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# PERFORMANCE ANALYSIS OF SCALABILITY AND MOBILITY ON ROUTING PROTOCOLS IN MANETS

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**Abstract**

In this paper, we investigated the effect of routing protocols on performance (energy consumption and average goodput) within MANETs. We studied different types of ad hoc routing protocols having different characteristics: reactive vs. proactive, distance vector vs. link state, and source routing. It is found that AODV as a routing protocol leads to most accepted protocol and this is confirmed at different mobility levels. In this paper, we further analyze the performance using routing protocols by varying scalability & mobility in MANET.

***Keywords:*** Performance Analysis, Scalability, Mobility, Routing Protocols, MANETs.

## 1. Introduction

An ad hoc network is a collection of wireless mobile nodes that forms a temporary network without any centralized administration. Mobile Ad Hoc Network (MANET) is a collection of communication devices or nodes that wish to communicate without any fixed infrastructure and pre-determined organization of available links. The nodes in MANET themselves are responsible for dynamically discovering other nodes to communicate. Some Adhoc routing protocols are used to improve TCP performance, AODV: It uses an on-demand approach for finding routes. DSR: It is a simple and efficient routing protocols. DSDv: It is a table-driven routing scheme based on Bellman-Ford algorithm. MANETs performance depends on many factors such as mobility, scalability network topology, obstacle positions and so on. In this work, our objective is analyzing effect of scalability and mobility on TCP Performance using adhoc routing protocols. Mobility is the movement from one place to another place is mobility and scalability is Adhoc network can have a large no. of nodes. System should be scalable to handle these nodes.

## 2. Mobility and Scalability

Destination Sequenced Distance Vector (DSDV) is a Proactive routing protocol that solves the major problem associated with Distance Vector routing of wired networks *i.e.*, Count-to-infinity, by using Destination sequence numbers. Dynamic Source Routing (DSR) is a reactive protocol, which uses source routing. Adhoc On-demand Distance Vector (AODV) essentially a combination of both DSR and DSDV. It borrows the basic on-demand

mechanism of Route discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers from DSDV. Mobility may induce link breakage and route failure between two neighboring nodes, as one mobile node moves out of the other's transmission range. Link breakage in turn causes packet losses. TCP congestion control mechanisms react adversely to such losses caused by route breakages. Meanwhile, discovering a new route may take significantly longer time than TCP sender's RTO. If route discovery time is longer than RTO, TCP sender will invoke congestion control after timeout. The already reduced throughput due to losses will further shrink. It could be even worse when the sender and the receiver of a TCP connection fall into different network partitions. In such a case, multiple consecutive RTO timeouts lead to inactivity lasting for one or two minutes even if the sender and receiver finally get reconnected. Many simulations have been conducted considering mobility, channel error, and shared media-channel contention. It is indicated that mobility-induced network disconnections and reconnections have the most significant impact on TCP performance comparing to channel error and shared media-channel contention. As mobility increases, compared to a reference TCP, TCP New Reno suffers from a relative throughput drop ranging from almost 0% in a static case to 90% in a highly mobile case (when moving speed is 20m/s). In contrast, congestion and mild channel error (say 1%) have less visible effect on TCP (with less than 10% performance drop compared with the reference TCP). Adhoc network can have a large no. of node. System should be scalable to handle these nodes. There are basically four parameters for evaluation : Area of MANET, No. of nodes, No. of transmit nodes and No. of receiver nodes.

## 3. IMPLEMENTATION OF MOBILITY AND SCALABILITY

The goal of this was to study effect of scalability and mobility on performance using adhoc routing Protocols in MANET. Comparison of the different protocols is done by simulating them and examining their behavior. In the simulations in the following section, the effect of different protocols is evaluated. The following quantitative metrics are to be used to evaluate the scalability and mobility performance under different routing protocols combinations in the fixed network and the MANET.

| *Parameter* | *Value* |
|---|---|
| Terrain Size | 500 × 500 – 1500 × 1500 meters |
| Mobility Model | Random Waypoint |
| [Min, Max] speeds | (0 $ms^{-1}$ , 20 $ms^{-1}$) |
| MAC Protocol | CSMA |
| Routing Protocol | AODV, DSR, DSDV |
| Nominal traffic type | Constant Bit Rate (CBR), 5-25 connections |
| Number of Nodes | 10–90 |
| Simulation Time | 600S |

**Packet Delivery Ratio (PDR):** It is the ratio of the number of packets actually delivered without duplicates to the destinations versus the number of data packets supposed to be received. This number represents the effectiveness and throughput of a protocol in delivering data to the intended receivers within the network. Number of successfully delivered legitimate packets as a ratio of number of generated legitimate packets.

$$PDR = \frac{\text{Total No. Packets Received}}{\text{Total No. Packets Sent}}$$

**Number of Collisions:** In a network, when two or more nodes attempt to transmit a packet across the network at the same time, a packet collision occurs. When a packet collision occurs, the packets are either discarded or sent back to their originating stations and then retransmitted in a timed sequence to avoid further collision. Packet collisions can result in the loss of packet integrity or can impede the performance of a network. This metric is used to measure such collisions in the network.

**Energy Consumption:** Total energy consumed in the network is energy consumption. It is measured in Whr.

## 4. RESULTS

In our simulation, we have studied the effect of Scalability and Mobility using ad hoc routing Protocols under the following conditions:

- Different number of parameters in Scalability; and
- Different node mobility

### 4.1. Effect of Mobility

Figure 1 shows effect of mobility on collision. AODV protocol has average collisions 61.74, DSDV 103.48 and DSR 106.12 respectively. Data comparison by graph in three protocols i.e. AODV, DSR and DSDV shows that AODV protocol is good because its shows less collision. Figure 2 shows the effects of Mobility on average Energy consumption on packet delivered in AODV; DSR and DSDV protocol is 150.37, 150.38 and 150.46 mWHr respectively. Comparison of average Energy consumption shows that DSDV consumes more power as compare to AODV and DSR. Figure 3 shows the effects of different mobility on packet delivery ratio. From the table it is clear that mobility has greater effect on PDR. Packet delivery Ratio of AODV by the data comparison shows much better than DSDV.

Overall study of effect of mobility shows that no. of collisions in AODV is less as compared to other two protocols. As the node mobility increases, link breakage occurs

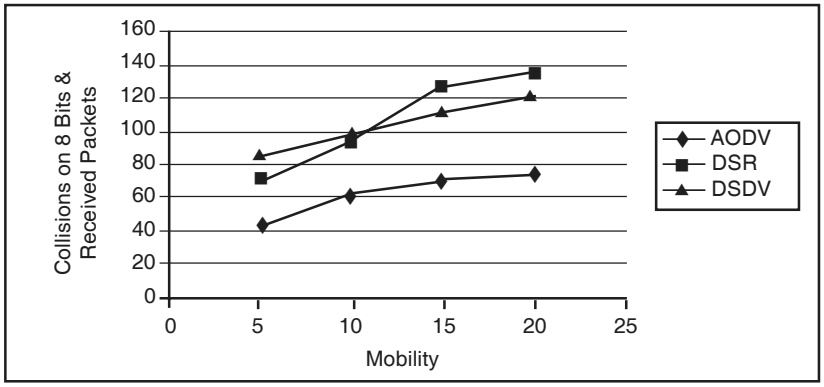


**Figure 1: Effect on Mobility on Collission**

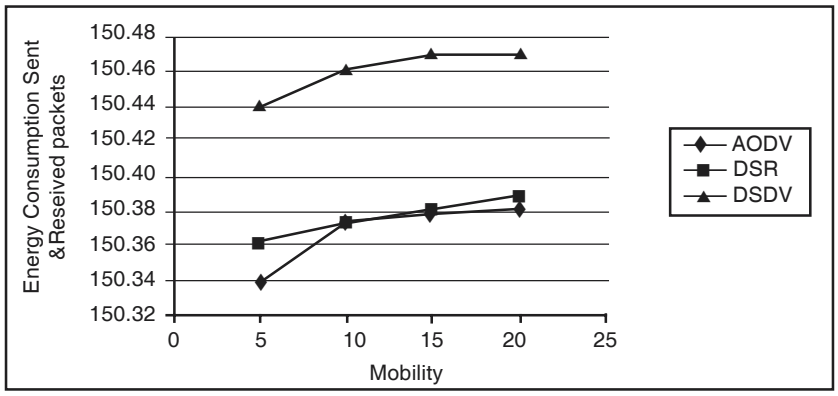


**Figure 2: Effect on Mobility on Energy Consumption**

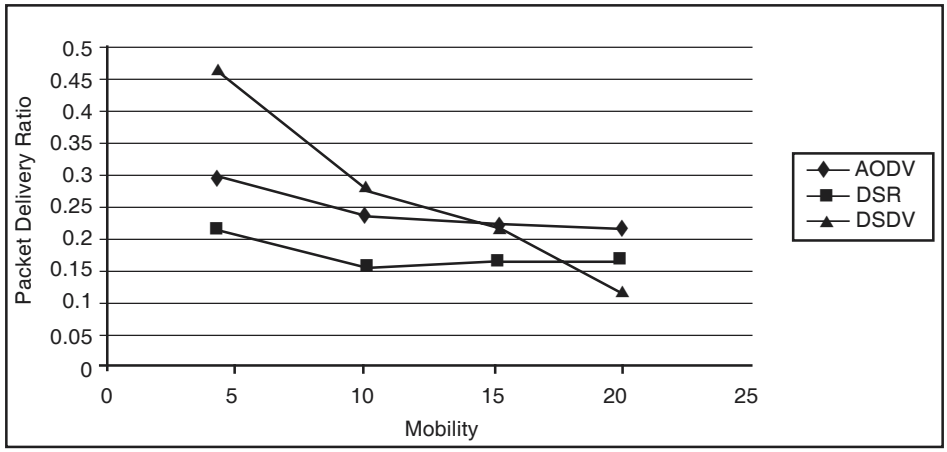


**Figure 3: Effect on Mobility on Packet Devlivery Ratio**

more frequently, this leads to more route repair and maintenance. Comparison between three protocols shows that Average Energy Consumption of DSDV is more as compared to AODV and DSR. Packet delivery Ratio of AODV is much better than DSDV.

### 4.2. Effect of Scalability

*No. Transmit Nodes:* Figure 4 show the effect of Collisions with different number of transmitted nodes. Average Collision on packet delivered in AODV, DSR and DSDV protocols are 172.75, 290.23 and 1196.18 respectively. Figure 5 shows the effect of Scalability on Energy Consumption with different number of transmit nodes. Average Energy consumption on packet delivered in AODV, DSR and DSDV protocol are 150.28, 150.34 and 150.31 respectively. This shows that AODV energy consumption is minimum as compared to other two protocols i.e. DSR & DSDV. Figure 6 shows the effects of

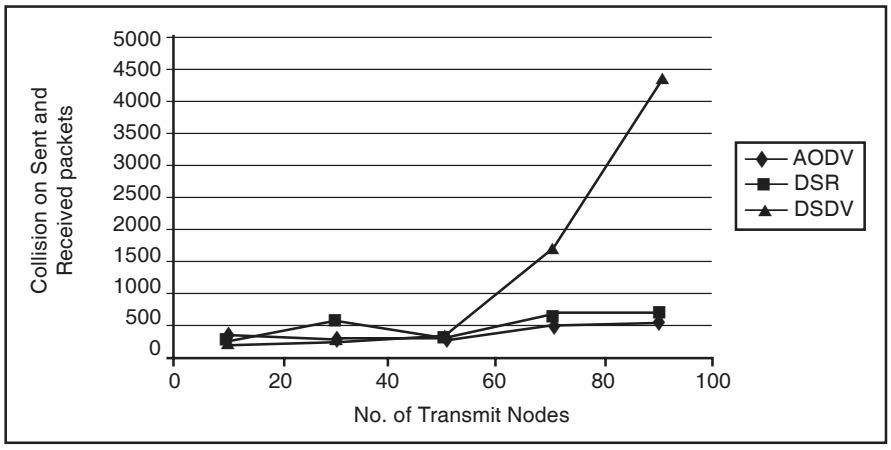


**Figure 4: Effect on Number of Transmit Nodes on Collisions**

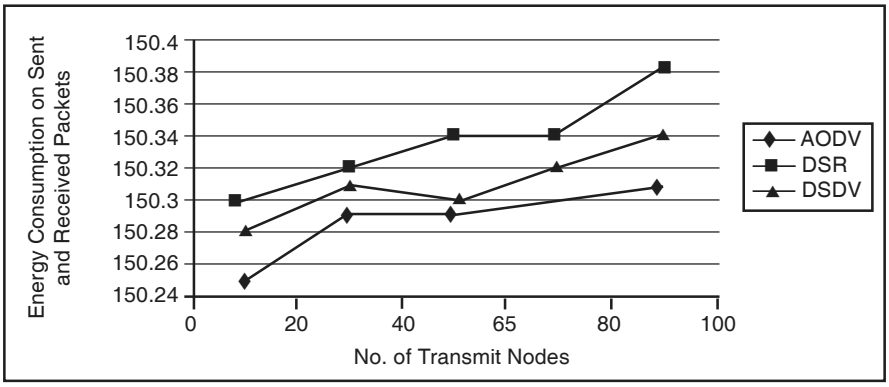


**Figure 5: Effect on Number of Transmit Nodes on Energy Consumption**

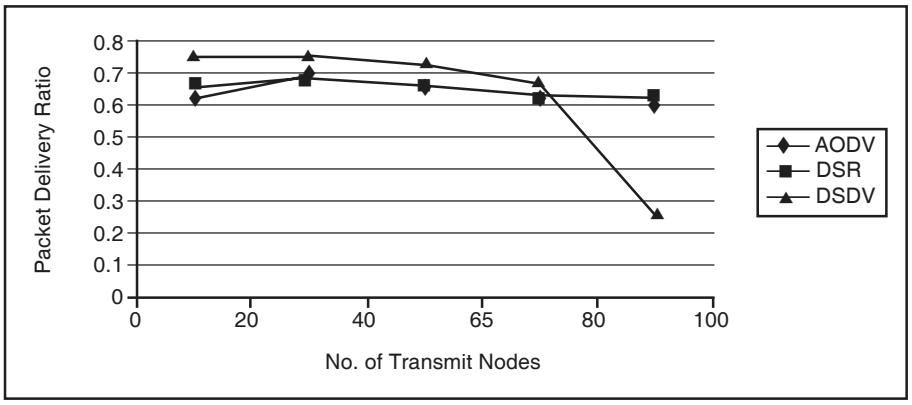


**Figure 6: Effect on Number of Transmit Nodes on PDR**

no. of transmit nodes on packet delivery ratio. As the number of transmit nodes increases; number of collision ns increases i.e. packets are unable to reach at their destination. Thus, we can predict that as the number of transmits nodes increases, the performance of the network will deteriorate. AODV, DSR and DSDV have almost same packet delivery ratio up to 70 transmitted nodes. But DSDV has less packet delivery ratio as compare to AODV and DSR if no of nodes are increased further.

Overall study of effect of transmitted nodes (number) shows that number of collisions in AODV is less as compared to other two protocols. Average Energy consumption on packet delivered in AODV, DSR and DSDV protocol are 150.28, 150.34 and 150.31 mWHr respectively. From given data, average Collision and average Energy Consumption is better for AODV as compared to other protocols. AODV, DSR and DSDV have almost same packet delivery ratio up to 70 transmitted nodes. But DSDV has less packet delivery ratio as compared to AODV and DSR if no of nodes are increase further.

*No. of CBR Links:* Figure 7 show the effects of collisions with varying no. of CBR links. The study shows that there is little bit difference between three protocols. As the number of CBR links increases, link breakage occurs more frequently and this leads to more collisions in the network. Average collision in AODV, DSR and DSDV protocols is 3523.85, 3430.12 & 3459.92 per 10 min. respectively. The graph shows that all three protocols having almost same value. Figure 8 shows the effects of CBR links on energy consumption. The CBR links of all three protocols have average energy consumption on AODV; DSR & DSDV protocol is 150.31, 150.37 and 150.39 respectively. So, AODV has less energy consumption as compare to other two protocols on the same CBR Links.Figure 9 shows the effects of No. of CBR links on AODV, DSDV and DSR having the same packet delivery ratio up to 15 transmitted CBR links. After that DSR and DSDV have less packet delivery ratio than AODV.

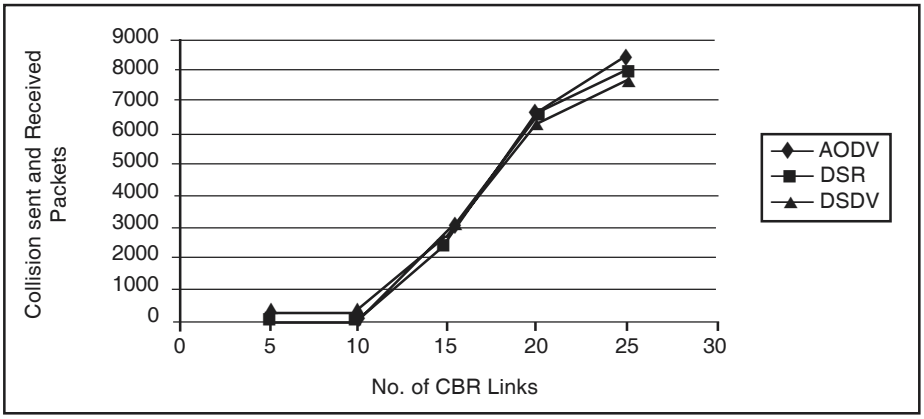


**Figure 7: Effect on Number of CBR Links on Collisions**

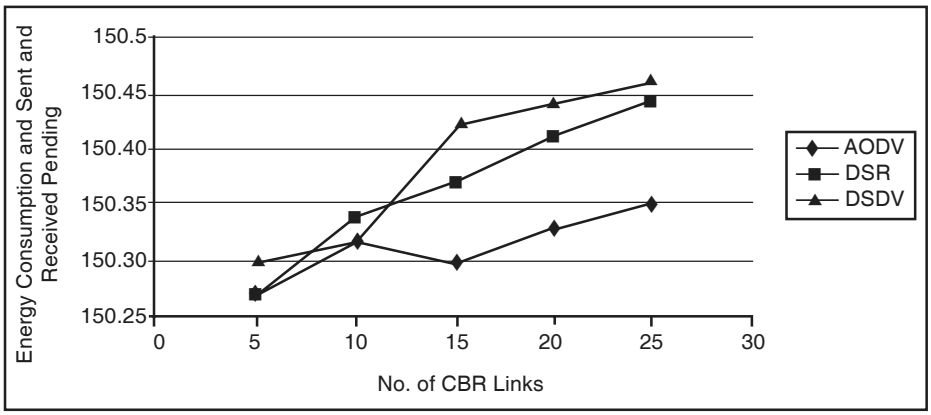


**Figure 8: Effect on Number of CBR Links on Energy Consumption**

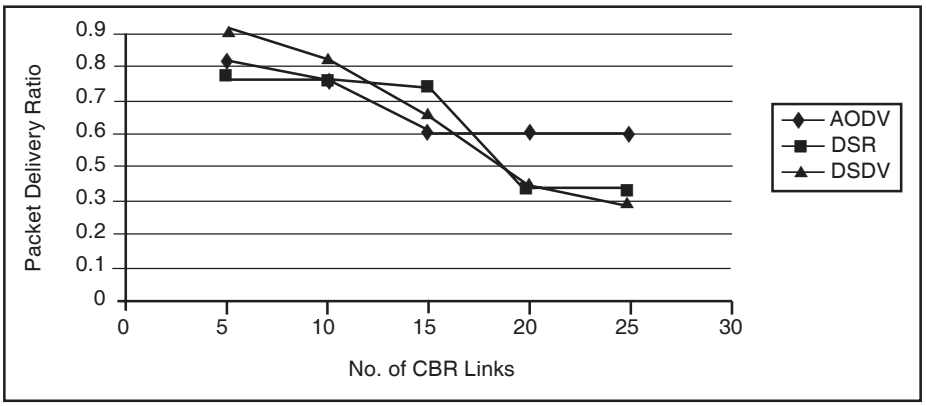


**Figure 9: Effect on Number of CBR Links on PDR**

Overall study of effect of CBR links shows that there is little bit difference between three protocols. As the numbers of CBR links increases, link breakage occurs more frequently and this leads to more collisions in the network. An average collision in AODV, DSR and DSDV protocols is 3523.85, 3430.12 and 3459.92 per 10 min respectively. Here, AODV's average collision lies in between DSR and DSDV. In no. of CBR links of all three protocols average Energy Consumption on AODV, DSR and DSDV protocol is 150.31, 150.37 and 150.39 mWHr respectively. So, AODV has less energy consumption as compare to other two protocols. The effects of no. of CBR links on AODV, DSDV and DSR having the same packet delivery ratio up to 15 transmitted CBR links. After that DSR and DSDV have less packet delivery ratio than AODV.

*Area of MANET :* Figure 10 show the effects of Area of MANET on collisions. As we increase the area of MANET, average collision on packets increases. Average Collision on data packet delivered in AODV, DSR, and DSDV protocol has 72.28, 166.27 and 174.33 respectively. Figure 11 show the effects of Area of MANET on energy consumption. Average Energy consumption on packet delivered in AODV, DSR and DSDV protocols is 150.27, 152.41 and 150.46 mWHr respectively. This comparative study shows AODV protocol having minimum energy consumption given area of MANET. Figure 12 shows the effects of PDR with increasing area of MANET. Average Packet Delivery Ratio of AODV, DSR and DSDV protocol is 0.52, 0.39 and 0.45 respectively. Comparative studies of these three protocols shows that AODV protocols has maximum Packet Delivery Ratio as compare to other two protocols on same area of MANET.

Overall study of effect of area of MANET shows that no. of collisions is less as compared to other two protocols. Average Energy consumption in AODV, DSR and

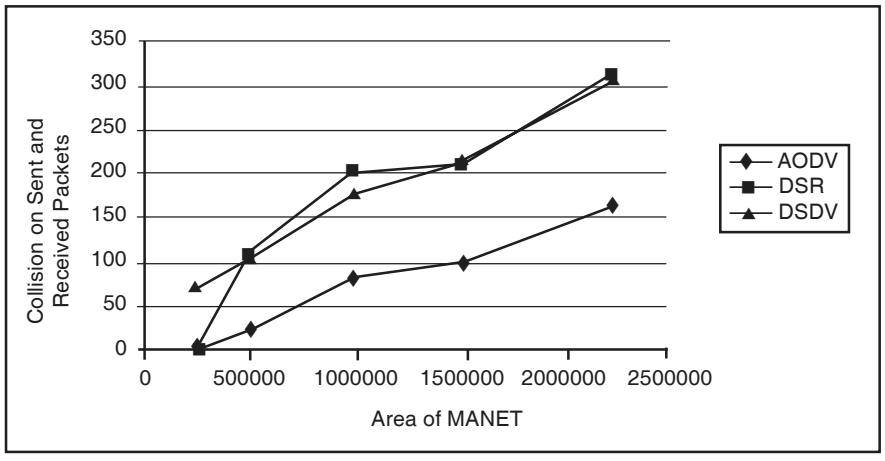


**Figure 10: Effect on Area of Manet on Collisions**

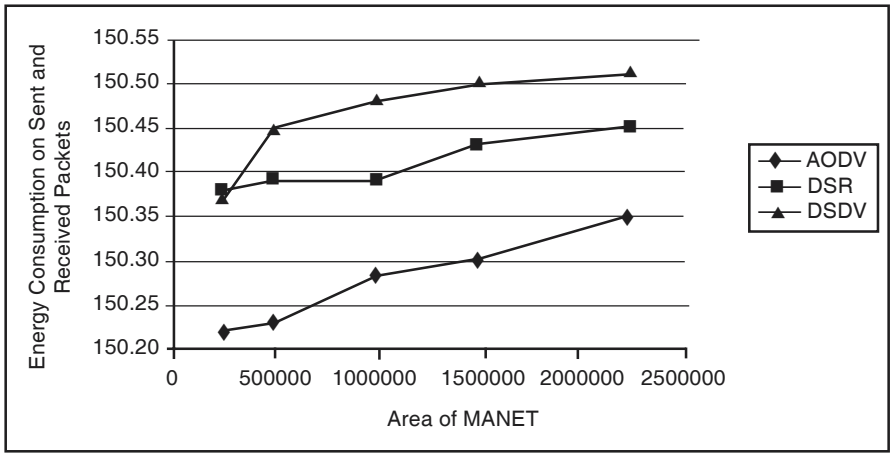


**Figure 11: Effect on Area of Manet on Energy Consumption**

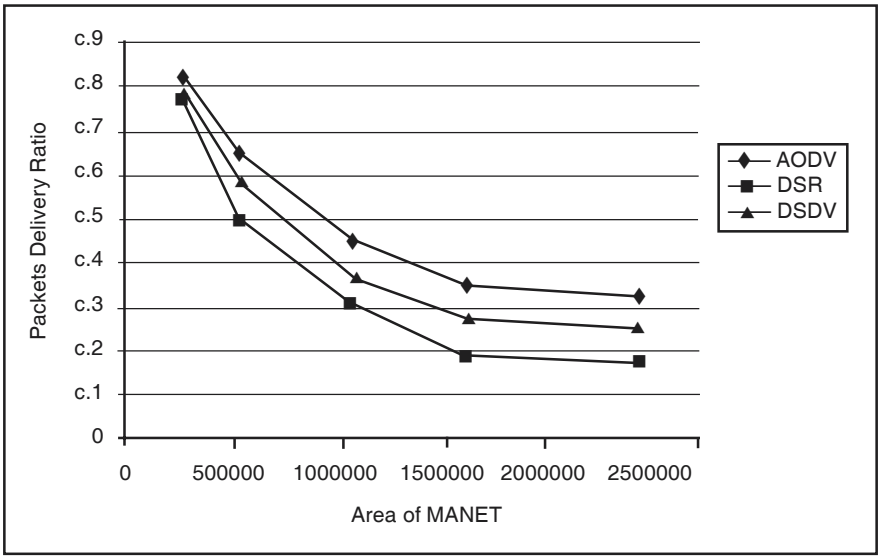


**Figure 12: Effect on Area of Manet on PDR**

DSDV protocol is 150.27, 152.41 and 150.46 mWHr respectively. This comparative study shows that AODV protocol having minimum Energy Consumption in given area of MANET. In Packet delivery ratio AODV is much better than DSDV and DSR.

## 5. CONCLUSION

In this paper, AODV, DSR and DSDV routing protocol were studied .The performance evaluation parameters for these protocols were PDR, Collisions & Energy Consumption

and it was found that effect of mobility shows that no. of collisions in AODV is less as compared to other two protocols. Energy Consumption of DSDV is more as compared to AODV and DSR. Packet delivery Ratio of AODV is much better than DSDV. The effect of changing the no of transmit nodes shows that average collision and energy consumption is better for AODV as compared to other protocols. DSDV has less packet delivery ratio as compared to other two if no of nodes are increased. The effect of changing no. of CBR links shows that average energy consumption is less in case of AODV. PDR is also better in case of AODV. The effect of changing area of MANET also shows that energy consumption and PDR is better in case of AODV.

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