40367 |
| 150 | 9.7448 | 9.3465 | 9.2958 | 9.26412 |
| 200 | 9.2444 | 9.235 | 9.2236 | 9.20778 |

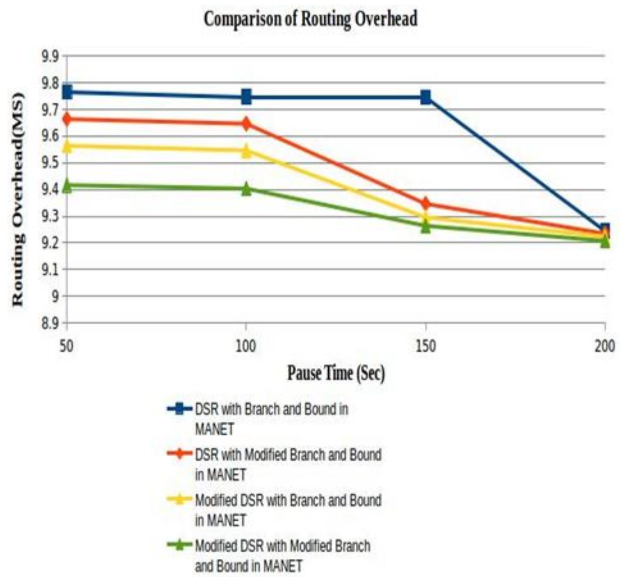


Figure 10: :Pause Time Vs Routing Overhead

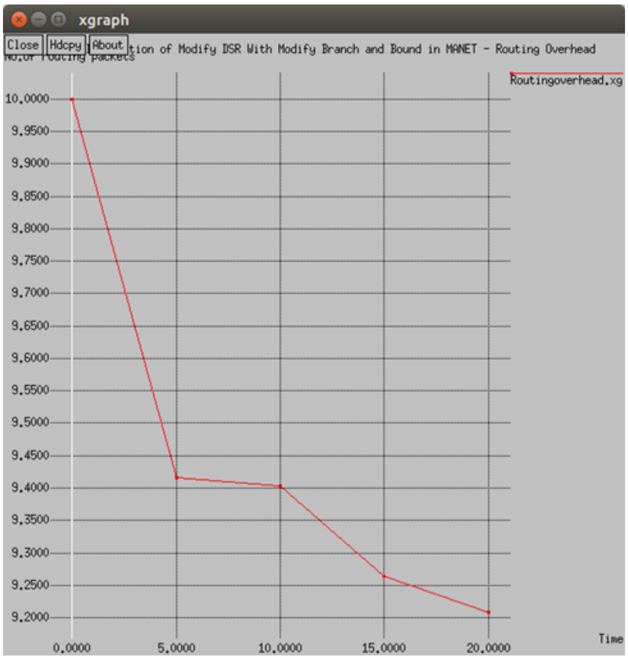


**Figure 11: Graph for Routing Overhead**

**f. Throughput**

The success rate of the packet that involved in the transmission of the network is stated as throughput. The transmission rate is estimated as bits/bytes. The network with higher throughput is the essential factor.

*Throughput= Success Rate of Total Packet-Total Packet involved in Transmission / Transmission time*

**Table 7: Pause Time Vs Throughput**

| Pause Time (Sec) | DSRBB | DSR MBB | MDSRBB | MDSRMBB |
|---|---|---|---|---|
| 50 | 9.5958 | 9.676 | 9.7756 | 9.87514 |
| 100 | 9.6133 | 9.6935 | 9.7935 | 9.89334 |
| 150 | 9.6153 | 9.7015 | 9.7958 | 9.93846 |
| 200 | 9.9646 | 9.976 | 9.9837 | 10.003 |

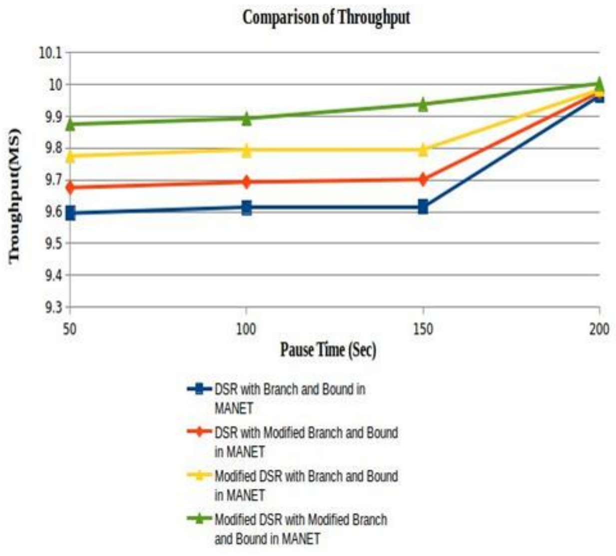


Figure 12: Pause Time VsThroughput

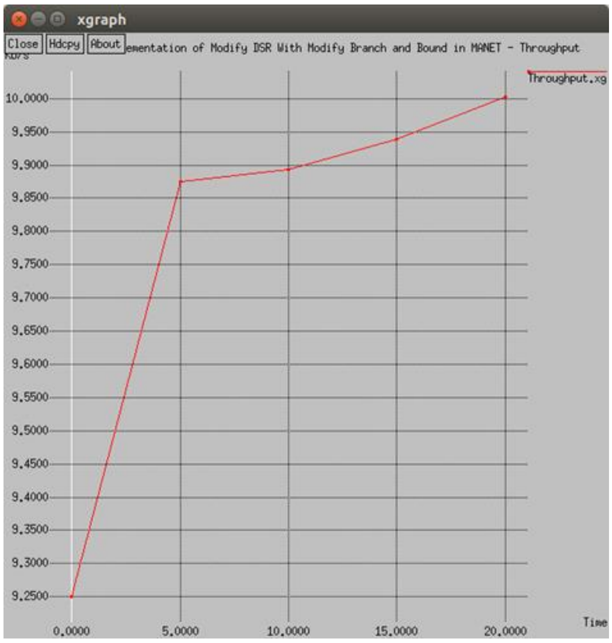


Figure 13: Graph for Throughput

## VI. Conclusion

DSR protocol is designed to react hastily to the network changes with very low overhead. In DSR the source decides the entire routing process. To achieve the low routing overhead, delay time, and optimal path selection is accomplished with the help of Modify Branch and Bound algorithm in MANET. In this paper DSR and BB algorithm is enhanced for MANET. The newly developed algorithm is used to route the packets across the transmission path by assuring the factors like minimal energy consumption, QoS and fault tolerance. Performance metrics of MDSRMBB tested with the existing algorithm. From the comparison study, it is understood that the proposed work performs with greater optimality. The performance metrics like, PDR and throughput values are improved. This resultant observation states that the missing of packets in minimized. The propagation path of the data is optimized by delay time and routing overhead. The proposed algorithm achieves better outcome in the network transmission.

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