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# Simulation & Performance Analysis of Proactive, Reactive & Hybrid Routing Protocols in MANET

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*Abstract-* ***A Mobile Ad-hoc Network (MANET) consists of a number of mobile wireless nodes, the communication between these mobile nodes is carried out without any centralized control. MANET is a self organized and self configurable network where the mobile nodes move arbitrarily. The mobile nodes can receive and relay packets as a router. Routing is a critical issue and an efficient routing protocol makes the MANET reliable. There are two types of features of MANET - absence of fixed infrastructure. & absence of central administration. In this paper we discuss about simulation & comparison of the performance between three types of routing protocols, Table Driven (Proactive), On-Demand (Reactive) & Hybrid Protocol using the NS-2 (2.26) simulation tool. These routing protocols compared in terms of packets delivery ratio, average delay and speed.***

***Keywords*— *Ad-hoc network, DSDV, AODV, DSR & ZRP routing protocol, MANET.***

## I. INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless mobile nodes that dynamically establishes the network in the absence of fixed infrastructure. The main distinctive feature of MANET is, each node must be able to act as a router to find out the optimal path to forward a packet. MANET protocols provide an emerging technology for civilian and military applications. *A* ***mobile ad-hoc network*** **(MANET)** is a self-configuring infrastructureless network of mobile devices connected by wireless. *ad hoc* is Latin and means "**for this purpose**". Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route the traffic. Such networks may operate by themselves or may be connected to the larger Internet. MANETs are a kind of wireless ad hoc networks that usually has a routable networking environment on top of Link Layer in ad hoc network [13]. The growth of laptops and 802.11/Wi-Fi wireless networking have made MANETs a popular research topic since the mid 1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space, usually with all nodes within a few hops of each other [5] – [10]. Different protocols are then evaluated based on measure such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput etc.

### MANET Network Model

The MANET is a collection of nodes, which have the possibility to connect on a wireless medium and form an arbitrary and dynamic network with wireless links [1]. In infrastructure network computers nodes are connected via a inter connection network such as Bus, LAN etc. This means that links between the nodes can change with time, new nodes can join the network, and other nodes can leave it. A MANET is expected to be of larger size than the radio range of the wireless antennas, because of this fact it could be necessary to route the traffic through a multi-hop path to give two nodes the ability to communicate. There are neither fixed routers nor fixed locations for the routers as in cellular networks which is also known as infrastructure networks.

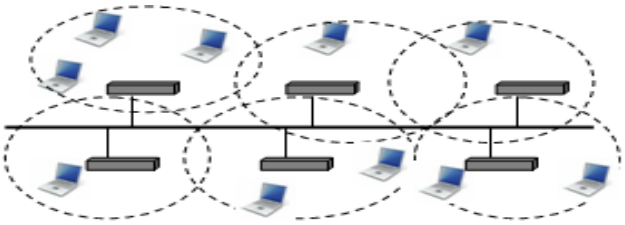

**Fig-1 (Wireless Network Structures-I (Infrastructure Networks))**

A MANET is a collection of various nodes which are connected via wireless network such as wireless Mesh Network. Cellular networks consist of a wired backbone, which connects the base-stations [1]. The mobile nodes can only communicate over a one-hop wireless link to the base-station; multi-hop wireless links are not possible. By contrast, a MANET has no permanent infrastructure at all. All mobile nodes act as mobile routers. A MANET is highly dynamic because links, quality of the links and participants are often changing. Furthermore, asymmetric links are also possible. New routing protocols are needed

 

to satisfy the specific requirements of mobile Ad hoc networks. There exists a large family of ad hoc routing protocols.

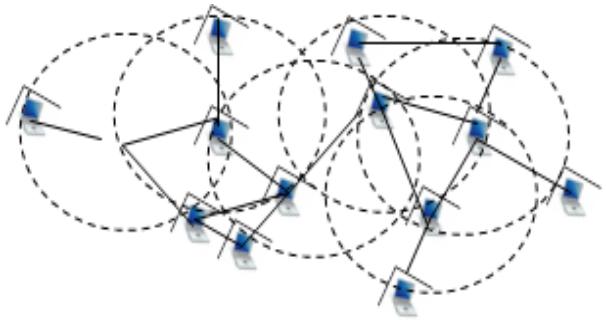

**Fig-2 (Wireless Network Structures-II (Infrastructureless Networks)**

## II. MOBILE AD-HOC NETWORK (MANET) ROUTING PROTOCOLS

Nodes in ad hoc network also function as routers that discover and maintain routes to other nodes in the network. Thus, the primary goal of MANET is to establish a correct and efficient route between a pair of nodes and to ensure the correct and timely delivery of packets. A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks. These protocols find a route for packet delivery and deliver the packet to the correct destination [15].

**MANET** routing protocols devided into three general categories:

1. Proactive routing protocols
2. Reactive routing protocols
3. Hybrid routing protocol

**Pro-Active/Table Driven Routing Protocols:**

These types of protocols are called table driven protocols in which, the route to all the nodes is maintained in routing table. Packets are transferred over the predefined route specified in the routing table. In this scheme, the packet forwarding is done faster but the routing overhead is greater because all the routes have to be defined before transferring the packets. Proactive protocols have lower latency because all the routes are maintained at all the times [2], [4].

**Example Protocols**: DSDV, OLSR (Optimized Link State Routing).

*Destination-Sequenced Distance-Vector (DSDV) Protocol-*

The Table-driven DSDV protocol is a modified version of the Distributed Bellman-Ford (DBF) Algorithm that was used successfully in many dynamic packet switched networks. In DSDV, each node is required to transmit a sequence number, which is periodically increased by two and transmitted along with any other routing update messages to all neighbouring nodes [11].

**Reactive /On-Demand Protocols**

These types of protocols are also called as On Demand Routing Protocols where the routes are not predefined for routing [2]. A Source node calls for the route discovery phase to determine a new route whenever a transmission is needed. This route discovery mechanism is based on flooding algorithm which employs on the technique that a node just broadcasts the packet to all of its neighbours and intermediate nodes just forward that packet to their neighbours. This is a repetitive technique until it reaches the destination. Reactive techniques have smaller routing overheads but higher latency [4].

Example Protocols: DSR, AODV

*Ad Hoc On-demand Distance Vector Routing (AODV) Protocol*

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a reactive unicast routing protocol for mobile ad hoc networks. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, the routing information is maintained in the routing tables at all the nodes. Every mobile node keeps a next hop routing table, which contains the destinations to which it currently has a route [12]. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. In AODV, when a source node wants to send packets to the destination but no route is available, it initiates a route discovery operation. In the route discovery operation, the source node broadcasts route request **(RREQ**) packets which includes Destination Sequence Number. When the destination or a node that has a route to the destination receives the **RREQ**, it checks the destination sequence numbers it currently knows and the one specified in the RREQ. To guarantee the freshness of the routing information, a route reply **(RREP)** packet is created and forwarded back to the source only if the destination sequence number is equal to or greater than the one specified in **RREQ**.AODV uses only symmetric links and a **RREP** follows the reverse path of the respective **RREQ** [12], [14].

**Hybrid Protocols**

Hybrid protocols are the combinations of reactive and proactive protocols and takes advantages of these two protocols and as a result, routes are found quickly in the routing zone. Hybrid routing protocol requires the following three properties **Adaptive, Flexible, Efficient and Practical** for successful deployment [3].

Example Protocol: ZRP (Zone Routing Protocol)

*Zone Routing Protocol (ZRP)*

In mobile ad-hoc network, **Zone Routing Protocol** or **ZRP** was the first hybrid routing protocol with both a proactive and a reactive routing component. ZRP divides the whole network into small routing zones. Each node is a center node for its zone. Hence, the entire network consists of overlapping zones. Within the zone, the **IntrAzone Routing Protocol (IARP),** which can be a specific proactive routing protocol, is used to maintain the topology information of the zone. The **IntErzone Routing Protocol (IERP)** is responsible for discovering the global routes with destination nodes beyond the routing zone. Additionally, ZRP exploited *bordercasting* mechanism, which directs the query request to the border of the zone, rather than flooding. The bordercast packet delivery is performed by the Bordercast Resolution Protocol (BRP).

ZRP was proposed to reduce the control overhead of proactive routing protocols and decrease the latency caused by route discovery in reactive routing protocols. ZRP defines a zone around each node consisting of the

 

node's *k*-neighbourhood (that is, all nodes within *k* hops of the node). A proactive routing protocol, Intra-zone Routing Protocol (IARP), is used inside routing zones, and a reactive routing protocol, Inter-zone Routing Protocol (IERP), is used between routing zones. A route to a destination within the local zone can be established from the source's proactively cached routing table by IARP. Therefore, if the source and destination of a packet are in the same zone, the packet can be delivered immediately. Most of the existing proactive routing algorithms can be used as the IARP for ZRP.

## III. PROPOSED PROBLEM AND SOLUTION

The objective of this paper is to study the comparison in mobile ad hoc networks and evaluate proposed routing protocols for wireless ad hoc networks based on performance. This evaluation could be done through simulation. The work comprises to simulate and implement Mobile Ad Hoc Routing protocol and detect the various possible properties of various protocols. The simulation environment that could be used as a platform is based on Network Simulator ns2 (2.26) .

The IETF currently has a working group named Mobile Ad hoc Network (MANET) that is working on routing specifications for Ad hoc Networks. Mobile networks that meet the demand for instantaneous communications establishment are called Mobile Ad hoc Networks [6]. Like the Internet, datagram in an ad hoc network may travel along multiple hops until they reach their destination. In adhoc networks, routing is a major challenge. Several routing protocols for ad hoc networks emphasis on stable and shortest routes while ignoring major issue of delay in response whenever break occurs. Some other areas of consideration are:-

- A general understanding of ad- hoc networks.
- Security issues in ad hoc networks
- Implement some of the proposed routing protocols for wireless networks
- Analyze the protocols through simulation in different mobility scenarios

*SIMULATION PARAMETERS FOR AODV, DSDV & ZRP*

In this analysis we have chosen the simulation of 5 nodes in 500x500 square meter area, in other words we have chosen two dimensional area (2D) rectangle. The position of each mobile node is represented in 2D grid, the X-axis value is chosen from the range of (0,500) and Y-axis value is chosen from the range of (0,500). The mobile node then moves to the destination at given speed. Once the destination is reached, the mobile node stops for a given pause time. The mobile node then chooses another random destination for mobile node's next movement. The complete simulation parameter are-

1. **Numbers of nodes – 5(0-4)** This is constant during the simulation. We used 5 nodes for simulations.
2. **Total simulation time – 270 sec.** The time for which simulations will be run i.e. time between the starting of simulation and when the simulation ends.
3. **Transferred packet size – 512 bytes.** Packet Delivery Ratio in this simulation is defined as the ratio between the number of packets sent by constant bit sources (CBR) and numbers of packets received by CBR sink at destination.
4. **Routing protocol – AODV,DSDV&ZRP**
5. **Network size – 500*500(square meter)** It determines the number of nodes and size of area that nodes are moving within. Network size basically determines the connectivity.
6. **Pause time – 0.01 sec.** Nodes will stop a "*pause time"* amount before moving to another destination point.
7. **Traffic type – Constant Bit Rate.**

In the simulation work we, apply same parameters for each MANET protocol (AODV, DSDV & ZRP).

## IV. COMPARISION PERFORMANCE ANALYSIS OF AODV, DSDV, AND ZRP

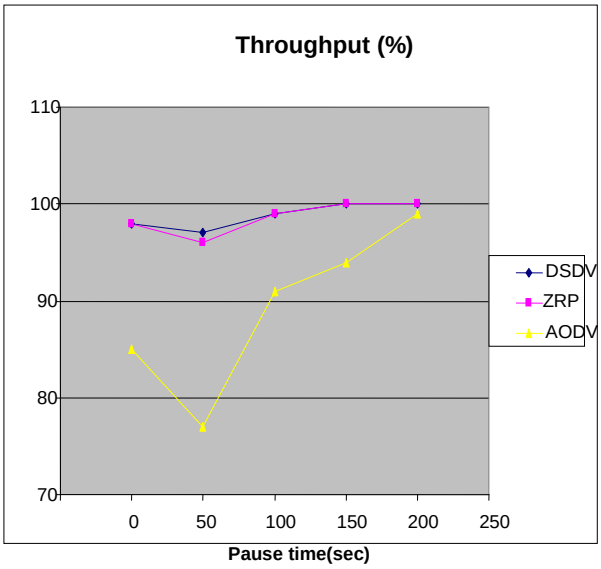


**Fig-2 (Throughput vs Pause Time)**

The relative throughput performance of three routing protocols although implicitly related to the pause time metric, we found it relevant to use another terminology for the "mobility" of the nodes, which basically show how fast the nodes are moving to a wide range of speeds for our mobile nodes from 1 m/s (3.6 km/hour) that corresponds to walking at a slow pace, to 50 m /s (180 km/hour).

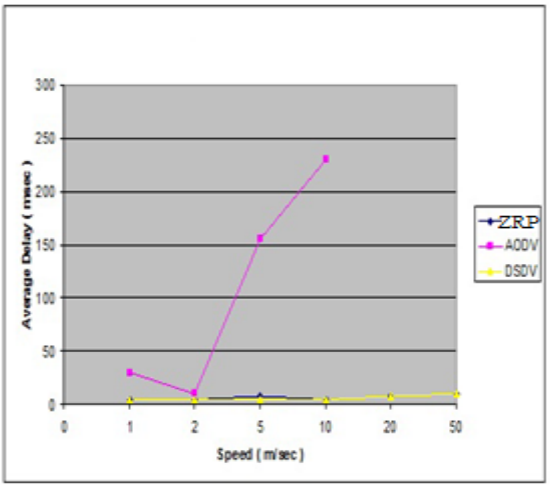


**Fig-3 (Average delay vs speed)**

 

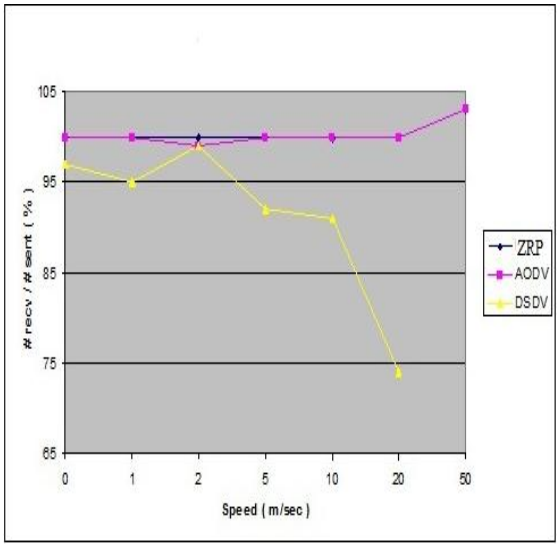


**Fig-4 (Throughput vs Speed)**

It is to be observed that increase in node speeds results in significant increase in the average end-to-end packet delivery delay of AODV protocol. This is because when a node receives a route request for which it has the answer in its routing table, it immediately replies with the route rather than forwarding it to the destination. The source can now start to communicate with the destination. Since AODV maintains only one routing entry per destination, it has to do more route discoveries as the speed increases. The average delay increases as the time taken to find a route to the destination increases when there is no entry for it in the intermediate nodes.

## V. CONCLUSION

This paper presents a performance & simulation of routing protocols which are proposed for ad-hoc mobile networks and also provides a classification of these protocols according to the routing strategy (i.e. table driven, on-demand routing protocol and hybrid routing protocol). It has also presented a comparison of AODV, DSDV and ZRP, and reveals their packet delivery, throughput, speed and pause time. The performance of these protocols is analyzed with NS2 simulator with scenario of 5 nodes. The observations are made with variation in node speed in network. After analysis in different situations of network it is to be observed that AODV perform better than DSDV and ZRP in terms of throughput and average delay while ZRP is proved to be best in case of Packet delivery ratio. If Reliability and throughput are main parameters for selection then AODV gives better results compared to others because its throughput is best among others.

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