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Performance Comparison and Analysis of AD-Hoc Routing Protocols (DSDV, AODV) in MANET bearing CBR and FTP Traffic.

Md Ashek Raihan Mahmud, Md Saifuzzaman, Khandaker Takdir Ahamed
Akm Wahed Juberi
(Associate Professor, Dept. of Information and Communication Engineering, Islamic University, Bangladesh)
(B.Sc(Hon's) Dept. of Information and Communication Engineering, Islamic University,Bangladesh)
(M.Sc. Dept. of Information and Communication Engineering, Islamic University,Bangladesh)
(Lecturer, Dept. of Information and Communication Engineering, Islamic University, Bangladesh)
Corresponding Author: Md Ashek Raihan Mahmud

Abstract: *An ad hoc network is a dynamic collection of mobile nodes forming a network. It works in infrastructure less environment. As mobile ad hoc network applications are deployed, many issues become vital such as routing stability, end to end delay, security and power. There are various routing protocols available for MANETs. The most popular ones are DSDV and AODV. In this work, an attempt has been made to compare these two protocols on the basis of performance basis under different environments. The comparison has been done under the CBR, FTP payload. The tools used for the simulation are NS2 which is the main simulator, NAM (Network Animator) and Tracegraph which is used for preparing the graphs from the trace files. The results presented in this project work clearly indicate that the different protocols behave differently under different environments. The results also illustrate the important characteristics of different protocols based on their performance and thus suggest some improvements in the respective protocols.*

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I. Introduction

A Mobile Ad hoc Network (MANET) is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which forms an arbitrary topology. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet.The transport layer protocols are responsible for hooking up the programs that are communicating with each other, whereas the underlying IP is simply responsible for getting the packets from machine to machine. It is necessary to understand the characteristics and performance of different data and traffic agents that take the responsibility to transport data in the network to find the suitability of each type in a network.

The objective of this project is to evaluate and compare the performance of different traffic patterns used by the above mentioned transport layer protocols over various ad-hoc routing protocols in terms of different metrics.

1.1 Protocols Under Consideration:

1.1.1 Destination-Sequences Distance Vector (DSDV) Routing Protocol

The destination sequenced distance-vector routing protocol (DSDV) is one of the first protocols proposed for ad hoc wireless networks. It is an enhanced version of the distributed Bellman-Ford algorithm where each node maintains a table that contains the shortest distance and the first node on the shortest path to every other node in the network. It incorporates table updates with increasing sequence number tags to prevent loops, to counter the count-to-infinity problem, and for faster convergence.As it is a table-driven routing protocol, routes to all destinations are readily available at every node at all times. The tables are exchanged between neighbors at regular intervals to keep an up-to-date view of the network topology. The tables are also forwarded if a node observes a significant change in local topology. The table updates are of two types: incremental updates and full dumps. An incremental update takes a single network data packet unit (NDPU), while a full dump may take multiple NDPUs. Incremental updates are used when a node does not observe significant changes in the local topology. A full dump is done either when the local topology changes significantly or when an incremental update requires more than a single NDPU. Table updates are initiated by a destination with a new sequence number which is always greater than the previous one. Upon receiving an updated table, a node either updates its tables based onthe received information or holds it for some time to select the best metric(which may be the lowest number of hops) received from multiple versions of the same update table from different neighboring nodes. Based on the sequence number of the table update, it may forward or reject the table.

1.1.2 Ad-hoc On-demand Distance Vector (AODV)Routing Protocol-:

On request or Reactive routing protocols were intended to beat the overhead that was made by proactive routing protocol in the event of expansive and exceptionally dynamic network. AODV depends on Bellman-Ford Distance algorithm [9]. It is on-request routing protocol. In this routing protocol, route is finding from source to destination just on request premise.AODV is guide full routing protocol implies trading of hello message to make the association with the neighbours.AODV have the different stages like route discovery stage, route maintenance stage, route table management and local connectivity management.In route discovery stage the source node speak with the destination node through the intermediate nodes. The route request for (RREQ) sends by the source node. This RREQ contain source address, destination address, source sequence number, destination succession number, communicate id and TTL. The source sequence number is utilized to maintain a strategic distance from the loops. The source sequence number and the destination succession number are utilized to keep up the most combine is utilized to recognize the RREQ exceptionally.At the point when a node finds link break then it communicates route error packets to its neighbours.

The goals of this Project are to:

-Get a general understanding of mobile ad hoc networks & protocols.

-Generate simulation scenarios for performance measurement and enhancement.

-Implementation UDP and TCP separately over AODV and DSDV routing protocols theoretically and through simulation.

II. Simulation and Performance Evolution

2.1.Simulation Environment

The simulator used to simulate the ad hoc routing protocols is the Network simulator2 (Ns2) [1] that is developed by the CMU Monarch project at Carnegie Mellon University.

Table1: Simulation Setup for Phase1

Simulator	NS-2.29
Simulation Area	1000m X 1000m
Mac protocol	IEEE 802.11
Antenna type	Omni-antenna
Packet size	512 byte
Routing protocol	DSDV & AODV
Traffic Source	UDP,TCP
Simulation time	200 s
Mobility model	Random way point
Number of Node	30
Speed	5,10,15,20,25,30m/s

Phase 2: In this Phase, we considered fixed mobility speed of 5 m/s and fixed pause Time of 50s and measured the performance only by varying the number of nodes. Each simulation lasted for a period of 200s with 10, 20, 30, 60, 90 and 120 nodes. In Table 2, we have summarized the model parameters that have been used for phase

Table2: Simulation Setup for Phase2

Simulator	NS-2.29
Simulation Area	1000m X 1000m
Mac protocol	IEEE 802.11
Antenna type	Omni-antenna
Packet size	512 byte
Routing protocol	DSDV & AODV
Traffic Source	TCP,UDP
Simulation time	200 s
Mobility model	Random way point
Number of Node	10,20,30,60,90,120
Speed	5m/s

2.2 Performance Evolution Matrix

There are two main performance parameters that are considered Packet delivery fraction and Average End to End delay. Packet delivery fraction accounts to the percentage of packets delivered when the network is subjected to different traffic conditions. These two parameters are evaluated through the two phases of the project to make the performance analysis of the ad-hoc routing protocols.

Packet Delivery Fraction (PDF): It is the ratio of data packets received to packets sent. It tells us about the fraction of the packets delivered from source to destination.
PDF = Number of packets Received/ Number of packets sent

End to End Delay (EED): A networks end-to-end delay is defined as the average time interval between the generation and successful delivery of data packets for all nodes in the network, during a given period of time. Packets that are discarded or lost are not included in the calculation of this metric.
Average End-to-End Delay = ∑tPR - ∑tPS
Where,
tPR – Packet Receive Time,
tPS – Packet Send Time.

It is an important routing performance metric since voice and video applications are especially dependent on low latency to perform well. End-to-end delay is to some extent dependent on PDR. That is because if fewer packets are delivered then the average is calculated from fewer samples. The end to end delay should be decreased as much as possible to get a better performance in MANET.

III. Performance evaluation and analysis

3.1 PDFPerformance analysis by varying mobility speed (phase 1):

While defining the simulation metrics, packet delivery fraction is calculated by dividing the total number of data packets delivered at all the nodes, by the total number of data packets generated by the sources getting result by percentage. The number of data packets successfully delivered at the destination depends mainly on path availability, which in turn depends on how effective the underlying routing algorithm is in a mobile scenario.

In the **figure 3(a),** the packet delivery fractions are plotted at different speeds to see how the PDF varies for different network scenarios.

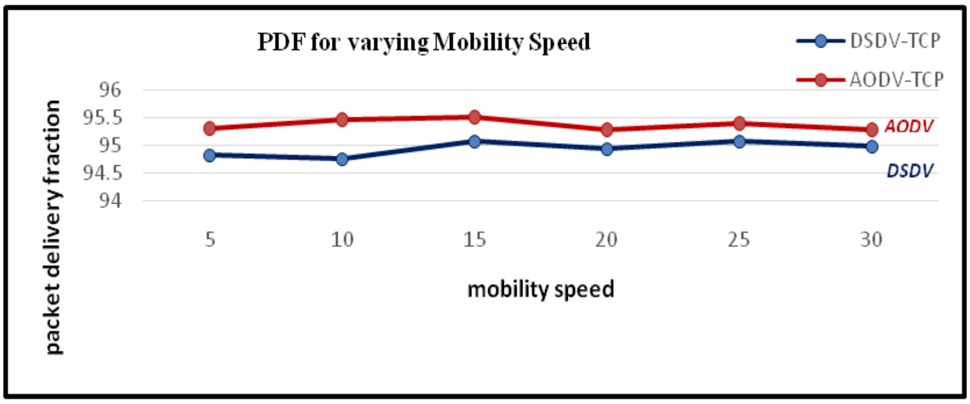

Figure 3.1(a): PDF comparison between AODV & DSDV for variable speed.

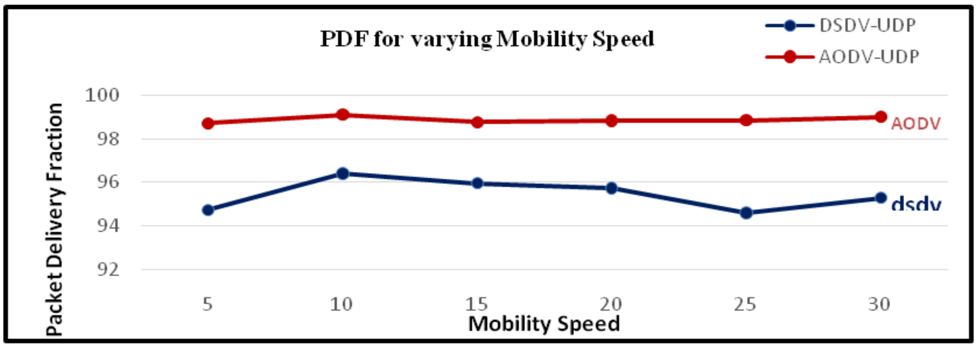

Figure 3.1(b): PDF comparison between AODV & DSDV for variable speed

Figure 3.1(a) shows that AODV offers higher PDF than DSDV. An optimization of AODV is the local repair of link breaks in active routes. When a link break occurs, instead of sending a RERR to the source, the node upstream of the break can try to repair the link locally itself. If successful, fewer data packets are dropped because the route is repaired more quickly.

In case of UDP traffic Reactive protocols deliver almost all the originated data packets converging to 100% delivery whereas Proactive protocols (DSDV) Packet Delivery Ratio is approx. 95% **(Figure 3.1(b)).**

Table 3.1: Simulated Result of PDF for variable speed

Node	Speed	AODV		DSDV	
		TCP	UDP	TCP	UDP
30	5	95.3017	98.7	94.8248	94.76
	10	95.4621	99.09	94.7581	96.42
	15	95.5108	98.73	95.0695	95.98
	20	95.2779	98.81	94.9348	95.75
	25	95.3907	98.83	95.0723	94.61
	30	95.2739	98.99	94.9831	95.30

3.2 End to End Delay Performance analysis by varying mobility speed (phase 1):

This metric is a measure of how efficient the underlying routing algorithm is, because primarily the delay depends upon optimality of path chosen, the delay experienced at the interface queues and delay caused by the retransmission at the physical layer due to collisions. The following figures shows that the End-to-End delay measured in second for transferring TCP packets from source to destination over three routing protocols.

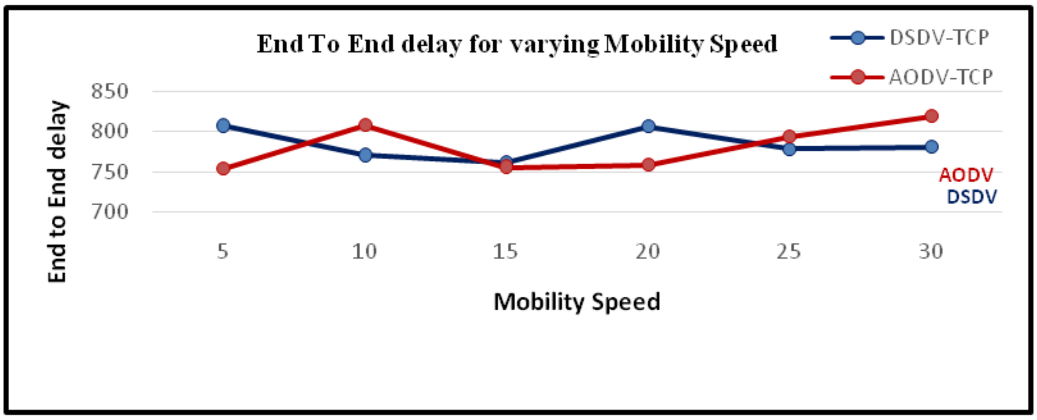

Figure 3.2(a): E2E Delay comparison between AODV & DSDV for variable speed.

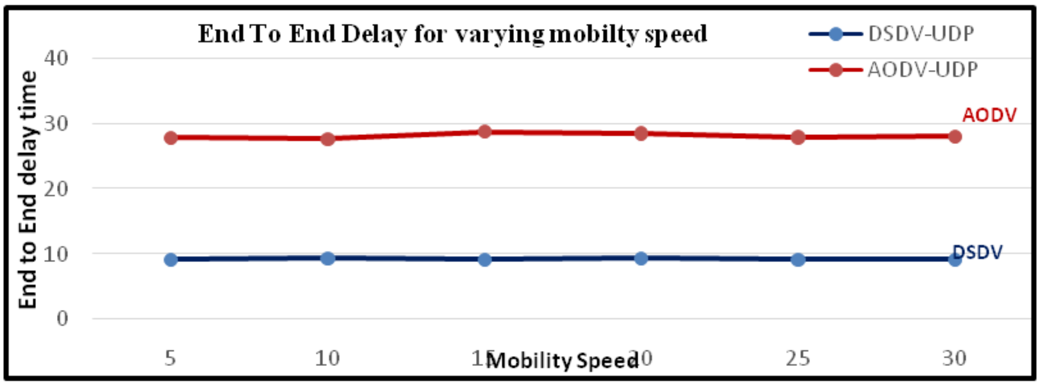

Figure 3.2(b): E2E Delay comparison between AODV & DSDV for variable speed

In Figure 3.2 end-to-end delay for varying mobility speed is plotted. These graphs show the comparison between AODV & DSDV with variation speed on the basis of average end-to end delay. In each graph delay for AODV Routing protocols is higher than DSDV. AODV operation totally depends on route request & route reply strategies. So there is a long time required to find a new path b/w source &destination. While DSDV is a table drive protocol, in DSDV no need of Route request & Route Reply due to this delay of DSDV is less as compare to AODV

Table 3.2: Simulated Result for End-to-End Delay for variable speed

Node	Speed	AODV		DSDV	
		TCP	UDP	TCP	UDP
30	5	754.134	27.94	807.857	9.15
	10	808.672	27.7	771.291	9.30
	15	756.237	28.81	761.265	9.16
	20	759.141	28.57	806.395	9.36
	25	794.002	27.95	778.324	9.23
	30	819.513	28.1	781.104	9.21

3.3 PDFPerformance analysis by varying node number (phase 2):

In the **figure 3.3**, the packet delivery fractions are plotted at different node number to see how the PDF varies for different network scenarios.

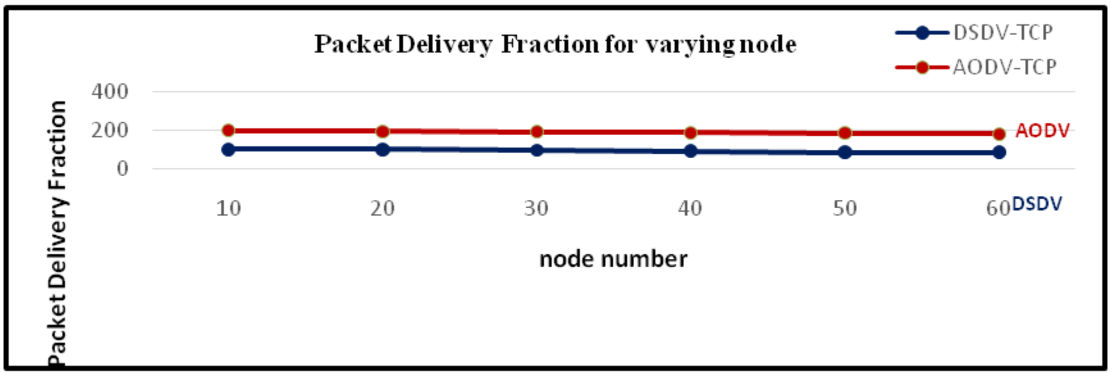

Figure 3.3(a): PDF comparison between AODV and DSDV for variable node number

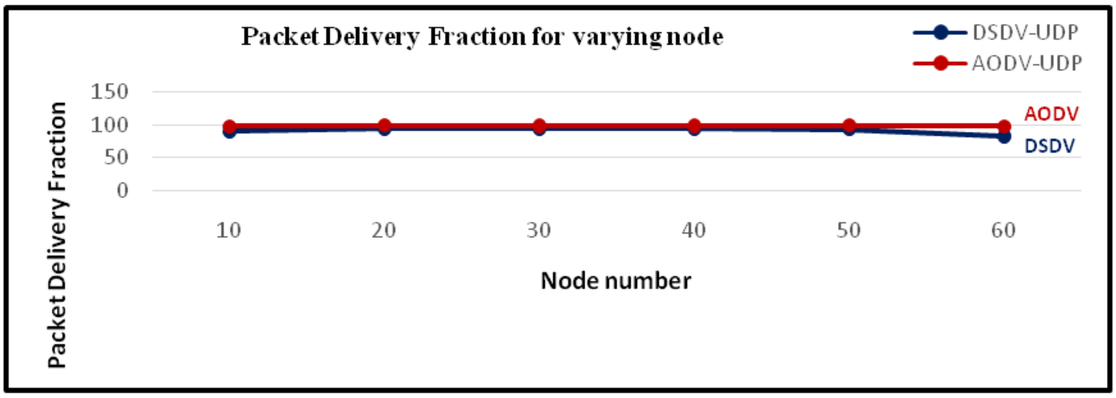

Figure 3.3(b): PDF comparison between AODV and DSDV for variable node number

Overall, Packet delivery ratio of AODV is better than DSDV for all topologies. The reason for DSDV's low packet delivery ratio is that it is a table-driven protocol and updates its table periodically which leads to an increase in the routing load in the network and less packet delivery ratio.

On the other hand, AODV is an on demand routing protocol and adapts faster than DSDV to the change of the routing caused by nodes. AODV can find an alternate route if the current link has broken whereas DSDV is rendered useless at that point. As the Number of nodes increases in the network Packet delivery ratio decreases,

The simulated results of different scenarios for PDF are summarized in the table below.

Table 3.3: Simulated Result for PDF for Phase 2

Node Number	Speed	AODV		DSDV	
		TCP	UDP	TCP	UDP
10	5	98.5523	98.01	98.6226	89.70
20	5	96.5488	99.26	96.5003	94.56
30	5	95.3017	98.7	94.8248	94.76
40	5	95.3015	98.46	89.8380	93.92
50	5	97.4184	98.98	85.7248	93.14
60	5	95.9594	97.74	83.6017	82.58

3.4 End to End DelayPerformance analysis by varying node number (phase 2):

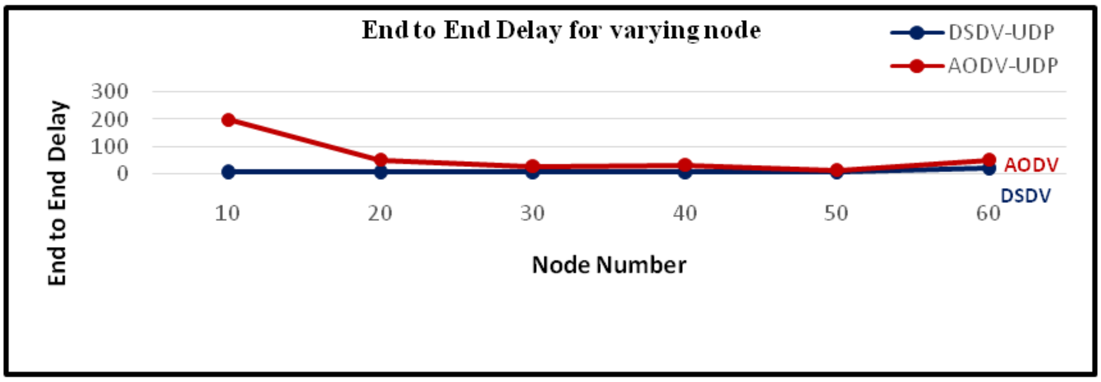

Figure 3.4(a): End-to-End Delay comparison between AODV and DSDV for variable node number

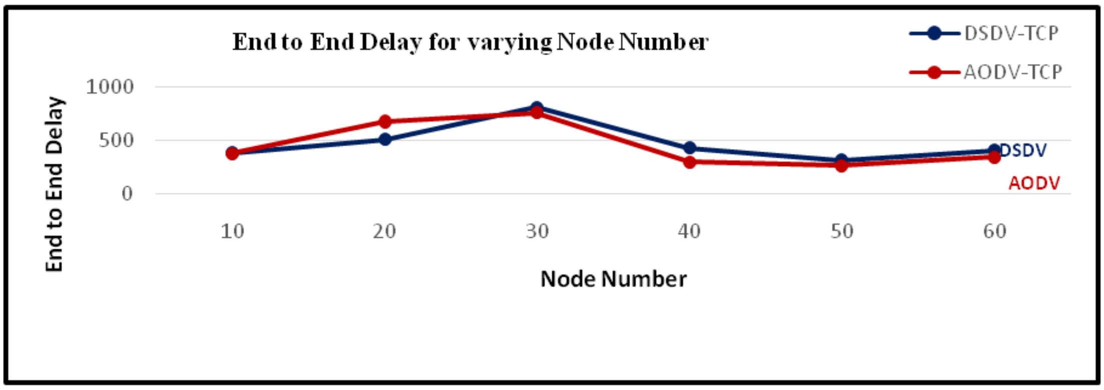

Figure 3.4(b): End-to-End Delay comparison between AODV and DSDV for variable node number

Figure 3.4 shows the performance of Average End to End Delay over AODV and DSDV Protocol by varying Number of nodes.

If a link break occurs in the current topology, AODV would try to find an alternate path from among the backup routes between the source and the destination node pairs resulting in additional delay to the packet delivery time. In comparison, if a link break occurs in DSDV, the packet would not reach the destination due to unavailability of another path from source to destination.

As the Number of nodes increases in the network both Protocols shows a considerable performance.

Table 3.4: Simulated Result for End-to-End Delay for Phase 2

Node Number	Speed	AODV		DSDV	
		TCP	UDP	TCP	UDP
10	5	372.814	198.95	383.82	8.96
20	5	674.212	53.24	511.428	8.42
30	5	754.134	27.91	807.857	9.15
40	5	290.331	35.5	429.957	8.94
50	5	261.515	15.53	315.91	9.59
60	5	336.387	53.88	310.623	21.77

IV. Discussion

Most of the discussion being made is based on previous studies.

– DSDV is a proactive routing protocol, which maintains routes to each and every node in the network, while AODV is a reactive routing protocol which finds the path on demand or whenever the route is required.

– Broadcasting in DSDV is done periodically to maintain routing updates and in AODV, only hello messages are propagated to its neighbors to maintain local connectivity.

– DSDV routing algorithm maintains a sequence number concept for updating the latest information for a route. Even, the same concept is adapted by AODV routing protocol.

– Due to the periodic updates being broadcasted in DSDV, bandwidth is wasted when the nodes are stationary. But, this is not the case with AODV, as it propagates only hello messages to its neighbors.

– For sending data to a particular destination, there is no need to find a route as DSDV routing protocol maintains all the routes in the routing tables for each node. While, AODV has to find a route before sending a data.
– DSDV cannot handle mobility at high speeds due to lack of alternative routes hence routes in routing table is stale. While in AODV this is the other way, as it finds the routes on demand.
-For small network AODV is better for its higher PDF.
- The performance of DSDV is better with more number of nodes in comparison with the performance of AODV, which is consistently uniform. In terms of dropped packets, DSDV's performance is the worst.

V. Conclusion

Packet delivery ratio of AODV is better than DSDV for all topologies. The reason for DSDV's low packet delivery ratio is that it is a table-driven protocol and updates its table periodically which leads to an increase in the routing load in the network and less packet delivery ratio.

On the other hand, AODV is an on demand routing protocol and adapts faster than DSDV to the change of the routing caused by nodes. AODV can find an alternate route if the current link has broken whereas DSDV is rendered useless at that point. As the Number of nodes increases in the network Packet delivery ratio decreases.

The performance of DSDV is better with more number of nodes in comparison with the performance of AODV, which is consistently uniform. In terms of dropped packets, DSDV's performance is the worst. The performance degrades with the increase in the number of nodes. AODV performs consistently well with increase in the number of nodes.

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