Evaluating AODV & DSR Routing Protocols in Mobile Ad-Hoc NetworksUsing TCP Traffic Class

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Abstract—

Mobile Ad-Hoc Networks are those networks which don't have any fixed infrastructure. There is no central administrator Due to mobility of nodes, frequent link breakage takes place. Therefore routing in MANETs is challenging task and this has led to the development of many different routing protocols. This paper analyses the performance of AODV and DSR routing protocols for the metrics Packet Delivery Ratio. This would be a great help for the people conducting research on real world problems in MANET security.

Keywords— MANET's, routing protocols, reactive, proactive, hybrid, AODV, DSR.

I. INTRODUCTION

Ad hoc networks [1] are autonomous, self configuring, adaptive which make them applicable in various fields. At present there are two variations of wireless network- first is [2] known as Infrastructure or base stations. A mobile unit, which moves within these networks, communicates to nearest base station. When it moves out of one base station, a process called Handoff and it comes in the range of the other base station. In Infrastructure less or Ad Hoc wireless network [3] the mobile node can move while communicating, there are no fixed base stations and all the nodes in the network act as routers. The mobile node changes their location and establishes their own network 'on the fly'.

II. CHARACTERISTICS

Some of the major characteristics of these protocols are :

i.Dynamic Network topology: Since the nodes are mobile, the topology may change rapidly and the connectivity within the network varies with time.
ii.Limited Bandwidth: the bandwidth [4] available is limited than that of wired networks. The power is limited and the computation should be energy efficient
iii.Distributed Operation: there is no central control and nodes collaborate them to implement functions.
iv.Security: The wireless links lack defense against threats. Various attacks such as denial of services, eavesdropping, replay attacks are possible.

III. ROUTING PROTOCOLS

Routing protocols tells the way how a message is sent from source to the destination. These protocols are categorized as shown in figure Taxonomy of routing protocols

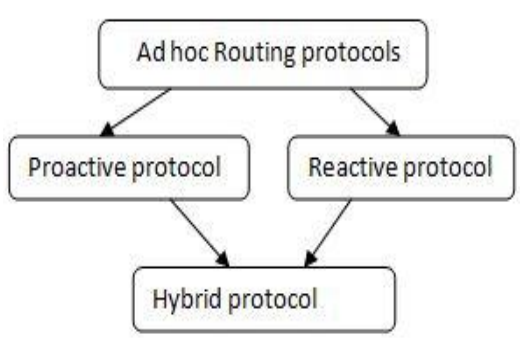

Figure 1: Taxonomy of routing protocols [4]

i. Reactive Routing Protocols
In Reactive routing protocols or demand routing protocols, nodes are set up when needed Nodes. When a node wants to send a packet to another node, it initiates communication with that node [13], if no node is present earlier. The reactive routing protocols have two major components [4]
Route discovery: When [5] the source wants to send a packet to the destination node, it first scans its cache to find the route to the destination, if route not present, it initiates route discovery process containing through a 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. Route maintenance is achieved through the use of acknowledgement.

ii. Proactive routing protocols
Proactive routing protocols are also knows as table driven protocol. In these protocols, each node maintains a routing table consisting of routing information to every other node in the network [10]. Since the nodes are mobile, they keep on changing their location. So the routing tables maintained by different nodes are periodic or whenever a change occurs, are updated. There are a number of proactive routing protocols. They differ in various areas like number of routing table [7] maintained and how the changes are propagated in the network

iii. Hybrid routing protocols
Hybrid routing protocols [10] are both proactive and reactive in nature. There protocols work on the merits of these protocols to increase scalability and to decrease the routing overhead.

IV. DYNAMIC SOURCE ROUTING (DSR)

It uses the concept of [5] source routing in which the source creates routes only when source requires [7]. It is based on link state algorithm [4]. As it is on demand routing protocol, the routing overhead is less [14] This Protocol is composed of two essential parts of route discovery and route maintenance.

Route Discovery: When a source node S wants to send a packet to the destination D, it checks its route cache first. If it finds the route, then the source uses the available route in cache. If route not found or the the route cache has an expired route, then it initiate the route discovery process. Route cache contains the recently discovered routes. Route discovery requires 7 fields during this process such as sourceid, destid, ReqID,Addresslist, Hoplimit,NetworkInterf---aceList, Acknowledgment list. Then source node broadcasts the message to its neighbor. Moreover, source node also maintains a replica of send message in its send buffer. Packets can be dropped if send buffer is overflow the time limit for route discovery is over. When a nodes destination or the intermediate node having route to destination receives the route request message, it generates route reply [7]

Route Maintenance: Route maintenance includes monitoring the routes against failure through route error messages and route cache [5]. There is no need of keeping routing table in DSR [3] protocol. Route cache can further decrease route discovery overhead. DSR reduces overhead of route maintenance. However DSR is not scalable to large networks and packet Size grows with length of the route due to source routing.

VI. AODV (Ad Hoc On Demand Distance Vector)

AODV [3] is based on DSDV and DSR collectively. It keeps Routing tables .Route is between two nodes is discovered as when needed. When a source S node wants to send a packet to the destination node D, it checks route table and if there is route not present, it initiates route discovery process. It broadcasts a route request (RREQ) packet to its neighbors [7]. The RREQ contains IP addresses of S and D, current sequence number of S and last known sequence number of D, a broadcast ID from S, which is incremented each time S sends a RREQ message. The broadcast ID, IP address pair of the source S forms a unique identifier for the RREQ. AODV utilizes destination sequence numbers to guarantee the fresh route. When a node broadcast RREQ message, it waits for RREP. If the reply is not received within certain time limit, the source node rebroadcast the RREQ or it assumes that there is no route present. When a node receives a RREQ message, it broadcast the RREQ message to its neighbor if it is not the destination route and creates a temporary reverse route to the source IP address in its routing table with next hope equal to the IP address of neighboring node that sent the RREQ. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ. Once the RREQ reaches the destination or an intermediate node with a fresh enough route, it generates RREP and it is unicasted back to the requested node which eventually reaches the Source node. The intermediate node records the route to the destination as the RREP follows from destination to source. The nodes are mobile, so it can move anytime. IF the source node moves to different location, it can rediscover the route the destination node by route discovery process. IF the destination node/the intermediate node moves to different location [7], it informs the upstream node through Route error message which eventually reaches the source node. The source node terminates the ongoing communication and initiate route discovery process. Hello messages are used to maintain the local connectivity. AODV reduces number AODV protocol reduces number of routing messages in the network. It handles the dynamic behavior efficiently. However there is possibility of various attacks on AODV. The route discovery latency is high.

VI. Performance Metrics

i. Packet Delivery Ratio (PDR)

Packet delivery ratio [14] is defined as the ratio of data packets received by the destinations to those generated by the sources. This performance metric gives us an idea of how well the protocol is performing in terms of packet delivery at different speeds and different pause time.

ii. Pause Time

Pause time refers to the rest time of the node. A node begins by staying in one location for a certain period of time (i.e. a pause time). Once this time expires, the node chooses a random destination in the simulation area and a speed that is uniformly distributed between [min speeds,max speed]. The node then travels towards the newly chosen destination at the selected speed. Upon arrival the node pauses for a specified time period before starting the process again.

VII. Simulation Methodology

The simulations were performed using Network Simulator 2 (Ns-2.34) [15], particularly popular in the ad hoc networking community. The traffic sources are TCP. The source-destination pairs are spread randomly over the network. During the simulation, each node starts its journey from a random spot to a random chosen destination. Once the destination is reached, the node takes a rest period of time in second and another random destination is chosen after that pause time. This process repeats throughout the simulation, causing continuous changes in the topology of the underlying network. Different network scenario for different number of nodes and pause times are generated. The model parameters that have been used in the following experiments are summarized in Table 1.

Table 1: Simulation Parameters

Parameters	Value
Simulator	NS 2.34
Simulation Area	1000X1000
Number of Mobile Nodes	10,20,50,75
Pause Time	100,200,300,400,500 Sec.
Speed	2,3,5,7,10 m/s
Channel	Wireless
Routing Protocols	AODV & DSR
Simulation Time	500 C

VIII. Simulation Results & Analysis

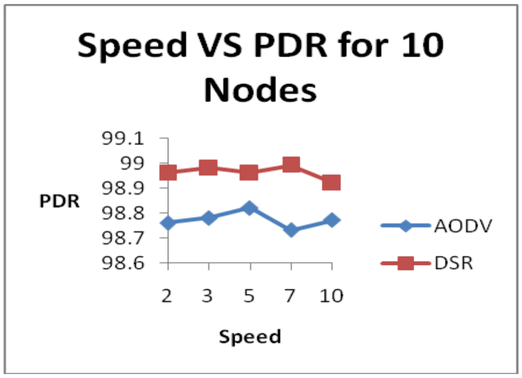

Figure2: PDR Vs Speed

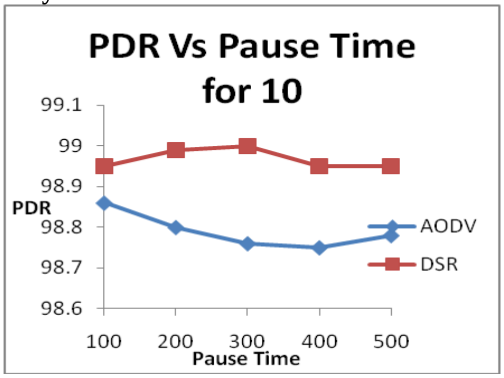

Figure 3: PDR Vs Pause Time

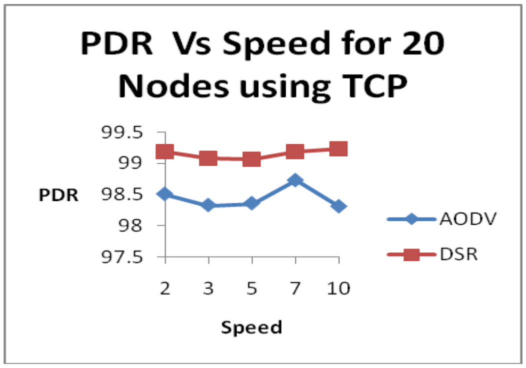

Figure 5: PDR Vs Pause Time

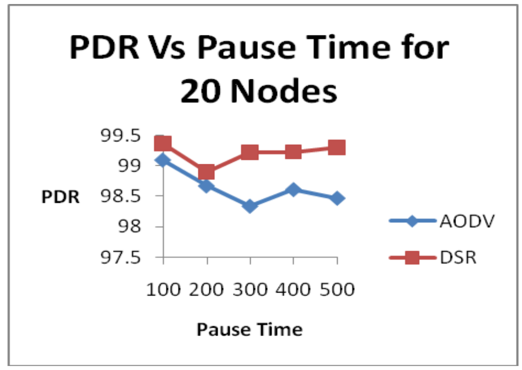

Figure 6: PDR Vs Pause Time

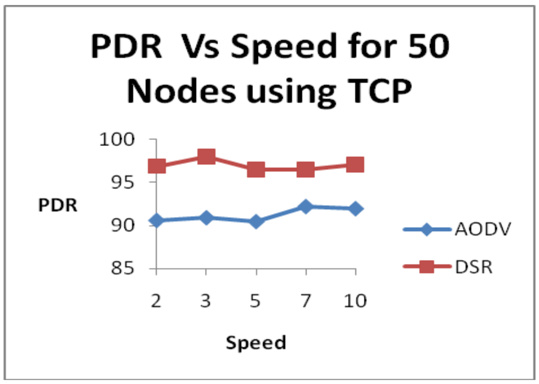

Figure 6: PDR Vs Speed

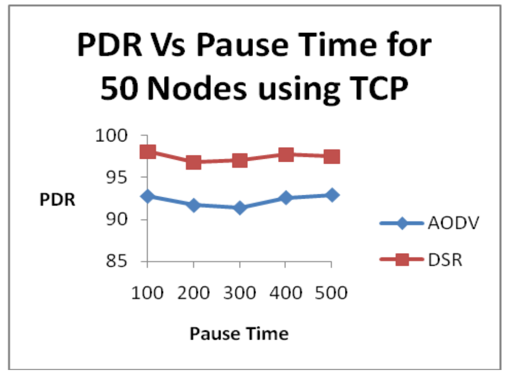

Figure 7: PDR Vs Pause Time

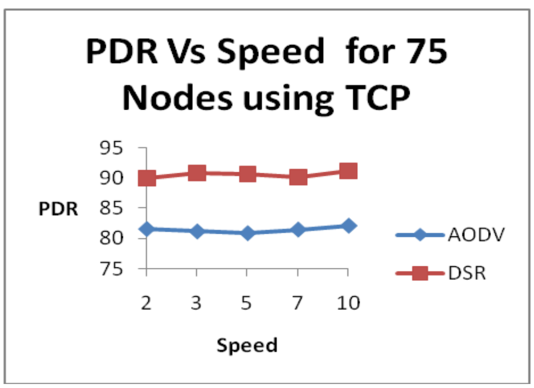

Figure 8: PDR Vs Speed

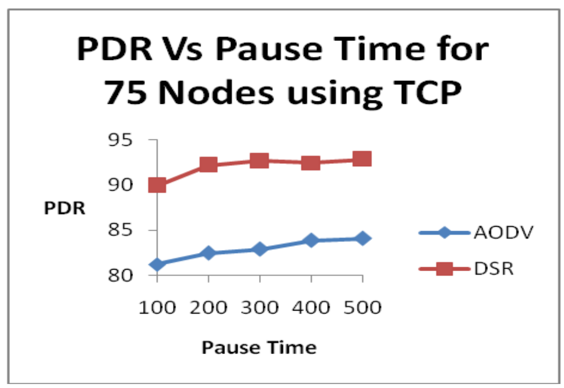

Figure 9: PDR Vs Pause Time

i. Comparative Study

A case study has been done using TCP connections. Various cases have been taken and a bias less scenario generation has been done. Scenarios has been created using TCL scripts and a real life situation has been assumed. Various cases have been taken for final results. Nodes taken are 10, 20, 50 and for denser medium as 75. Also two major metrics have been used for calculation of schemes. These are PDR for Pause time and speed. For more realism speed has been increased up to a car moving in a street and pause time has been increased from 0 to 500 to generate bias less patterns for data transmission. It has been observed in all experiments that DSR outperforms AODV in most cases and its PDR is above AODV.

The sudden abrupt rise and fall may be due to many reasons some of the important points to highlight in this regards are:

1. Scenario generated
2. Number of connections made
3. Transmission of data at time intervals
4. Motion pattern of various nodes

5. Simulation time and other simulation parameters
6. Lesser Link breaks in generated scenario (which in other case will lead to better performance by AODV)

More work is in progress to find out End to end delay and throughput which will the case study worth producing specific decisions for selection of a particular protocol.

IX. Conclusion & Future work

In this paper an effort has been made on the comparative study of AODV and DSR routing protocols using PDR as a function of node's speed and pause time. DSR outperforms AODV for the reasons stated above. Efforts can be made in future to increase the PDR with increase in speed and make it more consistent by modifying the phases of AODV and DSR routing protocols.

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