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Performance characteristics of DSR, AODV and AOMDV Routing Protocols for MANETs using ns-2: A simulation Study

Jatin Jindal* Parminder Singh** Sukhvir Singh***
* ECE department, DIET, Kharar,
** Assistant Professor, DIET, Kharar,
*** Assistant Professor, UIET, PU, Chandigarh,

Abstract: **Mobile Ad-Hoc Network (MANET) is a group of mobile hosts without the support of any fixed network infrastructure and centralized administration. In this paper we have presented brief description of routing protocols and analysis of the behavior of routing protocols for different scenarios. It then discusses the effect these differences have on the design and evaluation of network control protocols with an emphasis on routing performance evaluation considerations. From our simulation results we have found that in general performance of DSR is better than AODV and AOMDV even for complex scenarios.**

Keywords: - MANET, DSR, AODV and AOMDV.

I. INTRODUCTION

A mobile ad hoc network is a collection of autonomous mobile nodes that communicate with each other over wireless links with no fixed infrastructure or centralized administration such as base stations or access points [1, 2 and 13]. In MANET all the mobile nodes in the network dynamically set up paths among themselves to transmit packets temporarily. As the wireless network technology exploded, it has opened a new view to users and expanded the information and application sharing very conveniently and fast. Mobile ad hoc networks (MANETs) use wireless technology without a pre-existing infrastructure (access points). As the name states, MANETs consists of mobile nodes, which can vary from notebooks, PDAs to any electronic device that has the wireless RF transceiver and message handling capability. Mobility and no-infrastructure forms the basis of this network type.

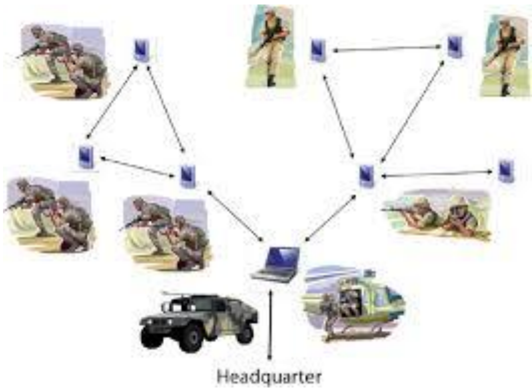

Fig 1: An example of MANET.

Mobility gives maximum freedom to users, as they can be connected to the network, whether they are fixed or moving, unless they are in the range of the network. Also, it is highly dynamic, as the new nodes come, they can be connected to the network very easily.

Unlike the fixed networks or traditional wireless networks, MANETs don't need any infrastructure to create and maintain communication between nodes (see Fig 1). This property provides the ability to create a network in very unexpected and urgent situations very quickly, also without any extra cost.

II. ROUTING PROTOCOLS FOR MANETS

There are a no. of routing protocols for MANETs but following are the three protocols which we have taken for comparative analysis.

a) DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

Routes are determined upon request. It can be taken from *route cache* of the node (if available), or a *route discovery protocol* is issued.

Once a source route is constructed at the sender, the sender places this route to the packet header and then forwards the packet to the first hop in the source route. Each node upon receiving a data packet, check whether it is the destination node for the packet, if it is, it passes the packet to the upper layer software, if it is not, it forwards the packet to the next node according to the source route at the packet header. DSR basically consists of two parts: route discovery and route maintenance [13].

b) AD-HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL (AODV)

The AODV Routing protocol uses an on-demand strategy for searching routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. AODV offers quick adaptation to dynamic link conditions, low processing and memory overhead, low memory utilization, and determines unicast routes to destinations within Ad-hoc network [3, 12].

The main difference between AODV and Dynamic Source Routing (DSR) is that DSR uses source routing in which a data packet carries the complete path to be traversed. The message types defined by the AODV protocol are Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs). However, in AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In an on-demand routing protocol, the source node floods the RREQ packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest.

The major difference between AODV and other on-demand routing protocols is that it uses a destination sequence number (DestSeqNum) to determine an up-to-date path to the destination. A node updates its path information only if the DestSeqNum of the current packet received is greater than the last DestSeqNum stored at the node.

A node offers connectivity information by broadcasting local Hello messages as follows. During every Hello interval milliseconds, the node checks whether it has sent a broadcast within the last Hello_Interval. If it has not sent one, it broadcasts a RREP with TTL = 1, called a Hello message, with the RREP message fields set as follows: The destination IP Address would be the node's IP address, the destination Sequence Number would be the node's latest sequence number. The value of hop count would be the Lifetime Allowed_Hello_Loss * Hello_Interval. AODV makes sure these routes do not contain loops and tries to find the shortest possible route. AODV is also deals with changes in routes and can create new routes if there is an error [10].

c) AD-HOC ON DEMAND MULTIPATH DISTANCE VECTOR ROUTING PROTOCOL (AOMDV)

Ad-hoc On-demand Multi path Distance Vector Routing (AOMDV) protocol is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths [4]. The routing entries for each destination contain a list of the next-hops along with the corresponding hop counts. All the next hops have the same sequence number. This helps in keeping track of a route. For each destination, a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths, which is used for sending route advertisements of the destination. Each duplicate route advertisement received by a node defines an alternate path to the destination. Loop freedom is assured for a node by accepting alternate paths to destination if it has a less hop count than the advertised hop count for that destination. Because the maximum hop count is used, the advertised hop count therefore does not change for the same sequence number. When a route advertisement is received for a destination with a greater sequence number, the next-hop list and the advertised hop count are reinitialized. AOMDV can be used to find node-disjoint or link-disjoint routes. To find node-disjoint routes each node does not immediately reject duplicate RREQs. Each RREQs arriving via a different neighbor of the source defines a node-disjoint path. This is because nodes cannot be broadcast duplicate RREQs, so any two RREQs arriving at an intermediate node via a different neighbor of the source could not have traversed the same node. In an attempt to get multiple link-disjoint routes, the destination replies to duplicate RREQs, the destination only replies to RREQs arriving via unique neighbors. After the first hop, the RREPs follow the reverse paths, which are node disjoint and thus link-disjoint. The trajectories of each RREP may intersect at an intermediate node, but each takes a different reverse path to the source to ensure link disjointness. The advantage of using AOMDV is that it allows intermediate nodes to reply to RREQs, while still selecting disjoint paths. But, AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQs those results are in longer overhead [6, 7].

III. RESULTS AND ANALYSIS

Simulations were performed in ns-2 [9, 11] for different scenarios as shown below. Mainly analysis was done on PDR, Throughput and Energy (residual) using different environments and simulation results for the same have been shown below (See Figures below). Two propagation models were used i.e. shadow propagation model in scenario-I and two-ray propagation model in scenario-II.

Scenario-I

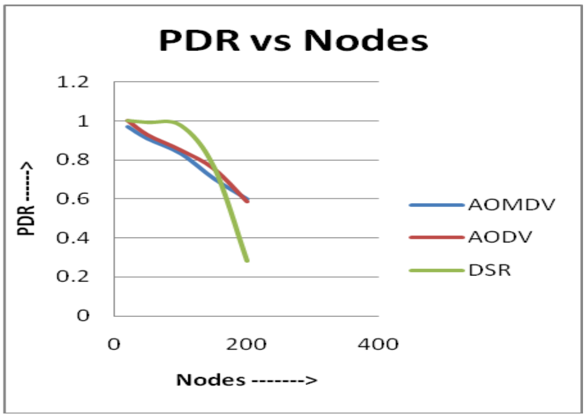

Fig 2: Comparison for PDR

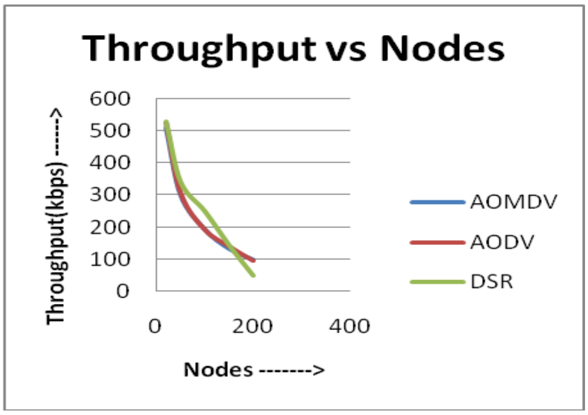

Fig 3: Comparison for Throughput

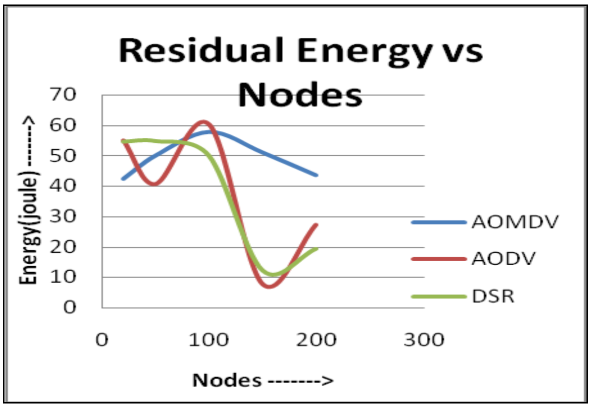

Fig 4: Comparison for Energy (residual).

Scenario-II

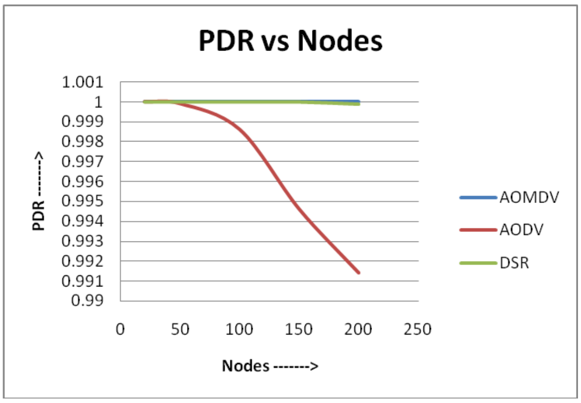

Fig 5: Comparison for PDR

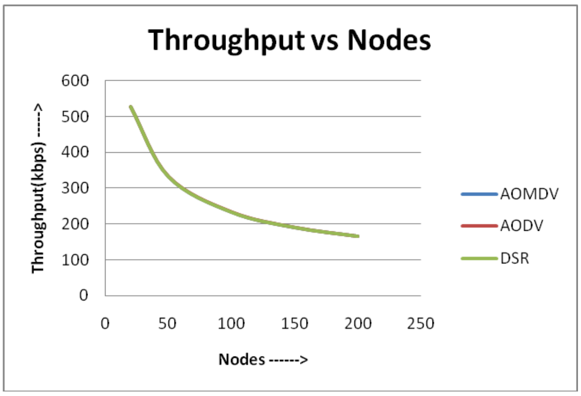

Fig 6: Comparison for Throughput

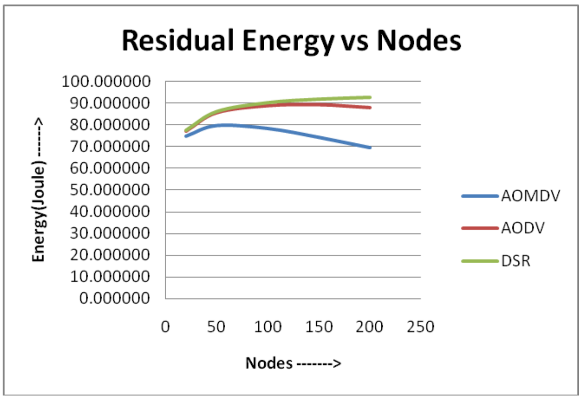

Fig 7: Comparison for Energy (residual).

It is clear from simulation results that DSR performs better than others.

IV. CONCLUSION

The area of ad hoc networking has been receiving increasing attention among network researchers in recent years. One of the major issues in this was the energy consumption during the transmission. And other issues are related to QoS [5, 8]. Simulation was performed by introducing different scenarios and performance parameters like PDR, Throughput and Energy were observed. From our results it is observed that in general DSR protocol is the optimal choice because of its better performance.

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