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Routing Protocols for Mobile Ad Hoc Network: A Survey and Analysis

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Abstract

Ad hoc networks are mobile wireless networks where each node is acting as a router. The existing routing protocols such as Destination sequences distance vector, Optimized list state routing protocols, Ad hoc on demand routing protocol, Ad hoc on demand multipath routing protocol, Dynamic source routing are optimized versions of distance vector or link state routing protocols. In this paper, existing protocols such as DSDV, AODV, AOMDV, OLSR and DSR are analyzed on 50 nodes Mobile Ad Hoc network with random mobility. Packet delivery ratio, delay, control overhead and throughput parameters are used for performance analysis.

Keywords*: DSDV, OLSR, AOMDV, AODV, DSR, Ad Hoc Network, MANET*

1. Introduction

An ad Hoc network is a technology where no fixed infrastructure is required; all nodes are mobile, thus moving from one network to another. Ad hoc network is a temporary network where each node is also acting as a router. All nodes are self configured (addresses and routing features) nodes, multiple hops are required to transfer data from one node to another. Ad hoc network characteristics includes Peer-to-peer, zero administration, low power, Multihop, dynamic and auto configured.

Routing consists of two steps; forwarding packets to the next hop and to decide how the forwarding process to reach the packets to the destination in minimum number of hops. To judge the merit of a routing protocol, qualitative and quantitative metrics are used to measure its suitability and performance [1]. Various performance parameters such as packet delivery ratio, delay, jitter, control overhead etc are used judge the performance of routing protocols [2].

There are two types of protocols–proactive routing protocols and on demand also known as reactive routing protocols are widely adopted for an ad hoc network. Proactive protocols always maintains routing paths between all pairs of nodes irrespective of their usage while reactive protocols finds out the path to reach to the node only when needed [3].

Proactive routing protocols always find the optimum routes to reach to every destination nodes. But these types of protocols are not suitable for large network because of high overheads and their poor convergence behaviour. Destination sequenced Distance Vector (DSDV) is one of earliest protocols developed for ad hoc networks [4]. It is based on distance vector algorithm and uses sequence numbers to avoid count to infinity problem. Every node communicates, finds out their neighbours by sending hello messages and exchanges their routing tables with them. Periodic full updates and small updates are also transmitted to maintain routing tables up to date. Wireless Routing Protocol (WRP) [5] is another distance vector protocol optimized for ad hoc networks. WRP belongs to a class of distance vector routing protocols called path finding algorithms. The algorithm of this class uses the next hop and second-to-last hop information to overcome the count-to-infinity problem.

Optimized link state routing protocol [6, 7] is another proactive routing protocol based on link state algorithm. Here, every node broadcasts link state updates to every other node present in the network and thus creates link tables from which routing tables are designed. In order to reduce the overheads, multipoint relay concept is widely used. Figure 1 shows working

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of MPR. Node j chooses i, k, l and m as MPR nodes, since they are sufficient to reach all its two-hop neighbors.

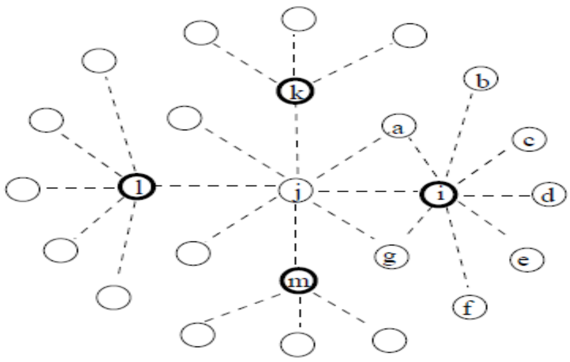

Figure 1. The Working of OLSR

In on demand routing protocols [8], route to the destination is obtained only when there is a need. When source nodes want to transmit data packets to the destination nodes, it initiates route discovery process. Route request (RREQ) messages float over the network and finally the packet reaches to the destination, Destination nodes replies with route reply message (RREP) and unicast towards the source node. All nodes including the source node keeps this route information in caches for future purpose. Dynamic Source Routing Protocol (DSR) is thus characterized by the use of source routing. The data packets carry the source route in the packet header. When the link or node goes down, existing route is no longer available; source node again initiates route discovery process to find out the optimum route. Route Error packets and acknowledgement packets are also used. Ad Hoc on Demand Distance Vector Routing (AODV) is also on-demand routing protocol. It uses traditional routing tables, one entry per destination [9-11]. In AODV, only one route path is available in routing table, if this path fails, it again initiates route discovery process to find out another optimum path. Route Request Message (RREQ) from the source to the destination and route reply message (RREP) from the destination to the source is shown in Figure 2 and Figure 3 respectively. To overcome this limitation, Ad Hoc Multipath Distance Vector (AOMDV) comes in picture.

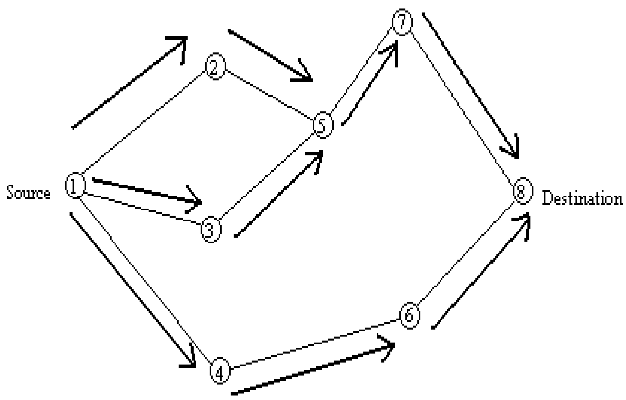

Figure 2. Route Request (RREQ) from Source to destination

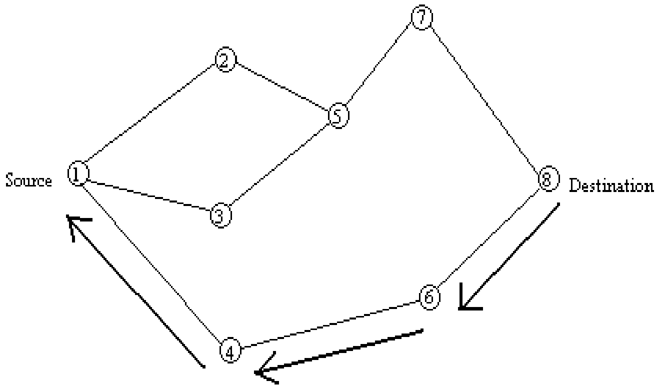

Figure 3. Route Reply (RREP) Reply from destination to source

2. Results and Analysis

The experiment is performed using the simulator NS2 (Network Simulator 2) which is open source software and used to do research on wired and wireless networks [12]. Fifty nodes MANET with random mobility is considered for the same (Figure 4). The topology Size is 1000 m × 1000 m. The simulation time is 200 seconds. DSDV, DSR, AODV, OLSR, AOMDV routing protocols are analysed. The interval between successive packets changes from 0.04 sec to 0.10 sec. The default size of packet is 512 bytes.

Table 1 shows the comparative values of interval vs. PDR for 50 nodes MANET with random mobility. Interval vs. PDR is shown in figure 5. AODV and DSR provides high packet delivery ratio while DSDV provides very low value. For 0.04 second interval of packets (25 packets/sec), AODV and AOMDV provides PDR of 99.54%, while DSDV provides PDR of 50.12%.

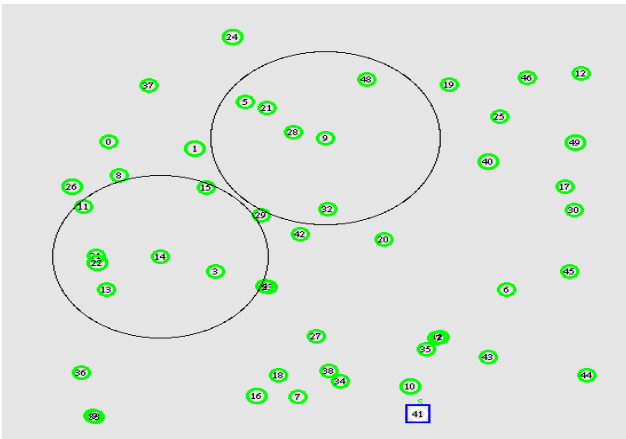

Figure 4. 50 Nodes MANET with Random Mobility

Table 1. Interval vs. PDR for 50 Nodes MANET with Random Mobility

	Interval (s) vs. PDR (%)				
Interval	0.04	0.055	0.07	0.085	0.10
AODV	97.72	86.81	99.78	86.59	99.54
AOMDV	97.72	86.81	99.78	86.59	99.54
DSDV	46.08	51.14	43.89	46.49	50.12
DSR	99.75	98.81	99.54	99.65	98.94
OLSR	84.92	90.54	89.27	86.50	88.49

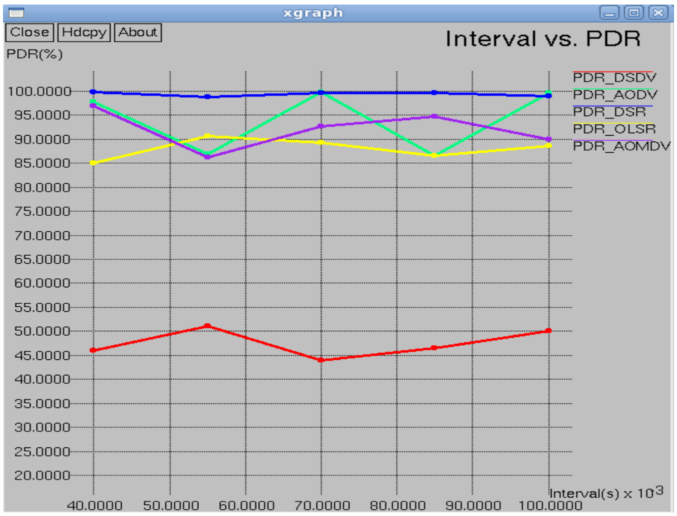

Figure 5. Interval vs. PDR

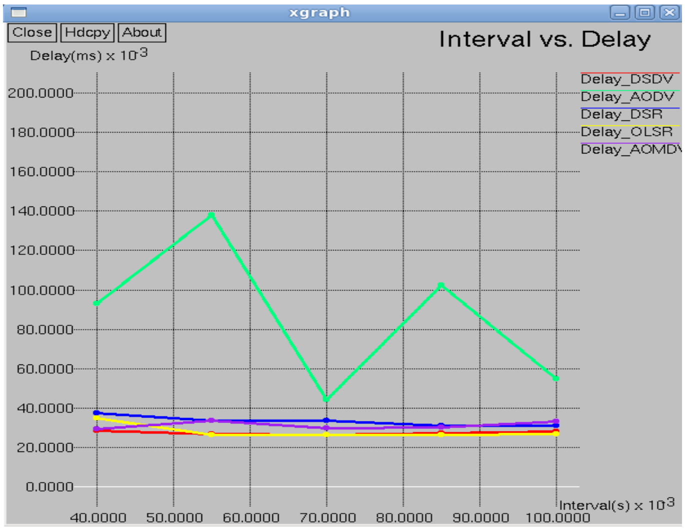

Figure 6. Interval vs. Delay

Table 2. Interval vs. Delay for 50 Nodes MANET with Random Mobility

Interval (s) vs. Delay (s)					
Interval	**0.04**	**0.055**	**0.07**	**0.085**	**0.1**
AODV	0.093	0.138	0.044	0.102	0.054
AOMDV	0.029	0.033	0.029	0.030	0.033
DSDV	0.028	0.027	0.026	0.027	0.028
DSR	0.037	0.033	0.033	0.031	0.031
OLSR	0.034	0.026	0.026	0.026	0.026

Table 2 shows the comparative values of interval vs. Delay for 50 nodes MANET with random mobility. Interval vs. Delay is shown in figure 6. DSDV provides minimum delay as it is proactive routing protocol. Entries in routing tables are already present before initiating delivery of packets from source to destination. AODV produces high end-to-end time for delivering packets as this is one demand routing protocol, need to do route discovery before transmitting packets from source to destination.

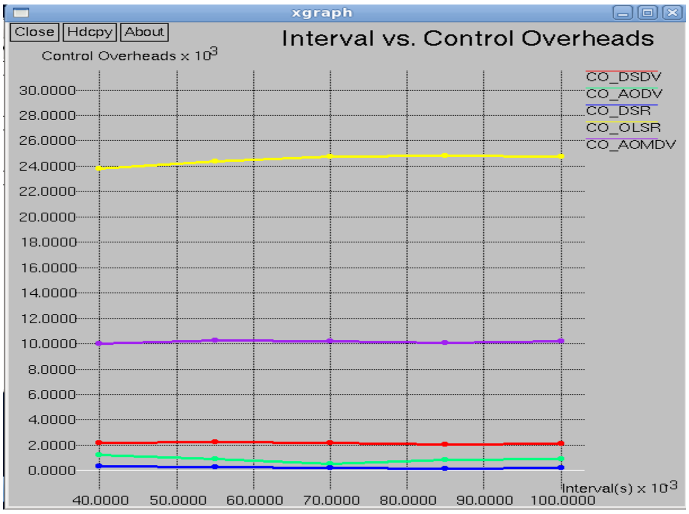

Figure 7. Interval vs. Control overheads

Table 3. Interval vs. Control Overheads for 50 Nodes MANET with Random Mobility

Interval (s) vs. Control Overheads (bytes)					
Interval	**0.04**	**0.055**	**0.07**	**0.085**	**0.1**
AODV	1254	943	529	843	897
AOMDV	10036	10260	10183	10089	10195
DSDV	2213	2275	2196	2069	2094
DSR	359	309	205	132	236
OLSR	23828	24359	24732	24817	24763

Table 3 shows the comparative values of interval vs. Control overhead for 50 nodes MANET with random mobility. Interval vs. Control Overhead is shown in figure 7. On-demand routing opposed to proactive routing is naturally adaptive to traffic diversity and therefore its overhead proportionately increases with increase in traffic diversity. On the other hand, for proactive routing overhead is independent of the traffic diversity. So when the traffic diversity is low, on demand routing is relatively very efficient in terms of the control overhead regardless of relative node mobility. DSDV produces high overhead because of exchange of control messages between nodes.

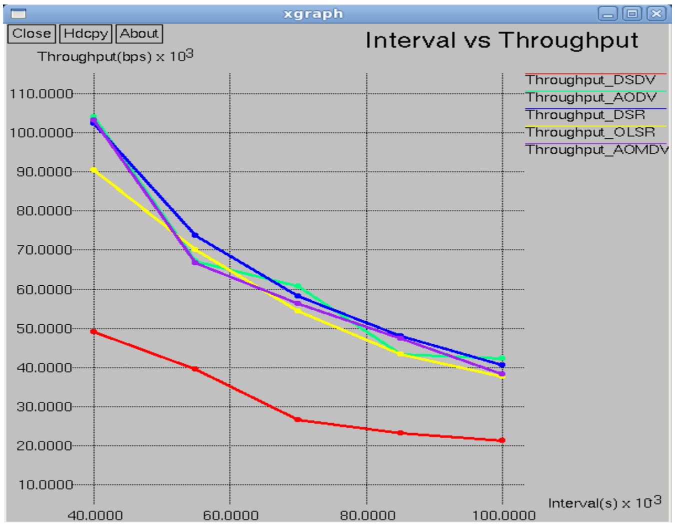

Figure 8. Interval vs. Throughput

Table 4. Interval vs. Throughput for 50 Nodes MANET with Random Mobility

Interval (s) vs. Throughput (bps)					
Interval	**0.04**	**0.055**	**0.07**	**0.085**	**0.1**
AODV	104005	67201	60693	43376	42388
AOMDV	103149	66709	56307	47397	38304
DSDV	49041	39589	26699	23292	21345
DSR	102190	73623	58292	48050	40556
OLSR	90381	70088	54296	43333	37683

Table 4 shows the comparative values of interval vs. Throughput for 50 nodes MANET with random mobility. Interval vs. Throughput is shown in figure 8. Because of high PDR, throughput is highly increased in AODV and DSR while DSDV produces low throughput and thus not suitable for high traffic on the network.

5. Conclusion

This paper explains the comparative analysis of various existing routing protocols such as DSDV, AODV, AOMDV, OLSR and DSR. PDR and delay are very important parameters when deciding how a reliable a protocols works. DSDV produces minimum delay but at the same time large control overhead is generated. AODV and DSR are much suitable for high traffic network, but provides larger delay. In addition, control overhad and throughput parameters are also analyzed. AODV, DSR and AOMDV protocols provides high throughput while DSDV protocol provides less throughput irrespective of the traffic present on the network. AOMDV and OLSR protocol provides high control overhead. As AOMDV is a multi-path protocol, a larger control overhead is generated to find multiple paths between the source and the destination. OLSR protocol based on link state routing, where link states are propagated through the network, thus generating larger control overhead.

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