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Performance Evaluation of Ad Hoc Network Routing Protocols with NS2

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***Abstract* -- Ad-hoc networks consist of various decentralized nodes without any support of central administration and have no any physical links and not follow particular topology due to the behaviour of node with frequent mobility of nodes. Protocol suite of this network consists of various routing protocols which are specifically designed mobile nodes. Each node in network moves randomly at unpredictable times. The motto behind this work is to getting the detailed understanding of ad hoc routing protocols, analyzing the performance differentials of routing protocols. The Ad Hoc routing protocols can be proactive, reactive or hybrid. This paper presents a performance comparison of proactive and reactive protocols based on two performance matrices network throughput and packet delivery ratio using the NS-2 simulator as a simulation environment.**

***Keywords*- Ad hoc Routing Protocols, Performance Evaluation, Routing, Ad hoc Networks, Protocols, NS2, Simulation.**

I. INTRODUCTION

An ad hoc network is a type of peer to peer wireless network mode where wireless devices communicate with each other directly, without the aid of a Wireless Access Point device [3]. An ad-hoc routing protocol is a convention, or standard, that controls how nodes decide which way to route packets between computing devices in network . The primary goal of any ad-hoc network routing protocol is to meet the challenges of the dynamically changing topology and establish an efficient route between any two nodes with minimum routing overhead and bandwidth consumption

In ad-hoc networks, nodes do not start out familiar with the topology of their networks; instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbours. Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them.

II. ROUTING IN AD HOC NETWORK

The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an internetwork. Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task [1]. Most protocols should be based on reactive routing instead of proactive. Multi cast routing is another challenge because the multi cast tree is no longer static due to the random movement of nodes within the network [5]. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

III. ROUTING PROTOCOLS CLASSIFICATION

Routing protocols can classify in different ways depending on how the protocols handle the packet to deliver from source to destination [4].

A. Proactive Protocols

Proactive protocols also known as table driven protocols due to nodes in complete route has to maintain a routing table, which specify a particular route for data packets transfer. This scheme has better and faster performance for packet forwarding, but routing overhead is greater due to routes have to be defined before transferring the packets. Proactive protocols have less latency due to all the routes should be maintain time to time [5].

These protocols are attempts to maintain consistent, up-to-date routing information from each node to every other node in the network. Routes information is generally store in number of different tables to use to forward a packet when needed. These tables are periodically updated as the network topology changes. Example of proactive protocol discussed here is Destination-Sequenced Distance Vector.

1) DSDV Protocol

In DSDV routes are established based on constant control traffic and they are available all the time. Each node maintains one or more tables that contain route information to other nodes in the network. Nodes continuously update the tables to provide fresh view of whole network. Updates are so frequent that the advertisement must be made regularly enough to make sure that every node can almost always find every other node in the network.

B. Reactive protocols

Reactive protocols also known as on demand driven protocol due to the routes followed by data packets are not predefined or regular updated. At the time of routing

source node make request for the preparation or discover route to decide a new route. This step performs only when a transmission is has to perform. This route discovery step is utilize flooding algorithm which based on the technique in which a node perform broadcasting of the transferring packet to all of the neighbours and they also forward that packet to respective near nodes. The repetitive way of this technique at last reaches the destination and have smaller routing overheads with higher latency.

On demand routing protocols does not maintain routes all the time but create route only when the transmission has to perform. This protocol performs two different operations to discover and prepare routes, first is discovery of routes and second maintains routes. At the time of transmission firstly it initiates the process of discover a route in the network, when all routes have found and examine and transmission begins then route maintenance process responds whenever it found changes in topology which happens due to mobility. Examples of on-demand protocol discussed here is Dynamic Source Routing.

1) DSR Protocol

DSR Protocol is a good example of On demand routing protocol. When transmission is needed, then only routes are discovered, no frequent updating in routing path. DSR also makes use of source routing. This routing technique follows source routing where a node originates a data packet and put in the header all the node address need to traverse to reach at the destination [2]. DSR protocol consists of some necessary components like route discovery and route maintenance.

Whenever a node requires a new route to reach on a particular destination, this node calls the process of discovery of new route by sending a route request message. Then this route request is broadcast with the address of the initiator and the destination. Every route request has a unique identification. This request received by a node, then checks the unique identification and examine that should not seen this request before or in other work it should not be duplicate, and if not then this node attach its address in the route request message and then broadcasts the message again to all ad joint its nodes, if duplicate then, this node ignore this message. At last the destination receives the route request message, and sends back a route reply message which consists of the route information attached with route request message.

C. Hybrid routing protocols

Hybrid routing protocols are actually combination of feature of both type of protocols, which aggregates all nodes into various areas in topology structure [9][10]. In each area the technique of proactive protocol is used to maintain routing information, for routing packets in various areas, the reactive technique is performs. In hybrid protocol, in a same area a route to a destination can created and maintain without so much delay, where as in different area of same topology route discovery and a route maintenance technique follows. According to a references “Routing is the most fundamental research issue in Ad hoc Network and must deal with limitations such as high power consumption, low bandwidth, high error rates and unpredictable movements of nodes” [9].

IV. RELATED WORK

Routing in an Ad Hoc network is always a hot research topic and still an open issue. Many ad hoc routing protocols had been proposed by the network community and still no agreement on a giving solution as it is the case for wired networks. Asma Ahmed [3] has discusses different routing protocols for each method as well as comparison between reviewed routing protocols and presents the three types of routing protocols in MANET and makes a comparative discussion of the features of each type of that routing protocol. Md. Anisur Rahman[6] proposed that the performance differentials can analyzed using varying network load, mobility, and network size. Samyak Shah[7] compared the performance of DSDV, AODV and DSR routing protocols for ad hoc networks using ns-2 simulations. Furqan Haq[9] compares emulated test bed results with simulation results from NS2and GloMoSim. OLSR was used as a routing protocol. Kapang Lego [12] has performed evaluation by simulation for compared different performance matrices on different scenarios of ad hoc network. There are very few papers discussing the accuracy of simulation results and the variation of the results among different wireless network simulators. Based on the findings of the above research , a need for detailed and carefully planned simulation and emulation experiments was realized. To ensure the reliability of the results, it was decided to perform detailed simulation.

V. SIMULATION AND EVALUATION

A. Simulation Environment

The detailed simulation model is based on network simulator-2, is to be use for the evaluation [7]. The NS2 instructions can be used to define the topology structure of the network and the motion mode of the nodes, to configure the service source and the receiver, to create the statistical data trace file.

Ns-2 is a discrete event simulator targeted at networking research. It provides substantial support for simulation of routing and multicast protocols over wired and wireless networks. It consists of two simulation tools. The network simulator (ns) contains all commonly used IP protocols. The network animator (nam) is use to visualize the simulations.

B. Traffic Model

Continuous bit rate (CBR) traffic sources are used. The source-destination pairs are spread randomly over the network. Only 512-byte data packets are used. The number of source-destination pairs and the packet sending rate in each pair is varied to change the offered load in the network.

C. Mobility Model

The mobility model [10] uses the random waypoint model in a rectangular field. The field configurations used is: 500 m × 500 m field with 50 , 75 or 100 nodes. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed. Once the destination is reached, another random destination is targeted after a pause. The pause time, which affects the relative speeds of the mobiles, is varied. Identical mobility and traffic scenarios are used across protocols to gather fair results.

D. Simulation Model

Network Simulator NS2 [7], is a well known powerful and simple event driven simulation tool. It is useful in examination of the logically implementation of networks and reduce burden of physical simulation implementation. It provides facility to simulate wired as well as wireless network with a lot of protocols support. We have perform a simulation to evaluate the performance of Mobile Ad Hoc Network routing protocols such as DSDV and DSR based various metrics like throughput and packet delivery ratio with various parameters[10][11].

Radio Model - Two Way Ground
Traffic Source -CBR
Packet Size - 512 Bytes
Network Speed - 10 m/s
Area - 500X500
Number of Nodes 50, 75 &100
MAC - Mac/802_11
Simulation Pause Time 20,40,60,80 & 100

E. Performance Matrices

Two important matrices are evaluated for evaluation of performance of routing protocol in different scenario.

1) *Throughput*: Throughput is a ratio of the transmitted data and transmission time from sender to receiver. Throughput of both protocol comprise and conclusion that DSR has the high throughput. It proves the effectiveness of a routing protocol. The throughput values of DSDV and DSR Protocols for 50, 75 and 100 Nodes at Pause time 20s, 40s, 60s, 80s and 100s are noted in Tables(see table 1,2,3) and they are plotted (see Fig 1,2,3)on the different scales to show the best effect of varying throughput of these routing protocols.

TABLE 1,2,3 THROUGHPUT OF NETWORK ON DIFFERENT NETWORK SIZE (50, 75 AND 100 NODES)

Throughput on Network Size 50		
Pause Time	DSDV	DSR
20	314933	680597
40	326862	579319
60	230359	492056
80	260288	451614
100	276990	428177

Throughput on Network Size 75		
Pause Time	DSDV	DSR
20	304192	630597
40	315232	575991
60	207078	490386
80	242423	450515
100	260298	425776

Throughput on Network Size 100		
Pause Time	DSDV	DSR
20	1738.57	680597
40	90390	579794
60	57521.5	493155
80	127322	452834
100	166929	429315

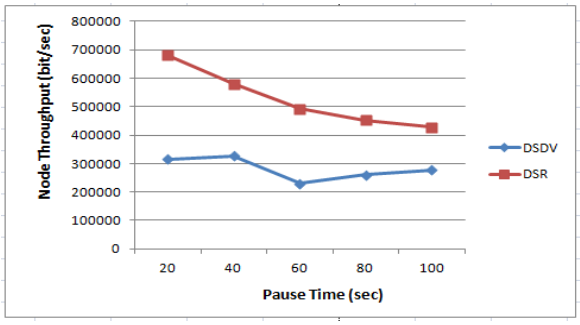

Fig 1: Node throughput comparision on network size 50

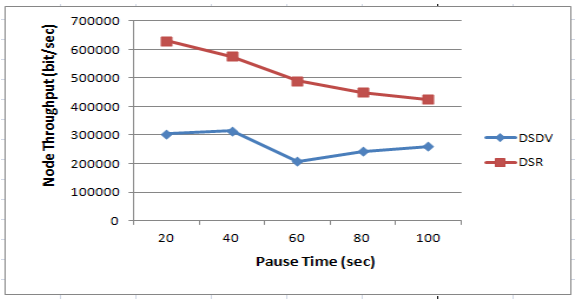

Fig 2: Node throughput comparision on network size 75

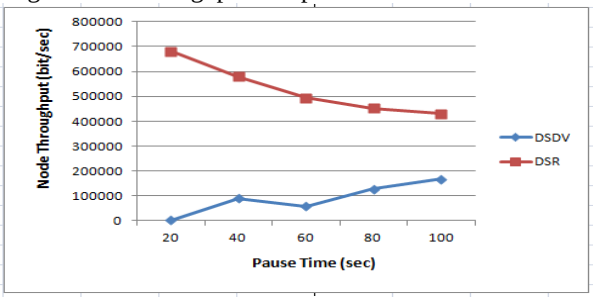

Fig 3: Node throughput comparision network size 100

Based on the simulation results, the throughput value of DSDV increases initially and reduces when the time increases. The throughput value of DSR increases at lower pause time and grows as the time increases. Hence, DSR shows better performance with respect to DSDV protocol.

2) *Packet delivery Ratio*: Packet Delivery Ratio (PDR) is the ratio of transmitted data and received data in a transmission process between a source and receiver node, also known as source and sink in network. By this ratio one can measure the packet loss in transmission process and can find effective and better performing network routing protocols. Every network require a high packet delivering ratio.

The simulation values of DSDV and DSR Protocols for 50, 75 and 100 Nodes at Pause time 20s, 40s, 60s, 80s and 100s are noted in tables(See Table 4,5,6) and they are plotted on the different scales(See Fig 4,5,6) to best show the effects of varying ratio of delivered packets of these routing protocols

TABLE 4, 5&6 PACKET DELIVERY RATIO OF NETWORK ON DIFFERENT NETWORK SIZE (50, 75 AND 100 NODES)

PDR Ratio on Network Size 50		
Pause Time	DSDV	DSR
20	97.6169	99.1919
40	98.8569	99.2434
60	98.4053	99.4335
80	98.8518	99.5467
100	98.4413	99.6223

PDR Ratio on Network Size 75		
Pause Time	DSDV	DSR
20	96.8661	99.1909
40	98.5653	99.2213
60	98.1191	99.4166
80	97.9306	99.5335
100	98.0971	99.6113

PDR Ratio on Network Size 100		
Pause Time	DSDV	DSR
20	80	99.1896
40	96.6102	99.2031
60	96.4644	99.404
80	97.2525	99.5233
100	97.4224	99.5026

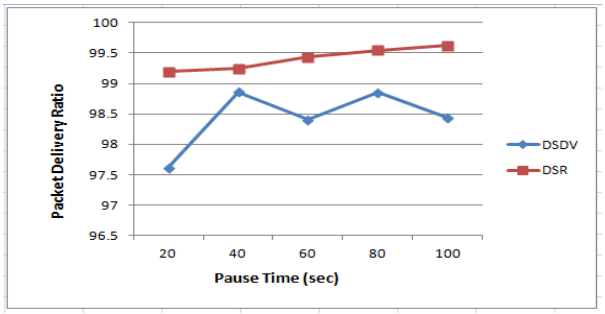

Fig 4: Packet Delivery Ratio comparision on network size 50

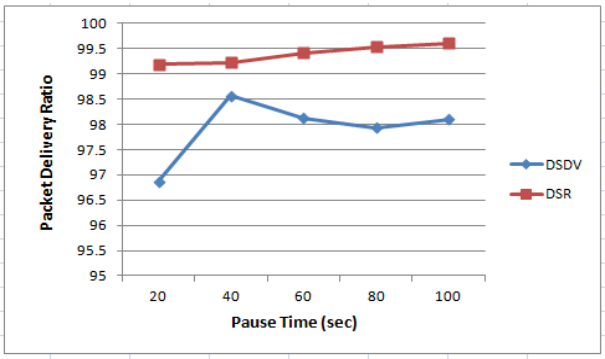

Fig 5: Packet Delivery Ratio comparision on network size 75

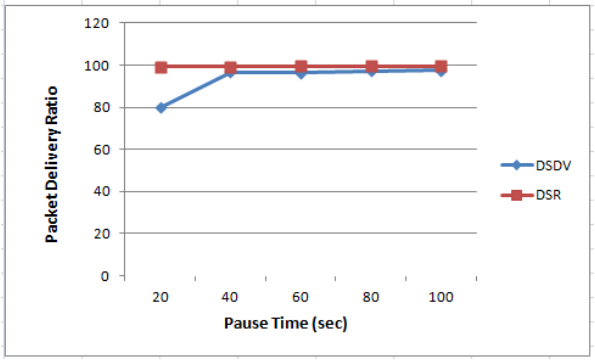

Fig 6: Packet Delivery Ratio comparision on network size 100

As per simulation results packet delivery ratio prove that which protocol is follows proper completeness and correctness of the routing protocol and also of efficiency the PDR value of DSR is higher than DSDV. The PDR value of DSDV is worse in lower pause time and gradually grows in higher pause time [7]. From the above study, in view of packet delivery ratio, reliability of DSR protocols is greater than DSDV protocol.

VI. CONCLUSION

We conclude from this simulation results some important characteristic differences between the routing protocols proactive and reactive. This paper is a result of the realistic comparison of two routing protocols DSDV and DSR. The performance of the proactive and reactive Ad Hoc Routing protocols such as DSDV and DSR was analyzed using NS-2 Simulator. Our main observation is to simulate network and get result based on theoretical analysis. It is found that for packet received DSR is better than DSDV where as DSR is better with complete rates of mobility and speeds and DSDV performs most like DSR, but till now needed transmission of various routing overhead packets. Due to higher mobility of node DSDV is more costly than DSR. Hence, DSR is preferable and better performing protocol.

VII. FUTURE WORK

In the future, we like to perform extensive complex simulations to gain a more in-depth analysis of performance of the ad hoc routing protocols. Other new protocol could be added in simulation. I like to study this investigation not only for the comparison between various routing protocols but for more and more vast areas of routing protocols in various important concepts in computer network and communications. In future try to focus more on various security issues in ad hoc networks.

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