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An Efficient Analysis of Ad-Hoc on Demand Distance Vector Routing Protocol at Different Transmitted Power and Speeds

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***Abstract*—Mobile Ad-Hoc Network (MANET) is a dynamic system which is totally free of fixed infrastructure. In (MANETs), each node is responsible for routing its data according to a specific routing protocol. The three most common ad hoc routing protocols are Ad-hoc On-demand Distance Vector (AODV), Optimized Link State Routing Protocol (OLSR) and Dynamic Source Routing protocol (DSR). This paper proposes an efficient evaluation of AODV routing protocol by testing the MANETs routing protocol with variation in transmission power at different speeds. The performance analysis has been given using OPNET Modeler simulations and evaluated using metrics of throughput and delay. The results show that the throughput increases as the transmission power increases up to a certain value after which the throughput decreases, also the network work optimally at a certain transmission power which varied at different speed.**

***Keywords*—MANET, AODV, Throughput, End to End Delay, OPNET**

I. INTRODUCTION

MANET devices can communicate without infrastructure which supported by wireless communication technologies such as WiMAX, ZigBee, and WiFi [1].The routing protocols of MANET can be classified into three categories as shown in figure 1:

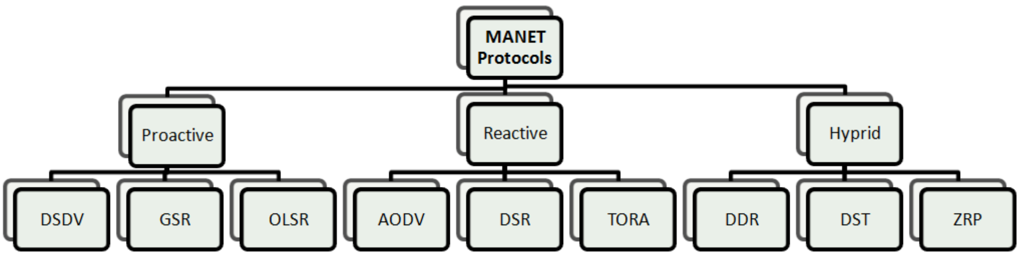

Figure 1: Routing Protocols in MANET

i. Proactive routing protocols: A route table about the position of each node is built frequently and routing is based on it. So, the proactive routing also called “table driven routing” such as Destination-sequenced distance vector (DSDV), Global state routing (GSR), and Optimized link state routing (OLSR).

ii. Reactive routing protocols: This cat- egory have no predefined routes, thus, route establishment is done on demand dynamically with the request packets. Based on the response, the next node is identified and this process goes on until a fixed path is established and the data packets reach the destination. So, the reactive routing also called “on demand routing”.

iii. Hybrid routing protocols: It is a mix of both proactive and reactive routing protocols. The choice of one or the other routing depends upon the particular type of application or typical cases.

A review of possible methods for apply- ing clustering algorithms to solve prob- lems in routing networks of MANET has been discussed in [2].

In [3], the performance of the three MANET Routing protocols AODV, DSR, and Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV) was analyzed using NS-2 Simulator. The simulation results of Average End-to-End delay, throughput, and packet delivery ratio over the routing protocols DSDV, DSR and AODV by varying network size. MANET routing protocols for video streaming have been examined in [4]. The routing protocols considered are AODV, Ad-hoc On-request multipath Distance Vector (AOMDV), and Enhanced Video Streaming in MANET (EVSM).

In [5], authors study the impact of two mobility models on the performance of MANET. The two mobility models con- siderd are random way point and Manet Down Left which applied to DSR routing protocol. Authors in [6] describe a case study involving many homes at a time treated as nodes. The simulation process is under progress using NS-2. An effort has been introduced in the paper to identify some issues, then taking care of fast and stable data transfer. MANET has been used as technology to achieve the target of data communication in smart homes.

Many papers proposed different mobil- ity models such as [7]. The obstcaleaware mobility models has been proposed in [8], and [9]. To enhance the stability of the mobile network, the mobility prediction has been introduced. The rest of this paper is organised as follows: In Section II, the research method is discussed. The simulation re- sults of the simulated model are presented in Section III. Finally, Section IV presents the conclusion of the proposed model.

II. RESEARCH METHOD

For perform simulations, a MANET scenario has been designed with the num- ber of nodes are 40 and 80 nodes ran- domly placed over 1500*1500 meters area size using OPNET Simulator [12]. The performance of AODV protocol is evalu- ated for the performance metrics, through- put and end to end delay. The perfor- mance of the designed network scenario has been examined with variation in trans- mission power. The mobility model used in the designed scenario is random way- point mobility model (RWMM). Also the performance of the designed network sce- nario has been evaluated with variation in node speed. The list of simulation param- eters and the values used in the simulated network scenario has been illustrated in table I.

Table I
Simulation Parameters

Parameters	Values
Simulation Area (m^2)	1500 × 1500
Routing Protocol	AODV
Transmitted Power (dBm)	1- 4
Node Speed (m/sec)	10, 20, 30, and 40
Simulation Time	3600 Sec
Network Size (nodes)	40 and 80
Mobility Model	RWMM

III. SIMULATION RESULTS

This section evaluates the proposed model using OPNET. Results have been carried out by varying the transmitted power, and speed of the nodes. The simulated network has been eval- uated by two metrics namely, throughput, and average end to end delay.

A. *Performance Evaluation at Different Transmission Power*

In this simulation, the performance of the network will be evaluated by through- put and delay. The results have been carried out at different transmitted power values, from 1 dBm to 4 dBm. The simulated network will be examined at different speeds, 10 m/sec, 20 m/sec, 30 m/sec, and 40 m/sec.

1) *Throughput:* Throughput represents the total number of bits in (bits/sec) forwarded from wireless LAN layers to higher layers in all nodes of the network. The results of the simulations shown in figure 2 compare the throughput across different transmitted power.

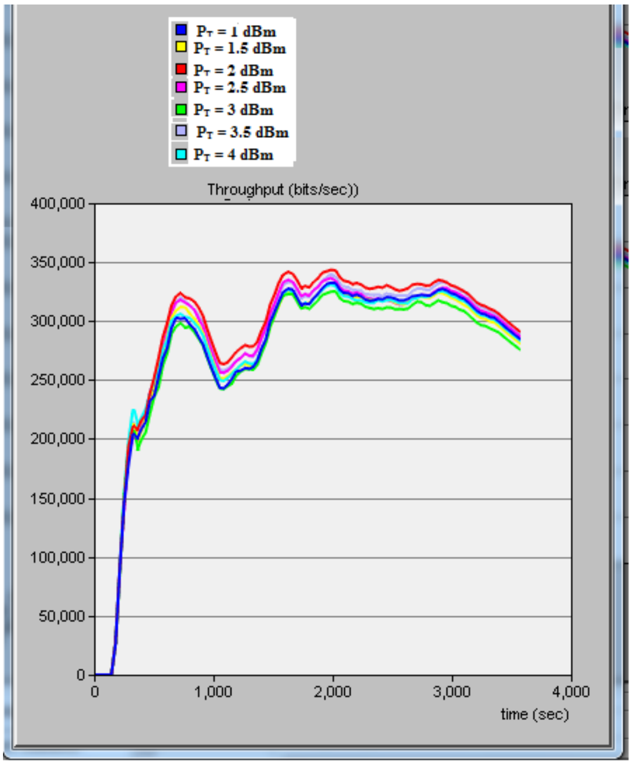

Figure 2: Throughput for 40 Node Network Size at Speed 10 m/sec

Figure 2 shows that, the maximum throughput acheived at 2 dBm which the average throughput is 301.36 Kbps. The average throughput at speed 20 m/sec has been illustrated in figure 3.

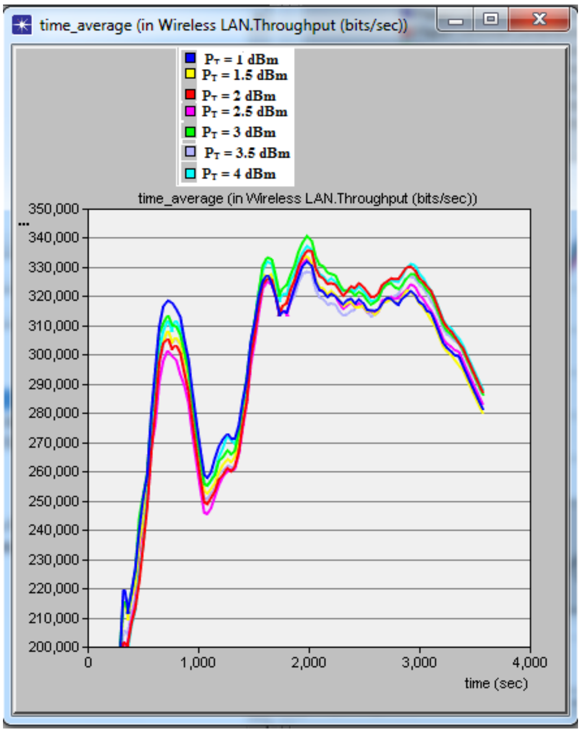

Figure 3: Throughput for 40 Node Network Size at Speed 20 m/sec

As shown in figure 3, the maximum throughput acheived at 3 dBm.

The results of simulations showed in figure 4 compares the throughput across different transmitted power at speed equal to 30 m/sec.

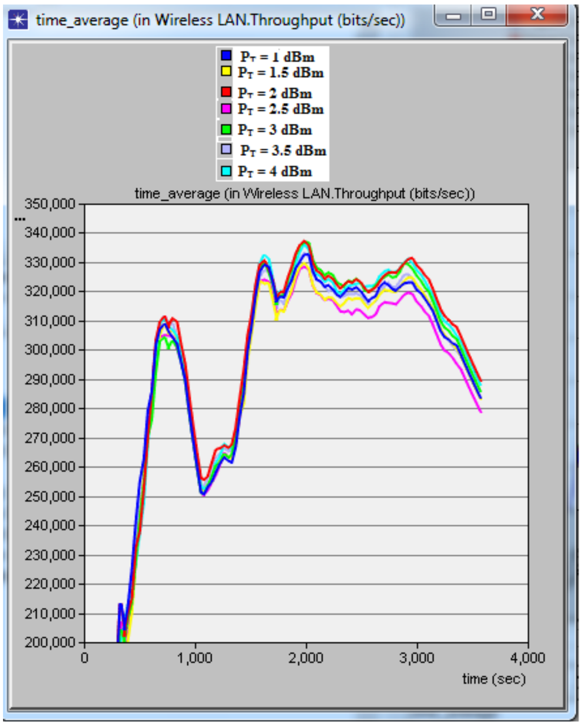

Figure 4: Throughput for 40 Node Network Size at Speed 30 m/sec

As shown in figure 4, the average throughput is 294735.47 Kbps at 2 dBm transmitted power.

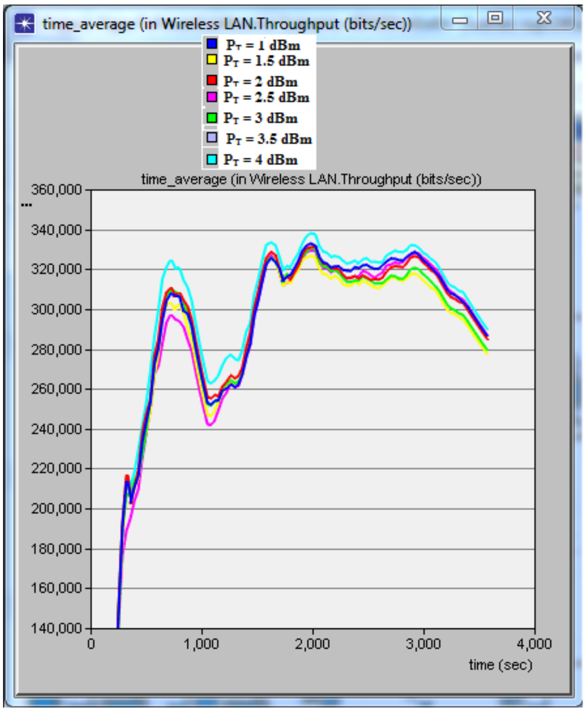

Figure 5: Throughput for 40 Node Network Size at Speed 40 m/sec

Figure 5 shows that, 1.5 dBm transmit- ted power achieves high throughput in the case of 40 m/sec speed.

2) Average End to End Delay:

In this simulation, the AODV routing protocol network will be examined at different speeds (10 m/sec, 20 m/sec, 30 m/sec, and 40 m/sec) and different transmitted power. The end to end delay at speeds 10 m/sec, 20 m/sec, 30 m/sec, and 40 m/sec will be depicted in figures 6, 7, 8, and 9 respectively. The network size is 40 nodes.

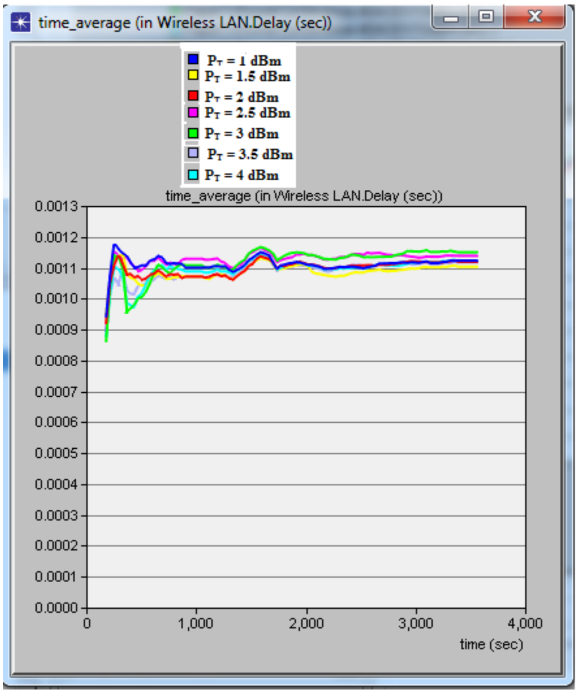

Figure 6: End to End Delay for 40 Node Network Size at Speed 10 m/s

Figure 6 shows that, the minimum de lay acheived at 1.5 dBm which the average end to end delays is 1.08719 ms

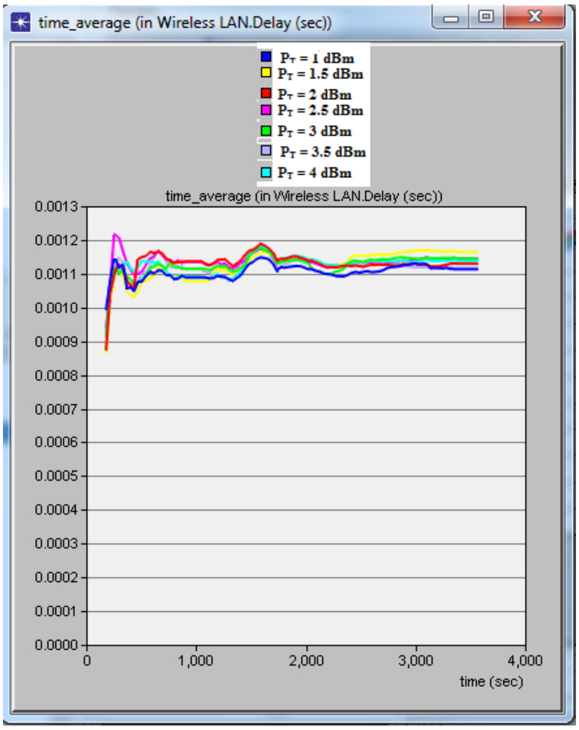

Figure 7: End to End Delay for 40 Node Network Size at Speed 20 m/s

Figure 7 shows that, the minimum delay acheived at 1 dBm which the average end to end delay is 1.10575 ms.

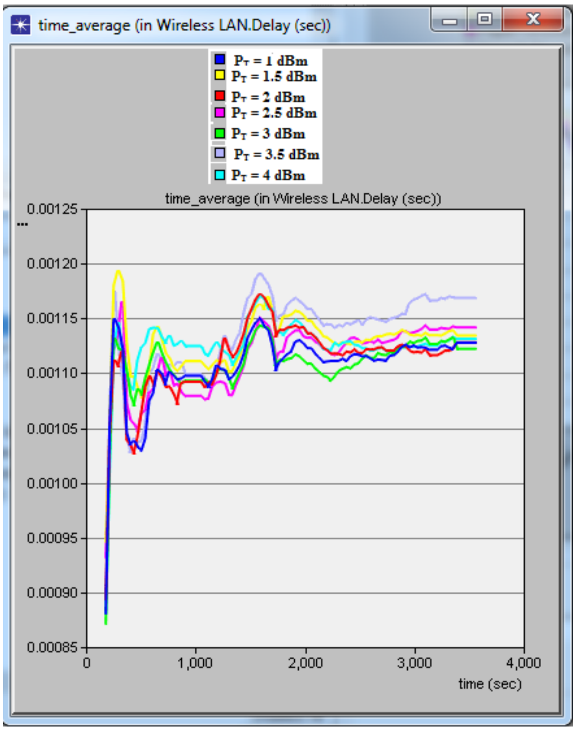

Figure 8: End to End Delay for 40 Node Network Size at Speed 30 m/s

As shown in figure 8, the minimum delay acheived at 1 dBm which the average end to end delay is 1.10715 ms.

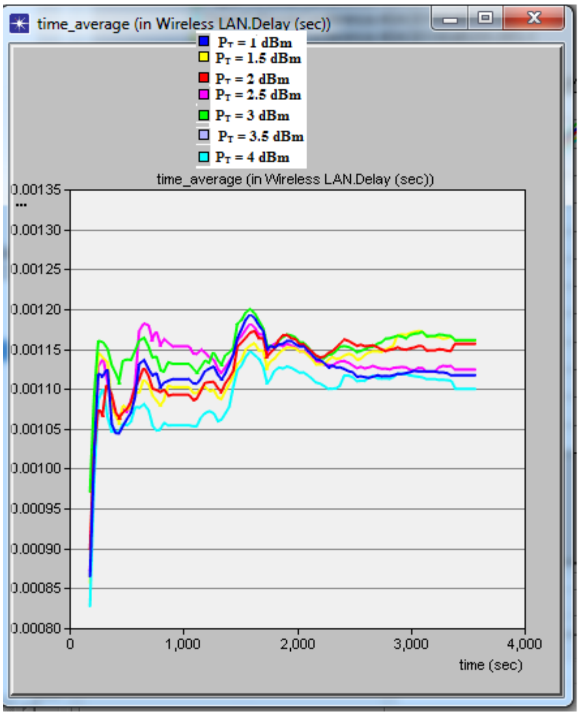

Figure 9: End to End Delay for 40 Node Network Size at Speed 40 m/s

Figure 9 shows that, 1.5 dBm trans- mitted power achieves low delay in the case of 40 m/sec speed. So, the optimum transmitted power in this case is 1.5 dBm wich has maximum high throughput and low end to end delay

B. *Comparative Analysis*

In this simulation, the AODV routing protocol network will be examined at different speeds (10 m/sec, 20 m/sec, 30 m/sec, and 40 m/sec) and different trans- mitted power. the comparison has been performed for two networks (40 Nodes and 80 Nodes).

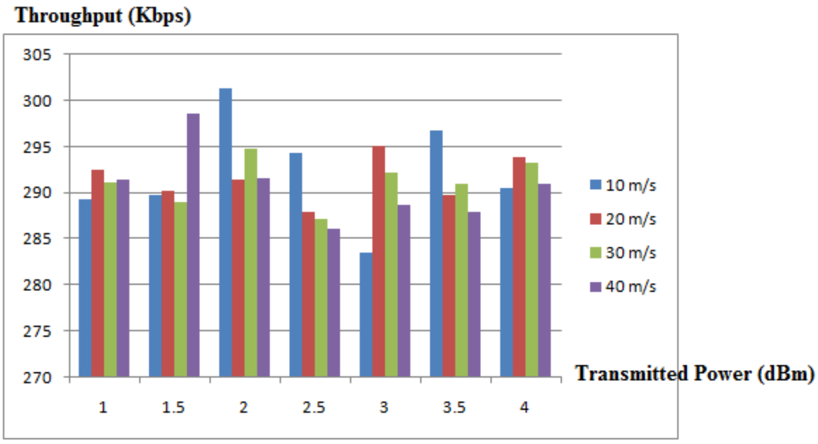

Figure 10: Throughput at 40 Node Network Size

The throughput for 40 node network size has been depicted in figure 10.

Results show that, at the point of transmitted power equals to 2 dBm the throughput is 301.36 Kbps, 291.42 Kbps, 294.74 Kbps, and 291.57 Kbps. The max- imum throughput achieves at 2 dBm for speed 10 m/sec. Results show that, at the point of transmitted power equals to 2 dBm the throughput is 1391.50 Kbps, 1412.08 Kbps, 1371.70 Kbps, and 1396.68 Kbps. The maximum throughput achieves at 2 dBm for speed 20 m/sec.

The delay for 80 node network size has been illustrated in figure 12.

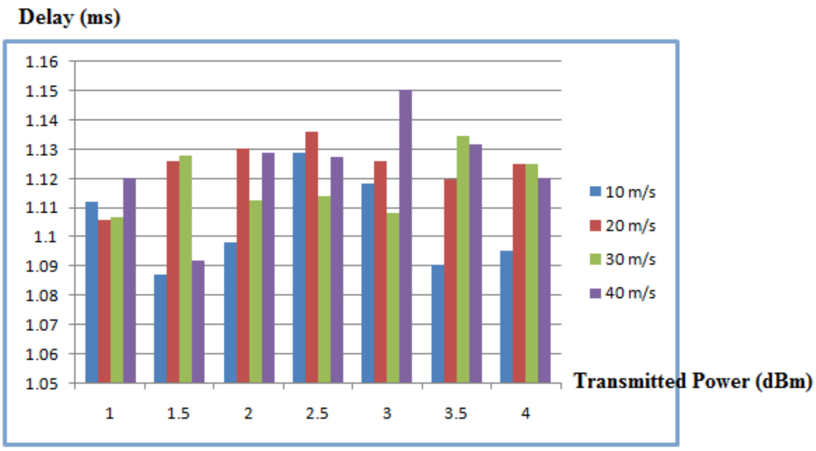

Figure 11: End to End Delay at 40 Node Network Size

Figure 11 shows that, the minimum end to end delay at 10 m/sec speed is 1.087 ms at 1.5 dBm transmitted power, the minimum end to end delay at 20 m/sec speed is 1.1058 ms at 1 dBm transmitted power, the minimum end to end delay at 30 m/sec speed is 1.1071 ms at 1 dBm transmitted power, and the minimum end to end delay at 40 m/sec speed is 1.0922 ms at 1.5 dBm transmitted power.

The throughput for 80 node network size has been illustrated in figure 12.

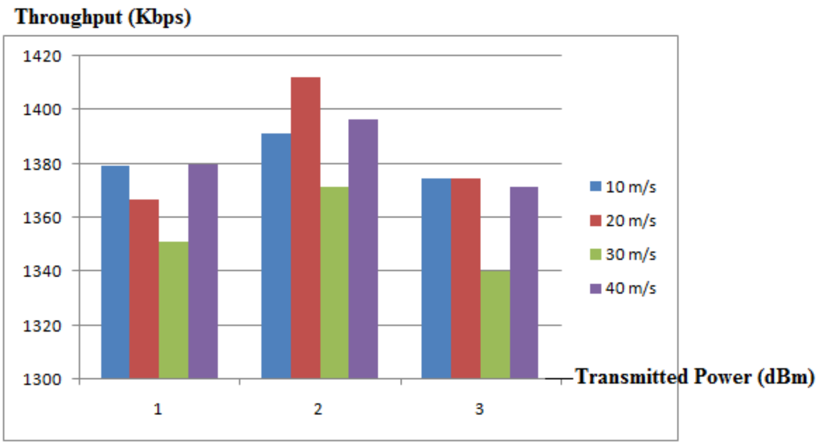

Figure 12: Throughput at 80 Node Network Size

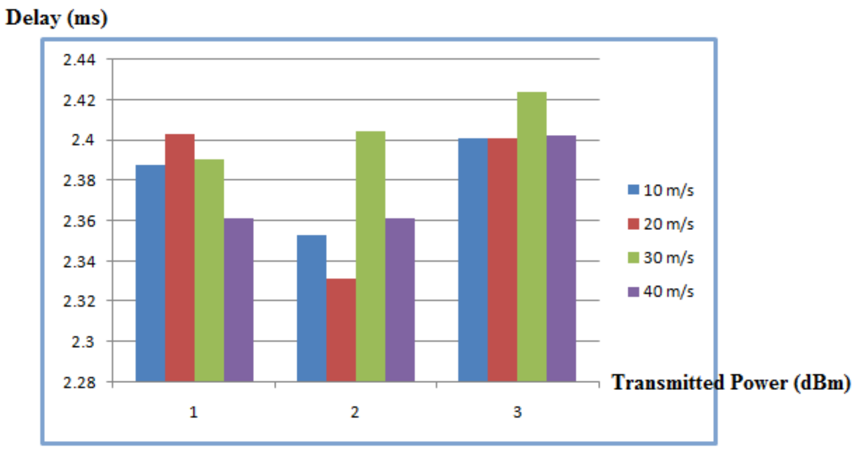

Figure 13: End to End Delay at 80 Node Network Size

Results show that, the minimum end to end delay at 10 m/sec speed is 2.3533 ms at 2 dBm transmitted power, the minimum end to end delay at 20 m/sec speed is 2.3315 ms at 2 dBm transmitted power, the minimum end to end delay at 30m/sec speed is 2.3908 ms at 1 dBm transmitted power, and the minimum end to end delay at 40 m/sec speed is 2.361184508 ms at 1 dBm transmitted power.

IV. CONCLUSION

In this paper, the throughput and aver- age end to end delay performance met- rics have been analyzed to AODV rout- ing protocol. The designed scenario with variation in node speed and transmission power over 40 and 80 nodes. The results show that the throughput increases as the transmission power increases up to a cer- tain value after which the throughput de- creases due to increasing interference. Itcan be concluded that the designed AODV routing protocol for 40 nodes MANET network performs optimally at a transmission power of 2 dBm at speeds 10 m/sec and 30 m/sec. The optimum transmitted power is achieved at 3 dBm and 1.5 dBm at speeds 20 m/sec and 40 m/sec respectively. The results also show that the maximum throughput can be achieved at 2 dBm at speeds 10, 20, and 30 m/s for 80 node network size.

This work will help the network design- ers in selecting various network parame- ters such as optimum transmission power and network size.

This work can be extended to evaluate routing protocols such as DSR, DSDV, and OLSR.

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