Comparative Performance Analysis of Study of Routing Protocols for Adhoc Networks

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Abstract— A mobile ad hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure. A number of routing protocols like Destination Sequenced Distance Vector Routing (DSDV), Dynamic Source Routing (DSR) and Ad Hoc On-Demand Distance Vector Routing (AODV) have been implemented. This paper presents the comparative performance analysis of three routing protocols for mobile ad hoc networks by analyzing them through various protocol properties. A network simulator has been used for performance evaluation of Routing protocols in this paper. To compare the performance of these routing protocols, the simulation results were analyzed using graphs and trace file based on Quality of Service metrics such as throughput, packet delivery fraction, packet loss and average end-to-end delay by varying network size up. The results presented in this paper clearly indicate that the protocols behave differently under different environments.

Keywords— *MANET; AODV;DSDV; DSR*

I. INTRODUCTION

The fast growth of mobile communication in recent years is especially observed in the field of mobile system, wireless local area network, and ubiquitous computing. The rapid growth in the mobile communication is mainly due to the mobility offered to end users, providing information access to anywhere, easy deployment, and user friendliness. The set of mobile terminals that are placed in a close location communicating with each other, sharing services ,resources or computing time during a limited period of time and in a limited space forms Spontaneous ad hoc networks. Network management should be transparent to the user. These types of networks have independent centralized administration; user can enter the networks and leave the networks easily.

A mobile ad-hoc network is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers connected by wireless links - the union of which form an arbitrary topology [1][2]. The routers are free to move randomly and organize themselves arbitrarily thus, the network's wireless topology may change rapidly and unpredictably [3]. Routing is the process of moving a data packet from source to destination. Routing is usually performed by a dedicated device called a router. Part of this process involves analyzing a routing table to determine the best path.

One of the important research areas in MANET is establishing and maintaining the ad hoc network through the use of routing protocols. However there are so many routing protocols present, this paper mainly focuses some of the routing protocols i.e. AODV, DSR and DSDV due to its familiarity among all other routing protocols.

The rest of this paper is organized as follows. Section II briefly discusses the MANET routing protocols i.e. DSDV [4], AODV [5-6] and DSR [7], and describes the comparative analysis of approaches using various protocol properties i.e. Loop Free, QoS Support, Distributed, Multicast Routes and Demand based Operations etc. Section III describes the simulation environment and results by considering different performance metrics. Finally, Section IV concludes the paper and discusses the future scope of work.

II. MOBILE ADHOC NETWORK ROUTING PROTOCOLS

In this section, we have described the various routing protocols that are used for Mobile Adhoc Networks.

A. Destination-Sequenced Distance-Vector (DSDV) Protocol

DSDV is a table driven routing scheme for ad-hoc mobile networks based on the Bellman-ford algorithm. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing table by using sequence numbers[4]. Each node acts as a router where a routing table is maintained and periodic routing updates are transfer, even if the routes are not necessary. A sequence number is associated with each route or path to the destination to prevent routing loops. The Routing updates are exchanged even if the network is idle which uses up battery and network bandwidth. So, it is not preferable for highly dynamic networks.

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B. Ad hoc On-Demand Distance Vector Routing (AODV)

The Ad hoc On Demand Distance Vector routing algorithm is a routing protocol designed for ad hoc mobile networks [5][6]. It makes routes using a route request / route reply query cycle. When a source node wants a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this data packet update their information for the source node and set up backwards pointers to the source node in the routing tables. A node receiving the RREQ may send
a route reply (RREP) if it is either the destination or if it has number more than or equal to that contained in the RREQ [5]. It uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes [5]. Figure 1(a) and 1(b) shows the example of sending RREQ packet and RREP Packet.

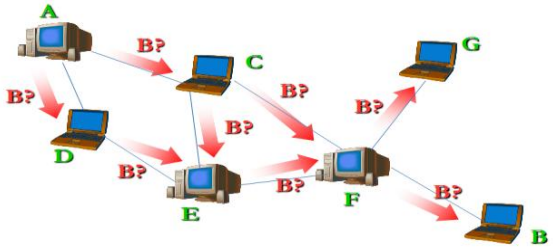

Figure 1 (a): RREQ Message[5]

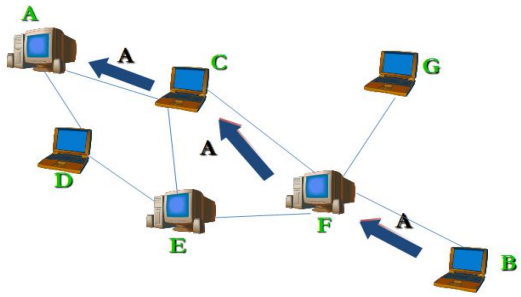

Figure 1 (b): RREP Message[5]

C. Dynamic Source Routing (DSR)

Dynamic Source Routing is a Pure On-Demand routing protocol, where the route is calculated only when it is necessary. It is designed for use in multi hop ad hoc networks of mobile nodes. It has only two major processes which are Route Discovery and Route Maintenance [7]. The key property of Dynamic source routing is the use of source routing instead of relying on the routing table at each intermediate device . Each node receiving a route request packets, rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the original source node. RREQ and RREP packets are also source routed.

DSR allows the network to be self-organized and self-configured without any central administration and network setup. It uses no periodic routing messages like AODV, thus reduces bandwidth overhead and conserved battery power and also huge routing updates. It needs only the effort from the MAC layer to identify link failure's uses source routing where the whole route is carried as an overhead. In DSR, the whole route is carried with the message as an overhead, whereas in AODV, the routing table is maintained thus it is not required to send the whole route with the message during the Route Discovery process.

Table 1 show below the comparison between Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV), and Destination-Sequenced Distance-Vector Routing (DSDV).

TABLE I. Comparative Routing Properties Analysis of Protocols

S.No	Protocol Property	AODV	DSR	DSDV
1.	Loop Free	Yes	Yes	Yes
2.	Distributed	Yes	Yes	Yes
3.	Multicast Routes	No	No	Yes
4.	QoS Support	Yes	Yes	Yes
5.	Periodic Broadcast	Yes(comparatively less as in DSDV)	No	Yes
6.	Demand based Operation	Yes	Yes	No
7.	Route Maintained in	Route Table	Route Cache	Route Table

III. PERFORMANCE ANALYSIS AND SIMULATION RESULTS

In order to evaluate the performance of ad hoc network routing protocols, the following Performance metrics is considered:

1) **End-to-End Delay:** The average time interval consumed between the generation of a packet in a source node and the successfully delivery of the packet at the destination node.
2) **Packet Delivery Fraction:** The ratio of the number of data packets successfully delivered to all destination nodes and the number of data packets generated by all source nodes.
3) **Number of Packets Dropped:** The number of data packets that are not successfully delivered to the destination.
4) **Throughput:** The throughput metric measures how well the network can constantly provide data to the

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sink. Throughput is the number of packet arriving at the sink per millisecond.

a) Simulation Environment

The following simulation parameters have been taken for the simulation and are presented in Table II:

TABLE II. Simulation Parameters

Channel type	Channel/Wireless Channel
Radio-propagation model	Propagation/TwoRayGround
Network interface type	Phy/WirelessPhy
MAC type	Mac/802_11
Interface queue type	Queue/Drop Tail/PriQueue
Link layer type	LL
Antenna model	Antenna/Omni Antenna
Max packet in ifq	50
X dimension of topography	500
Y dimension of topography	400

b) Simulation Results

Table III and Table IV show the performance of DSDV, AODV and DSR Routing Protocols, by calculating different performance network metrics such as Average throughput, packet delivery fraction, packet loss and average end-to-end delay etc on 10-node Adhoc network at varying Start and Stop Time of Simulation.

TABLE III. Simulation Results for 10-node Adhoc Networks

S.No	Performance Metric	DSDV	AODV	DSR	DSDV	AODV	DSR
1.	**Start Time (s)**	10	10	10	10	10	10
2.	**Stop Time (s)**	50	50	50	100	100	100
3.	**Generated Packets**	5316	5162	4357	14232	14919	12022
4.	**Received Packets**	2601	2566	2156	7035	7440	5984
5.	**Packet Delivery Ratio**	48.9278	49.71	49.48	49.43	49.8693	49.7754
6.	**Total Dropped Packets**	18	16	19	27	24	36
7.	**Avg. End-to- End Delay(ms)**	72.9527	101.95	279.852	139.567	168.924	163.81
8.	**Avg. Throughput (kbps)**	4616	5457	5754	15798	19180	18980

TABLE IV. Simulation Results for 10-node Adhoc Networks

S.No	Performance Metric	DSDV	AODV	DSR	DSDV	AODV	DSR
1.	**Start Time(s)**	10	10	10	10	10	10
2.	**Stop Time (s)**	150	150	150	200	200	200
3.	**Generated Packets**	22806	23380	22670	27385	30181	27622
4.	**Received Packets**	11303	11668	11315	13571	15057	13790
5.	**Packet Delivery Ratio**	49.5615	49.91	49.92	49.56	49.89	49.92
6.	**Total Dropped Packets**	15	42	25	25	65	30
7.	**Avg. End-to- End Delay(ms)**	97.9197	101.023	100.41	93.6956	185.362	148.373
8.	**Avg. Throughput (kbps)**	27288	30492	42960	29771.62	37913	52759

The graphs below show the behaviour of DSDV, AODV and DSR with respect to various metrics considered above. The X-axis shows the simulation time and Y-axis shows the metrics considered for simulation.

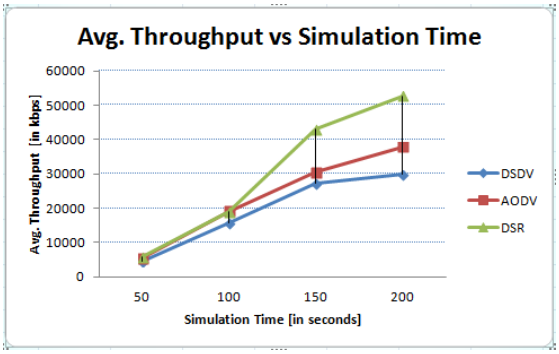

Figure 2 (a): Average Throughput vs. varying Simulation Time

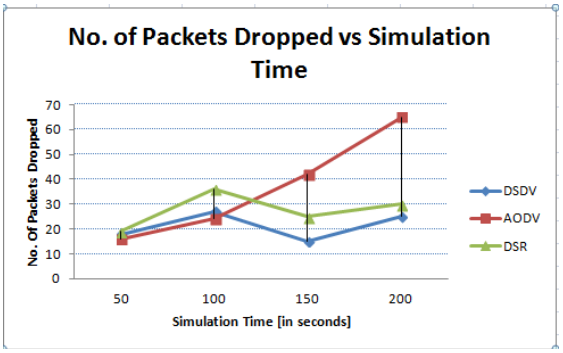

Figure 2(b): No. of Packet Dropped vs. varying Simulation Time

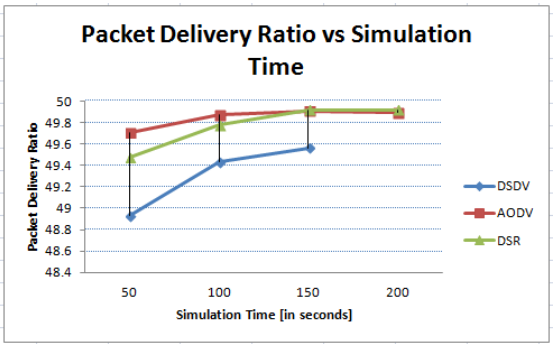

Figure 2(c): Packet Delivery Ratio vs. varying Simulation Time

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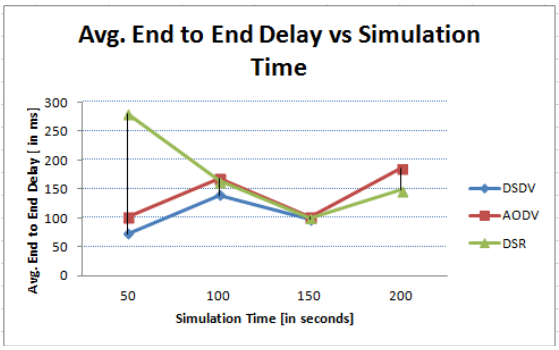

Figure 2(d): Average End to End Delay vs. varying Simulation Time

The graphs below show the performance of the various routing protocols with respect to various metrics considered above. Now, The X-axis shows the no. of nodes and Y-axis shows the metrics considered for simulation. Simulations were carried out with the number of nodes as 10, 25, 50 and 75.

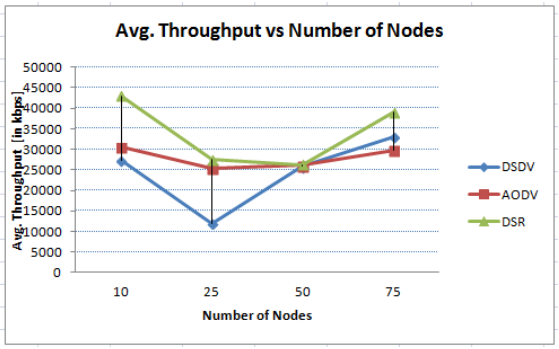

Figure 3(a): Average Throughput vs. varying Number of Nodes

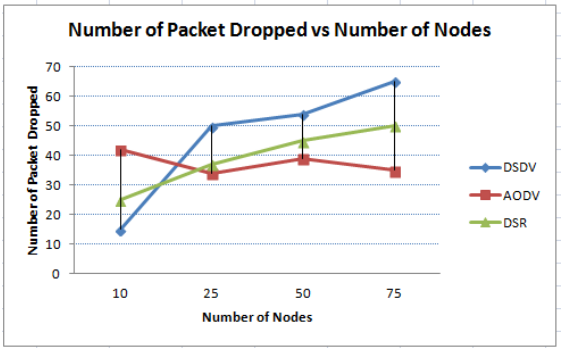

Figure 3(b): Number of Packet Dropped vs. varying No. of Nodes

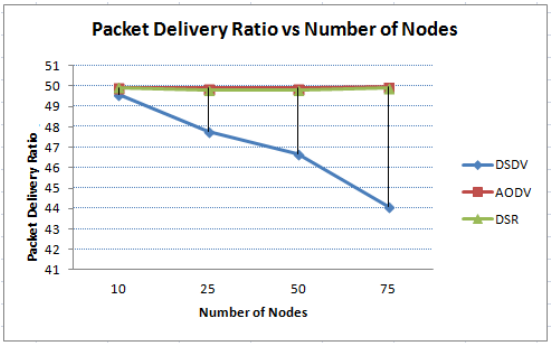

Figure 3(c): Packet Delivery Ratio vs. varying Number of Nodes

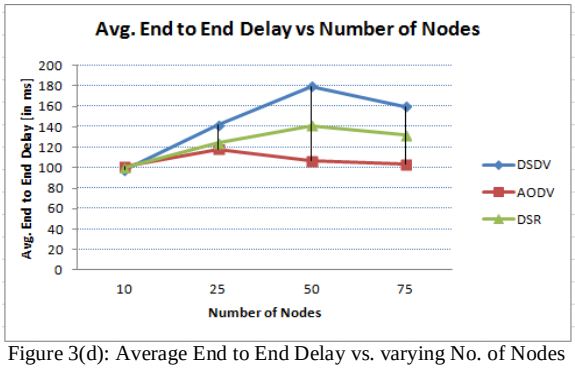

Figure 3(d): Average End to End Delay vs. varying No. of Nodes

1. **Throughput:** Figure 3(a) shows that with increase in number of nodes, the throughput of DSR increases as compared to AODV and DSDV. But throughput of AODV tends to be much constant as compared to DSDV and DSR.

2. No. of Packed Dropped: Figure 3(b) shows that the behaviour of AODV, DSR and DSDV in case of no. of packet dropped in which the no. of packet dropped in case of AODV is less as compared to DSR and DSDV with varying number of nodes.

3. Packet Delivery Ratio: Figure 3(c) shows the packet delivery ratio for AODV and DSR remains constant with increase in no. of nodes whereas the packet delivery ratio of DSDV decreases with increase in number of nodes.

4. End to End Delay: Figure 3(d) shows the end to end delay for DSR and DSDV increases with the increase in number of nodes whereas for AODV it decreases with the increase in number of nodes.

IV. CONCLUSION AND FUTURE WORK

In this Paper, we have discussed various routing protocols for Mobile Ad-hoc Networks. The AODV and DSR are Reactive Routing Protocols i.e. it establishes the Route on demand. But in DSDV, each node maintains routing information for all destinations. And it regularly update their routing tables, so consumes more bandwidth as compared to AODV.Further we have analyzed the Routing Properties of protocols i.e Loop Free, Distributed, Multicast Routes, QoS Support, Periodic Broadcast, Demand based Operation. At last, we have simulate these various routing protocols and analyse their performance by considering various network parameters i.e. as Average throughput, packet delivery fraction, packet loss and average end-to-end delay and it shows that when Mobile Ad hoc Networks are used for a longer duration of time then either Ad Hoc On-Demand Distance Vector Routing or Dynamic Source Routing can be used , because after some duration both the protocols show same behaviour with respect to packet delivery ratio.

By considering network performance metric Throughput the results shows that with increase in time of simulation, the

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throughput of DSR increases as compared to AODV and DSDV. But the end to end delay in DSR is more as compared to DSDV and DSR and ratio of packet delivery by using AODV is more as compared to DSDV and DSR. So, by considering all performance matrices, we can say that AODV is efficient faster Routing Protocol as compared to DSR and DSDV.

In **future**, to achieve more accurate results of these routing protocols for Adhoc Networks, we will apply it in physical environment and will study the results for any other possible measures.

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