Performance Enhancement of Ad-hoc On-demand Distance Vector Routing Protocol in MANETs using Multipath Approach

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Abstract—The Wireless technology is dominating current world of communications as it is found in most of the domains. Mobility is a key concept for wireless networking and to let the traffic pass across the network smoothly, the routing has to be quiet efficient. Mobile Ad hoc Network, as its name suggests are designed on fly for fulfilling a specific task within a specific boundary. In the domain of wireless ad hoc network, there must be an efficient routing mechanism to provide the correct and optimal route establishment and maintenance between a pair of nodes, so that messages may be delivered reliably and in a timely manner. There are many protocols available for doing the Ad hoc routing and selecting a proper candidate is totally based on the applications. We have analysed different routing protocols against several metrics through the simulations in Network Simulator – 2 (NS-2). Perfor mance parameters include Average end-to-end delay, Routing Overhead, Jitter Packet drops etc. In this work, we propose a Performance enhancement of Ad-hoc On-demand Distance Vector routing protocol in MANETs using multipath approach this mechanism setups multiple paths based on less hop count. It allows to store multiple paths based on threshold. At time of link failure, it will switch to next available path. To set up multiple path, we have used the information that we get in the RREQ packet and also send RREP packet to more than one paths. It reduces overhead of local route discovery at the time of link failure. And because of this End to End Delay and Drop Ratio decreases. routing protocol including our scheme and we compare it with the basic AODV and multipath extension of AODV-AOMDV routing

I. INTRODUCTION

The paper is organized in following manner: Chapter 1 Introduction Chapter 2, Literature Survey, focuses on different types routing protocols available for MANET. Working of standard routing protocol, AODV and its modifications Chapter 3, Study of NS-2 Simulator, focuses on basics of NS-2-discrete event network simulator which is heavily used in ad-hoc networking research. Chapter 4, Implementation of AODV, gives implementation details of AODV in ns2. Chapter 5, Proposed Work, includes detailed explanation of the proposed work. Chapter 6, Testing and Analysis of results, includes analysis of results in terms of three evaluation metrics: Average End to End Delay, Normalized Routing Load and Packet Drop Ratio. Conclusion, References, Appendices can be found towards the end of paper.

II. MOBILE AD HOC NETWORKS (MANETS)

Mobile Ad hoc Networks are autonomous systems which comprise a collection of mobile nodes that use wireless transmission for communication. They are self-organized, self-configured, and self-controlled infrastructure-less networks. This type of network can be set up or deployed anywhere and anytime because it poses very simple infrastructure setup and no or minimal central administration. These networks are mainly used by community users such as military, researchers, business, students, and emergency services. Nodes are using Internet Protocol and IP addresses are assigned to each of the nodes. Individual nodes discover dynamically which other nodes they can communicate with. Laptop computers, personal digital assistants are examples of nodes in an ad hoc network. An ad hoc network is not centrally administrated and the network will not collapse if one of the nodes moves out of range of the others. In addition to sending packets directly, some nodes may need other nodes to transmit information to some others (multi hopping). Multi hop networking increases network scalability, reduces interference, increases overall network throughput, decreases the delay and reduces energy consumption.

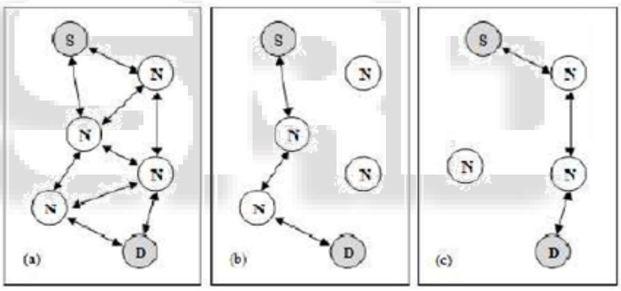

Fig. 1: Creation and adaptation of a MANET

A MANETs are defined by the manner in which the network nodes are organized to provide pathways for data to be routed from the user to and from the desired destination. Ad hoc networks are a new paradigm of wireless communication for mobile hosts (which are known as nodes). In an ad hoc network, there is no fixed infrastructure such as base stations or mobile switching centres. Mobile nodes that are within each other's radio range communicate directly via wireless links, while those that are far apart rely on other nodes to relay messages as routers. Node mobility in an ad hoc network causes frequent changes of the network topology. Some nodes may be beyond range; others may be detectable but have insufficient signal strength for reliable communications. For the data to be transferred from the source node to the destination node, the nodes themselves determine the best available shortest path. This process of determining the path is known as the self-configuring process.

III. TESTING AND RESULT ANALYSIS

As shown in figure 2, Network Simulator (NS-2) accepts as input a scenario file that describes the exact motion of each node and the exact packets originated by each node, together with the exact time at which each change in motion or packet origination is to occur.

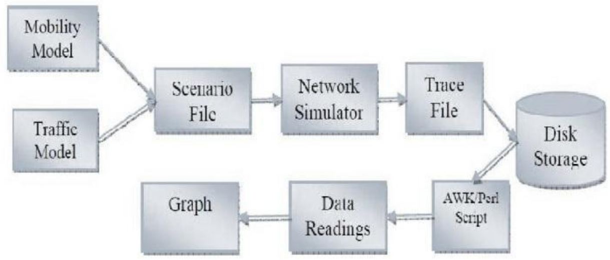

Fig. 2: Creation and adaptation of a MANET

The detailed trace file created by each run is stored to disk, and analyzed using a variety of scripts, particularly one called file *.tr that contains the number of packets successfully delivered and additional information about the internal functioning of each scripts executed. This data is further analyzed with AWK file and gun plot is used to produce the graphs. The simulation models are built using the Network Simulator tool (NS-2) version 2.34. The experiments use a fixed number of packet sizes (512bytes) with a changing of pause times varying from 0s to 900s.

IV. CREATING SIMULATION CODE

We wrote a tcl code to set up the wireless simulation components: network components types, parameters such as the type of Interface Queue (IfQ), the type of antenna, the radio-propagation model, the type of ad-hoc routing protocol, traffic model and mobility model generated in last section etc. A node is situated at a random position at the start of simulation and moves toward a random destination in the field with a random velocity (0-10 m/sec). Once the destination is reached another random destination is targeted after a pause. The pause time, which indicates mobility, is varied 0 sec to 900 sec. This will in turn, affect possibilities of link failure and facilitate performance analysis under different conditions.

V. SIMULATION RESULT

In case of lower mobility, A ODV performs better than AOMDV and DS R. Theoretically it should not be the case, i.e. in stable network also AOMDV should perform better or equal than AODV. While in case of higher mobility, AOMDV performs better than AOD V and DSR. It is because at the higher mobility, link breaks occur more frequently, and so multiple stored paths can be used. However it can be seen from the graph that O-AODV performs better than AODV, DSR and AOMDV because it has more path than AODV.

VI. ANALYSIS AND RESULT

A. Drop Ratio

The relationship between Drop Ratio and Pause time. Pause time indicates mobility.

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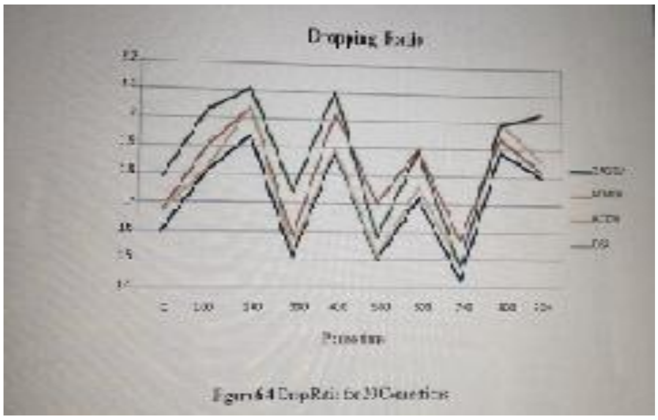

Fig. 3: Drop Ratio for 20 Connections

B. Average End to End Delay

Average end-to-end delay for 10, 15 and 20 connections respectively. As seen in all the plots the end-to-end average delay is continuously decreasing with increase in pause time as compare to basic AODV, AOMDV and DSR.

The reason behind that is at lower pause time, the failure of the route recovery attempts are more therefore the number of packets transferred between the source and destinations are also more. It causes time taken to recover the route at lower pause time is more.

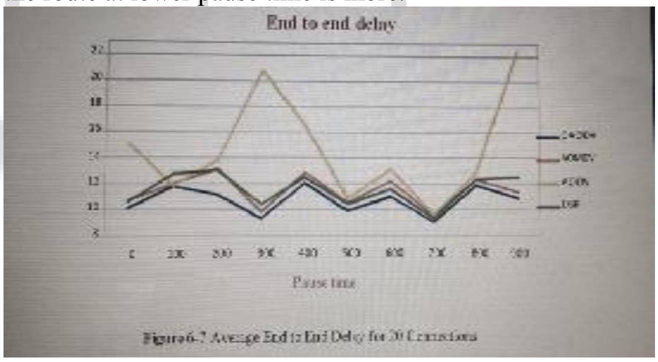

Fig. 4: Average End to End Delay for 20 Connections

C. Normalized Routing Load

Demonstrates routing load in presence of different number of connections with varying pause time. The number of connections will affect the requirement of route discovery between different pairs of source and destination, in addition to traffic on the MANET.

The pause time indicates the mobility of the nodes. This in turn shows increase in routing load increases with increase in number of connections It can also be observed in the fig, routing load is continuously decreasing with increase in pause time in all four conditions for all four cases. This is understandable, as increase in pause time indicates reduced mobility, which in turn reduces the requirements of route discovery. At lower pause time, (pause time 0) link layer reports high route failure to its upper layer.

We see that AOMDV has more routing overhead that AODV for any range of pause time. This is attributed to the different mechanism of AODV and AOMDV. Due to AODV being a unipath routing protocol, once a link breaks the packet delivery along that route stops. But AOMDV is a multipath routing protocol and it searches for alternate paths if the current route breaks by flooding the network with RREQ packets. Hence AOMDV incurs more routing overhead than AODV.

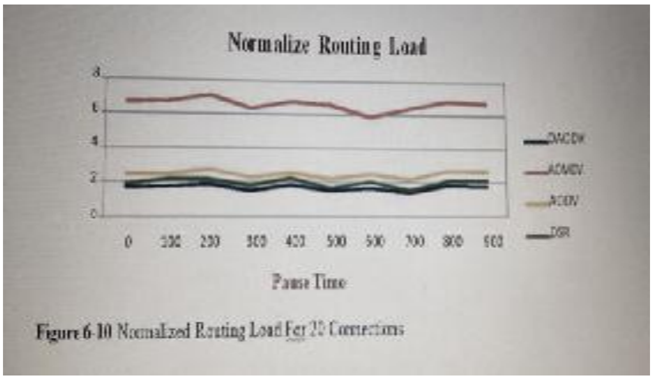

Fig. 5: Normalized Routing Load For 20 Connections

However, fig. also depicts some typical conditions, in which, the routing load is seen to be increased when pause time is high. A detailed analysis of simulation-based experiments under this condition revealed that the routing load increases because of the rise in number of Route Request packets (with ttl value of 0) being dropped. This led to more frequent RREQ and RERR packets increased as compared to the previous shorter pause time.

This compels for the initiation of fresh route discovery causing increase in routing load. The specific conditions exhibiting this behaviour are occurring because of a typical location of nodes in MANET, which is random in nature. However in an average the routing load of the O-AODV is lower than that AODV, AOMDV and DSR.

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