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EFFECT OF PAUSE TIME AND NODES ON PERFORMANCE OF AODV AND DSR ROUTING PROTOCOLS IN WIRELESS AD-HOC NETWORKS

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Abstract: A central challenge in designing of wireless ad hoc networks is the development of dynamic routing protocols that can efficiently find routes between two communication nodes when nodes are mobile. To accomplish this, a number of ad hoc routing protocols had been proposed and implemented. In wireless ad hoc network the selected protocol should find best route which can insure packet delivery and packet integrity. Performance evolution of the protocols is the key step before selecting a particular protocol. In this paper, the performance is compared on Ad hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR) at application layer by varying the pause time and number of nodes using QualNet 5.0.2 simulator. The average jitter, end-to-end delay, throughput and packet delivery fraction (PDF) are the four common measures used for the comparison of the performance of above protocols. The experimental results show that DSR perform better in low load and high pause time but in case of high load and less pause time AODV outperform DSR.

Keywords: Average jitter, End-to-End delay, Packet delivery fraction, QualNet 5.0.2 Simulator, Routing protocols, Throughput and Wireless Adhoc Network.

I. INTRODUCTION

Wireless ad hoc networks are collection of wireless nodes sharing a wireless channel without any base station or centralized control. These nodes can act as a router as well as both end system. It has flexible network architecture. There are variable routing paths to provide communication in case of limited wireless connectivity range and resources constraints. Due to the rapidly changing the topology, routing in wireless ad hoc networks can be challengeable task. A considerable amount of research has been done in this area, and number of routing protocols have been developed [2, 3]. Most of these protocols such as AODV, DSR, and DSDV use best effort to find out the routes. Routing protocol is the way to deliver the message from source to the precise destination. Routing protocols can be categorized as proactive routing protocol also known as table driven routing protocols and reactive routing protocols also known as on demand routing protocol [4, 5]. Each of these types of protocols may behave differently on different wireless scenarios. Hence, the performance evolution is main issue to know its behaviour in wireless environment. The main objective of this paper to study the effects on characteristics of AODV and DSR reactive routing protocols on varying the network load and pause time in the proposed scenarios shown in table 1. We emphasized on the four major performance matrices i.e. average jitter, average end-to-end delay, throughput, and packet delivery fraction for comparison of performance of AODV and DSR protocols. The rest of the paper is organized as follows. Section 2 gives the brief idea of DSR and AODV routing protocols used for performance evolution. Section 3 we present literature review. Section 4 describes the methodology and performance metrics. Section 5 discussions the simulation results. Section 6 gives the conclusion of the experimental results.

II. AD HOC NETWORK ROUTING PROTOCOLS

Routing protocol can be reactive and proactive. In Reactive or on-demand routing is a source initiative routing protocols. All possible routing routes are only discovered when they are actually demanded by source nodes. The reactive routing protocols have two major components i.e. route discovery and route maintenance [6-9].

Route discovery: It is required when any source node desires to send a message to the destination; it first looks at its route cache. If the required route is available in cache, the source node puts all the address of the nodes for the path to destination in the header. If route is not present, source node initiate a route discovery process through the broadcasts the packet having the destination address and the address of intermediate nodes to the destination.

Route maintenance: Due to mobility of nodes, the nodes change their topology and hence route maintenance is done through the use of acknowledgement.

In proactive routing protocols each node maintains its routing table. Tables are containing routing information to every other node in the network. Since, the nodes are mobile, so they require updating throughout the network periodically whenever change occurs.

2.1 AD HOC ON-DEMAND DISTANCE VECTOR ROUTING (AODV):

AODV is a reactive routing protocol, which is basically improvement of DSDV proactive routing protocol. It minimizes the number of broadcasts by creating routes based on demand, which is not in the case of DSDV. When any source node wants to send a packet to a destination, it broadcasts a route request (RREQ) packet. The neighbouring nodes in turn broadcast the packet to their neighbours and the process continues until the packet reaches the destination. During the process of forwarding the route request, intermediate nodes record the address of the neighbour from which the first copy of the broadcast packet is received. This record is stored in their route tables, which helps for establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. The reply is sent using the reverse path. If any intermediate node moves within a particular route, the neighbour of the drifted node can detect the link failure and sends a link failure notification to its upstream neighbour. This process continues until the failure notification reaches the source node. Based on the received information, the source might decide to re-initiate the route discovery phase.

2.2 DYNAMIC SOURCE ROUTING (DSR):

DSR is a reactive protocol based on the source route approach. DSR allows the network to be self-organizing without the need for any fixed network infrastructure or administration. Dynamic Source Routing (DSR), the protocol is based on the link state algorithm in which source initiates route discovery on demand basis. The sender determines the route from source to destination and it includes the address of intermediate nodes to the route record in the packet. DSR was designed for multi hop networks for small diameters.

III. LITERATURE REVIEW

During last few years' lot of research work had been done in the area of wireless ad hoc network to compare the performance of the popular routing protocols such as AODV and DSR on the basis of different parametric matrices like Throughput, Average end-to-end delay, Average jitter, Packet delivery fraction etc. Researchers had studied about performance of routing protocols in wireless ad hoc network for different scenarios [10-20]. In [10], the author observed that when increase the pause time DSR outperforms AODV in terms of packet delivery ratio. In that study, they have observed that DSR performs better in both the case of packet delivery fraction and throughput over DSDV routing protocol on varying the nodes [11]. It was seen that proactive routing protocol OLSR performed better than the reactive routing protocols AODV, DSR and TORA for medium size MANETs [12]. In [13] researchers analysed that in low mobility DSR are perform well but in case of high mobility AODV is better performed over DSR. In [14], researcher mentions in result that the DSR shows best performance than AODV, FSR and ZRP in terms of packet delivery ratio and throughput as a function of pause time. FSR show lowest end-to-end delay and ZRP has less average jittering than DSR, AODV and FSR. DSR and AODV performed the worst in case of average jitter and ZRP performed the worst in case of throughput. The authors [15], conducted a comparative study for AODV and DSR, and indicated that the AODV gives better PDF then DSR, while DSR gives better routing overhead and End- to- End delay in most mobility scenarios. In DSR [16] performs better than AODV and WRP in terms of packet delivery ratio and throughput when increase the pause time. In [17], that study, at low network load AODV performs better in case of packet delivery fraction but it performs badly in terms of average end-end delay, routing load and routing packets. At high network load and mobility OLSR performs well with respect to packet delivery fraction. In that study authors [18], simulation results show that amongst all the protocols, AODV has a stable End to End Delay despite mobility as it has the feature of On-Demand Routing protocol and also maintains a Routing table. In [19], authors show that EAODV improves the performance of AODV in most metrics, as the end to end delay, packet delivery fraction, average throughput and packet loss especially in high data rate. Authors observed [20], that DSR and DSDV have low and stable routing overhead as comparison to AODV that varies a lot. Avg. End to End delay of DSDV is very high for pause time 0 but it starts decreasing as pause time increases.

IV. METHODOLOGY AND PERFORMANCE MATRICES

4.1. SIMULATION SETUP

The Our aim of this simulation study is to analyze the performance of AODV and DSR wireless ad hoc routing protocol on the basis of varying nodes and pause time. The simulations have been performed using QualNet version 5.0.2, software that provides scalable simulations of wireless ad hoc networks. The simulation has carryout in terrine dimensions 500X500 with 100 nodes placed randomly and duration fixed 100 sec for each of simulation. The nodes moved following the random waypoint mobility model with 2 seed value and minimum and maximum speed of nodes are 2 and 20 metres per second respectively. The MAC protocol is used the IEEE 802.11b with the 2.4 GHz channel frequency. The nodes have application run on CBR (constant bit rate) traffic. We are taking 512 bytes size for the each packet to send the 10,000 packets in the said environment with the interval of 50 milliseconds.

Table 1

Simulator Parameters	
MAC Layer Protocol	802.11
Routing Protocols	AODV, DSR
Traffic Type	Constant bit rate (CBR)
Mobility Model	Random Way Point
Radio Type	802.11 b Radio
Channel Frequency	2.4 GHz
Interval	50 m/s
Start Time	50 m/s
End Time	0 m/s
1. Scenario Parameters(Varying Number of Nodes)	
Packet size	512
Item to be send	10000
Number of Nodes	10,30,50,70,90,100
Node Placement	Random
Terrine Dimensions	500 X 500
Seed value	2
Simulation time	100 sec
Number of CBR	5
Pause Time	30 sec
Maximum Speed	20 m/s
Minimum Speed	2 m/s
Performance Matrices in Application Layer	PDF, Average Jitter, Average End-to-End Delay, Throughput
2. Scenario Parameters(Varying Pause Time)	
Packet size	512
Item to be send	10000
Number of Nodes	100
Node Placement	Random
Terrine Dimensions	500 X 500
Seed value	2

Simulation time	100 sec
Number of CBR	5
Pause Time	10 ,20,30,40,50sec
Maximum Speed	20 m/s
Minimum Speed	2 m/s
Performance Matrices in Application Layer	PDF, Average Jitter, Average End-to-End Delay, Throughput

4.2. PERFORMANCE MATRICES

To analyze the performance of routing protocols, metrics are needed. So, we use four different metrics to compare the performance. They are:
Average Jitter: It is the variation in the time between packets arriving. Jitter is commonly used as an indicator of consistency and stability of a network.
Throughput: Throughput is the number of packet that is passing through the channel in a particular unit of time.
Average End-to-End Delay: End-to-end delay indicates how long it took for a packet to travel from the source to the application layer of the destination.
Packet Delivery Fraction: The fraction of packets sent by the application that are received by the receivers.

V. RESULTS AND DISCUSSION

In this paper the performance evaluation is carried out in wireless ad hoc network by varying two parameters i.e. number of nodes and pause time while keeping other parameters fixed. AODV and DSR protocols are considered for the analysis purpose.

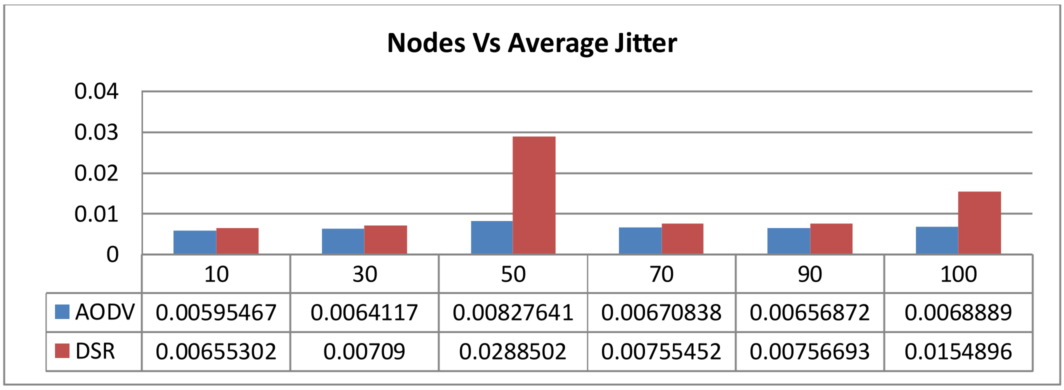


Fig. 1(a): Comparison of AODV and DSR Protocols with respect to Nodes Vs Average Jitter in Application Layer.

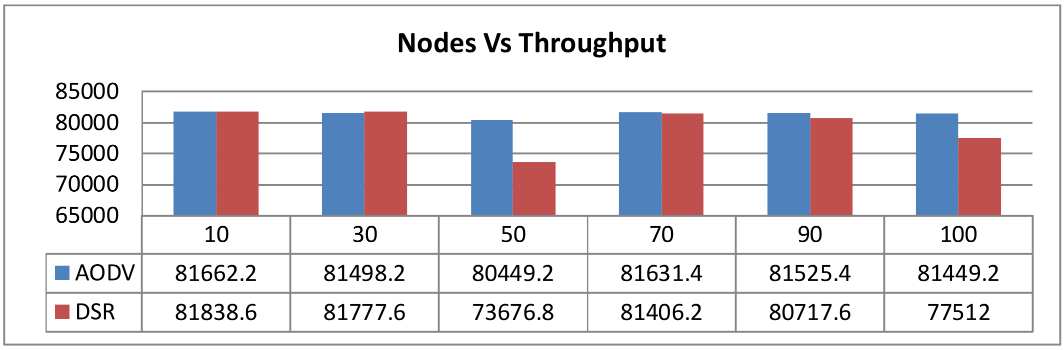


Fig. 1(b): Comparison of AODV and DSR Protocols with respect to Nodes Vs Throughput in Application Layer

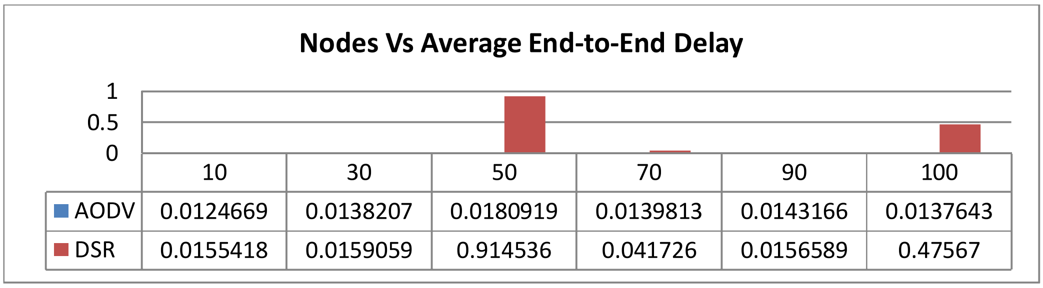


Fig. 1(c): Comparison of AODV and DSR Protocols with respect to Nodes Vs Average End – to-End Delay in Application Layer.

Table 2

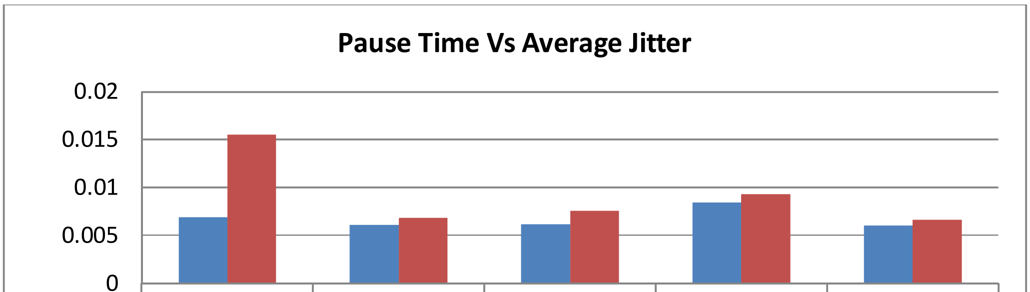
Comparison of AODV and DSR Protocols with respect to PDF in Application Layer on the basis of varying nodes.

AODV				DSR		
Nodes	Packet Received	Packet Send		Nodes	Packet Received	Packet Send
10	1992.2	1999		10	1995.4	1999
30	1988.2	1999		30	1992.6	1999
50	1961.6	1999		50	1791.6	1999
70	1991.6	1999		70	1984.2	1999
90	1989	1999		90	1967.2	1999
100	1986.6	1999		100	1884.8	1999
	11909.2	11994			11615.8	11994
PDF=	99.29297982			PDF=	96.84675671	

5.1. NETWORK LOAD ANALYSIS:

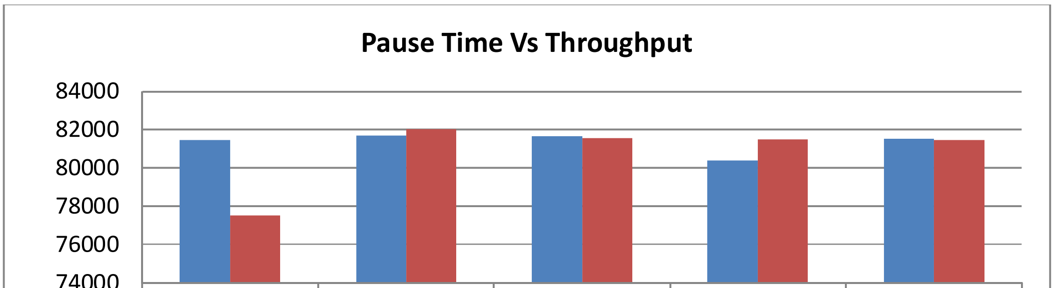
In this analysis the number of nodes varied as 10, 30, 50, 70, 90, and 100 where as the pause time, terrain dimension and simulation time are fixed at 30s, 500X500 and 100s respectively with 5 random CBR.

The performance plots i.e. Number of nodes Vs Average jitter, Number of nodes Vs Throughput, Number of nodes Vs Average End-to-End delay, and Numbers of nodes Vs Packet delivery fraction is shown fig 1(a), (b), (c), and table 2 respectively. In terms of average jitter the DSR and AODV have slightly differed up to 10 to 30 nodes but as increase the nodes the average jitter value of DSR is high as compared to AODV. But it is not fixed; vary as increase the number of nodes. From fig 1(b) the throughput of DSR is better than AODV up to 10 to 30 nodes but as increase number of nodes throughput is better in case of AODV than DSR. So we are observed that AODV outperform the DSR when the network load is high. Similarly the average end-to-end delay of DSR and AODV is likely similar up to 10 to 30 nodes. But as increase the number of nodes the average end-to-end is greater in case of DSR than AODV shown in fig 1(c). The PDF calculated value of AODV and DSR is 99.29297982 and 96.84675671 respectively as shown in table 2. According to the result the PDF value of AODV is greater than DSR as increase the network loads.



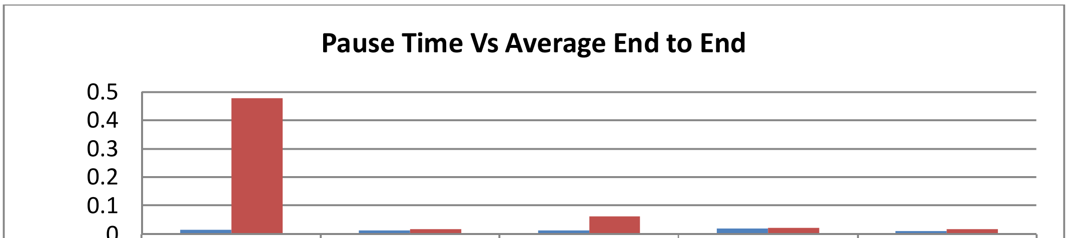
	10	20	30	40	50
AODV	0.0068889	0.00610351	0.0061824	0.00843398	0.00601519
DSR	0.0154896	0.00686299	0.0075451	0.00930424	0.00657086

Fig. 2(a): Comparison of AODV and DSR Protocols with respect to Pause Time Vs Average Jitter in Application Layer



	10	20	30	40	50
AODV	81449.2	81706	81674.4	80376.2	81503.6
DSR	77512	82017	81557.8	81484.8	81445.4

Fig. 2(b): Comparison of AODV and DSR Protocols with respect to Pause Time Vs Throughput in Application Layer



	10	20	30	40	50
AODV	0.0137643	0.0118307	0.0133239	0.0182973	0.0111597
DSR	0.47567	0.0170689	0.0632807	0.0237423	0.0174015

Fig. 2(c): Comparison of AODV and DSR Protocols with respect to Pause Time Vs Average End – to-End Delay in Application Layer

Table 3

Comparison of AODV and DSR Protocols with respect to PDF in Application Layer on the basis of varying pause times.

AODV				DSR		
Pause Time	Packet Received	Packet Send		Pause Time	Packet Received	Packet Send
10	1986.6	1999		10	1884.8	1999
20	1993.4	1999		20	1993.6	1999
30	1992.4	1999		30	1988.2	1999
40	1961	1999		40	1983.2	1999
50	1988	1999		50	1980.4	1999
PDF=	99.26363182			PDF=	98.35117559	

5.2. PAUSE TIME ANALYSIS:

In simulation we considered the following pause times: 10s, 20s, 30s, 40s, and 50s with minimum and maximum speed of nodes is 2s and 20s respectively. And the number of nodes is fixed at 100 for each scenario of different pause time keeping all other parameters constant. The performance plots i.e. Pause time Vs Average jitter, Pause time Vs Throughput, Pause time Vs Average End-to-End delay, and Pause time Vs Packet delivery fraction is shown fig 2(a), (b), (c), and table 3 respectively. In terms of average jitter when pause time (0-10 m/s) DSR has higher average jitter as compare to AODV but as increase the pause time the average jitter of DSR is decreases but higher than AODV shown in fig 2(a). As shown in fig 2(b) in case of throughput the DSR is better performing as compare to AODV when as increase the pause time. But when the pause time less then 20m/s the AODV protocol is much better perform as compare to DSR. According to result shown in fig 2(c) average end-to-end Delay of reactive routing protocol DSR is higher than AODV at 10 m/s pause time. When as increase the pause time the average end-to-end delay is decrease for DSR but it is not fixed for particular range. Similarly the packet delivery fraction value on varying the pause time as shown in table 3 of AODV is better as compare to DSR protocol. The calculated PDF value for AODV is 99.26363182 and 98.35117559 for DSR.

VI. CONCLUSION

This paper compares the performance of two reactive routing protocols according to the four performance matrices i.e. Throughput, Average Jitter, Average End-to-End Delay, and Packet Delivery Fraction (PDF) on the basis of varying the number of nodes and pause times respectively. In considered mobility scenarios, AODV gives better PDF, Throughput and less average end-to-end delay, and average jitter than DSR in high load of the nodes and less pause time. In low load DSR are perform better than AODV routing protocol.

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